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Library Furniture and Furnishings

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Issue Editor

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Introduction

FRAZER G. POOLE

The successful choice of library furnishings requires a knowledge of many factors, including the functional requirements of the items concerned, the characteristics of the materials to be used in their manufacture, the measurements of human beings, the principles of good design, and the limitations of manufacturing methods and procedures, to name the more important ones. Few persons are familiar with all the details involved, but there is no question that a given item of furniture will be successful to the extent that all relevant factors are taken into consideration.

In most instances, the selection of furnishings for a library must be a team effort in which the librarian plays a major role. No matter how well qualified the other members of the team, i.e., the architect, designer, purchasing agent, and manufacturer’s representative, the librarian must assume ultimate responsibility for the success or failure of the furnishings and equipment of his building.

The librarian need not be a designer, nor need he have a knowledge of manufacturing processes or the characteristics of materials. He must, however, have as much information as he can absorb about the function of every item of furniture and equipment to be installed in his building. He should, in addition, know something about specification writing, and about ways and means of determining the extent to which a given piece of equipment meets the specifications established for it.

This issue of Library Trends is intended to provide some of the basic information the librarian needs if he is to play his part as a member of the furnishings team. In those instances, and they are numerous, where the librarian (perhaps with the aid of his purchasing agent) is the team, such information is all the more important. It is obviously impossible in a volume of this size to provide all the data needed, but each contributor has attempted to include as much practical information as possible on the functional requirements of the

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library furnishings he discusses. In some instances, however, such information is not available and more than one contributor to this issue has mentioned to the editor the lack of tested data in a given field.

The lack of suitable performance specifications is perhaps the most serious drawback to the successful purchase of many items of library furnishings and equipment. Such specifications, however, are very difficult to write. Moreover, this is a task in which, for understandable reasons, most manufacturers are but little interested. Thus, year after year sees a continuation of the typical “nuts and bolts” specifications written by individual suppliers to cover their own products. It is possible to write reasonably successful performance specifications for a few items, e.g., bracket-type steel bookstacks. Even here, however, additional investigation and engineering tests are highly desirable. Despite the general dearth of performance specifications, there are some useful measures of performance which, properly used, would make it possible for the librarian to be more certain of obtaining the quality of furniture he requires. Appendix I, following the article, “The Materials and Construction of Library Furniture,” and Appendices I and II, following the article, “The Selection and Evaluation of Library Bookstacks,” are of this nature.

In keeping with the policy of Library Trends, contributors to this issue have attempted to point out those trends and new developments that may be significant and of which librarians should be aware. One such trend in the general field of library furnishings is worth noting here.

In an earlier day, most library furnishings (there were exceptions) were purchased from a catalog, usually from one of the dozen or so suppliers to the profession with whom every librarian was familiar. Today, although much furniture is still purchased in this manner, there is an increasing tendency for the architect to insist that he be permitted to design the furniture or, at the least, that he be allowed to assist in its selection. The reason, of course, is obvious—the architect wants to be assured that the furnishings will complement the building he has created.

This attitude is understandable, but the trend has implications that may create problems for the librarian. First, some architects are not sufficiently aware of the functional requirements of library furnishings or are inclined to sacrifice function for aesthetics. In either case, unless the librarian himself is fully knowledgeable and can guide the architect in his thinking, the results of custom design are almost certain
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to be unsatisfactory in one or more instances. Second, custom designs, properly executed, are generally more costly than standard designs, and since this usually means a change in production for the manufacturer of a standard line, the number of bidders is likely to be sharply reduced. A third result of the trend toward involvement of the architect in furniture design is the increasing tendency to select furnishings from the so-called "high style" lines rather than from standard lines. Again, this can result in higher costs.

Furniture designed by the architect, or selected by the architect to complement his building design, if functionally correct, is almost certain to make the new library a much more attractive and effective structure. However, the librarian must share, with others of the design team, responsibility for knowing the functional requirements of the furnishings for his building. Where necessary, he must insist that these requirements be satisfied.

We hope that this issue of *Library Trends* will help librarians in these important aspects of planning new buildings.
Design of Library Furniture

MARTIN VAN BUREN

The physical environment of a library depends on two factors: the architectural quality of the building and the design of its furniture. These closely related elements must be harmonious if a successful aesthetic result is to be achieved. Architecture and furnishings must be compatible in color, texture, material, and form. This relationship is particularly important in the library building, with its large open spaces which the eye can distinguish as a single entity; such areas appear either unified or disjointed according to the correlation of elements.

This relationship creates two problems in library furniture design. First, the design of the library building must be developed before other elements—including the furniture—are considered. Second, the design of library furniture must fulfill certain functional requirements. Aesthetic and utilitarian needs, as they relate to the design of the building and to library operations, must be determined simultaneously.

A third problem in furniture design, not related to library architecture, arises from the fact that library furniture undergoes excessive abuse and wear. Not only is it subjected to long hours of use day after day, but some users mistreat the furniture. Further, certain areas of the library may be multi-purpose, involving frequent handling of folding or stacking furniture. Janitorial services such as waxing, mopping, and vacuum cleaning are also hard on furniture. Finally, library furniture is costly and cannot be replaced frequently; normally a life span of at least ten years must be expected.

Many samples can be seen of library furniture that succeed or fail in fulfilling these design requirements. Lewis Mumford, after praising the architecture of the American Embassy in London, has this to say about its library:

Mr. Van Buren is an Interior Designer in Charlotte, North Carolina.
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I cannot say as much in praise of the furniture. The clumsy, armless, almost immovable chairs were obviously chosen by someone with little experience in sitting or reading, much less in note-taking; they achieve a maximum of cushioned discomfort with a minimum of efficiency. . . . Here was a place for a dexterous innovation in modern library furniture, to match the high standard we have achieved in the conduct, if not always the design, of lending libraries.¹

Fortunately, such criticisms of library furniture are becoming less valid. Manufacturers are beginning to explore new materials and technologies. Furniture makers from other fields are showing increased interest in the expanding market of library technical furniture, thus creating keener competition and introducing new concepts in design. The stigma of sameness is disappearing from the American library scene as each year sees more examples of imaginative library furniture. Creativity and functional design in library furniture are not only overdue, these qualities are now vital to future library planning.

At the Institute for Library Consultants held at the University of Colorado in the summer of 1964, the effects of mechanization upon library planning were discussed. Of particular interest to the participants was the manner in which computer development and improvements in the miniaturization of graphic information might enable libraries to provide a type of service hitherto impossible. It seemed possible that such developments might lead to complex carrel designs for individual study that would require more space than traditional types of study space. Designs incorporating some of these ideas have already been developed by Ralph Ellsworth and others.² The use of these and similar designs may mean that the accepted formula of 25-30 square feet per reader may no longer be adequate for such situations.

Despite the extended discussion of these subjects, there seemed to be no general agreement of what the future would bring in this area of concern. Some of the best known authorities in library planning could not predict the future requirements of certain types of library furniture and equipment. This suggests the need for additional study and research on the part of the library profession, both by individual librarians and by such agencies as the Library Technology Project of the American Library Association, as well as on the part of the manufacturers of library equipment and furnishings.

The principles of library furniture design include six factors.

1. Function.—This relates to comfort, convenience, efficiency of operation, and serviceability. How well a unit of furniture performs
its function determines its degree of usefulness. Comfort, for example, implies a state of ease free from distress or pain. Furniture of proper dimensions, proportions, and materials is pleasant to use for reading, working, and lounging. Comfort in library furniture requires proper pitch and height of seating units, adequate area allowances of work surfaces, comfortable colors and light-reflecting qualities of top surfaces, and easy-moving working parts such as doors and drawers.

2. Construction.—Durability and resistance to wear are important. Surfaces must withstand abrasion and impact. Joints should not loosen. Moving parts should be sturdy and simply designed to minimize complex mechanical failure, as, for example, in folding furniture that is handled frequently and sometimes roughly.

3. Materials.—Increasingly rapid development of new materials such as synthetics (plastics and other man-made derivatives), as well as new methods of handling and fabricating traditional materials, have opened endless opportunities in the selection of furniture materials. Materials in furniture are selected for the following characteristics: beauty, versatility in forming and fabricating, strength, resistance to wear, resistance to dirt, adaptability to various finishing techniques, and cost.

4. Finish.—The main purpose of the finish is to protect the surface of the material and to enhance its natural beauty. Finishes may be surface-coated, penetrating, or integral. Surface-coated finishes include paint, lacquer, varnish, epoxy, and metal plating. A typical penetrating finish on wood surfaces is linseed oil. Integral finishes are those in which pigment is introduced into the material before it is formed and hardened, e.g., molded fiberglass chairs.

5. Scale.—This defines a certain value in size or degree within a group or system of related items. Furniture should be scaled to pleasing proportions with relation to the size and bulk of surrounding furniture, the dimensions of the room in which it is placed, and the mass of related architectural elements.

6. Proportion.—Whereas scale relates to other elements, proportion is an inherent quality in the design of a unit of furniture, implying the relationship of the parts to the whole. Proper proportions among the various parts result in aesthetic overall balance and symmetry.

The quality of beauty has been deliberately avoided in the above list because aesthetic values cover all aspects of furniture design. To a competent designer this quality underlies all other considerations. There is library furniture on the market which satisfies all the re-
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requirements listed above, including aesthetic compatibility with certain styles of architecture, but still lacks beauty. Beauty is the abstract feature that adds the final touch and brings pleasure to the senses. It is the mark of true design excellence when all of the practical requisites are met, yet overall beauty still emerges. This is particularly true of library technical furniture, where functional needs carry such a demanding—and sometimes difficult—burden.

Of all the objectives to which the library aspires, comfort of the user is perhaps the foremost. It is the objective most closely associated with the design of library furniture. The trend is comparatively recent; early libraries, such as those in Europe, ignored comfort as an aspect of library service. During the last half-century, however, the idea of emphasizing reader comfort along with efficient service has become accepted. In 1934, Angus Snead Macdonald stated: “If only a small part of the money saved on the building structure is put into comfortable furniture, the best available equipment, and attractive interior decoration, it will be possible to secure an atmosphere of comfort . . . wherein a love for reading can be readily cultivated.” Macdonald was stating a premise that is widely accepted today—that of encouraging patrons to use the library by making it an inviting place in which to work.

Once the aim was established, modern research techniques offered some logical solutions to the problem. It has long been known that comfort in furniture design is directly related to human measurements. But the accurate determination of these measurements, particularly in a mass society, was not scientifically attempted until recent years.

An example can be made of table-reader seating. Some studies of military personnel were conducted during World War II, mostly to determine human measurements for use in the design of military clothing, equipment, and aircraft seating. In 1945, the Heywood-Wakefield Company instituted a study by Earnest A. Hooton of Harvard on railway coach seating. The main purpose of this survey was to determine the dimensions and proportions of seating required to fit the majority of passengers. A more general survey of seating was conducted by Bengt Akerblom at the Karolinska Institutet in Stockholm in 1948.

Perhaps the most revealing and comprehensive study of seating and seat-to-table relationships was made at the University of Arkansas in 1959. Whereas the Hooton studies relied on sand molds to determine restful spinal curvatures in the sitting position, and the Akerblom
survey employed the bone structure to arrive at human measurements, the University of Arkansas tests utilized a unique seating contraption.

The experimental "chair" consisted of metal plungers inserted into holes in a wood frame (seat and back). The plungers, or pins, were in rows placed 1½ inches apart, supported on springs and capped by rubber discs. The angle between the seat and back frames was adjustable. For purposes of the study, basic sitting positions were established for the following activities: dining, writing, card playing, talking, and relaxing. For library use the most important of these are reading, writing, and relaxing (lounge seating).

Exhaustive tests were first made to determine average or mean dimensions of the human body. Both age and sex were considered and tabulated separately. Activities that involved table use, such as reading and writing, included studies on seat-and-table relationships. A summary of the conclusions covering the proper dimensions of chairs to be used for reading or writing follows:

Height of seat: 17 inches at front at highest point.
Slope of seat: 0.5 inches from front to back.
Depression of seat: 2.5 inches from highest to lowest point.
Depth of seat: 16.5 inches from front to back.
Width of seat: 17 inches at widest point.
Height of chair back: 17.5 inches from seat to top of back.
Width of chair back: 13.5 inches across top; 10 inches across bottom.
Slope of chair back: 2.4 inches backward, or 15 degrees from vertical.
Included angle (seat-back) 103.3 degrees (Derived from data furnished, not given in this form in the report.).

Depth of chair back: determined at 1½ inch intervals up the center of the back starting 4.5 inches above the seat:

16.3 inches at 4.5 inches above seat.
16.6 inches at 6 inches above seat.
17 inches at 7.5 inches above seat.
17.3 inches at 9 inches above seat.
17.8 inches at 10.5 inches above seat.
18.3 inches at 12 inches above seat.
18.7 inches at 13.5 inches above seat.
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In addition, data on the height, free depth, angle, and distance apart of arm rests were determined.

Another interesting test, made during the University of Arkansas survey, compared preferences of the most comfortable table height for reading or writing among the subjects cooperating in the tests. Table I summarizes the results:

<table>
<thead>
<tr>
<th>Height (inches)</th>
<th>Percent of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.0 to 23.9</td>
<td>1.9%</td>
</tr>
<tr>
<td>24.0 to 24.9</td>
<td>9.9</td>
</tr>
<tr>
<td>25.0 to 25.9</td>
<td>22.8</td>
</tr>
<tr>
<td>26.0 to 26.9</td>
<td>31.5</td>
</tr>
<tr>
<td>27.0 to 27.9</td>
<td>22.8</td>
</tr>
<tr>
<td>28.0 to 28.9</td>
<td>7.4</td>
</tr>
<tr>
<td>29.0 or more</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Mean height (in inches): 26.5

From these data the investigators concluded that table heights for the tested seat heights should be 27 inches, or 10 inches above the highest point of the seat. For readers above average in dimension, a one-inch increase in this dimension was allowed. This table height allows a two-inch top thickness, to permit adequate knee space or clearance.

Another factor in table reader requirements is the amount of work surface required per user. Again human measurements serve as a guide. For activities such as seminar discussion (talking), a minimum width based on the width of the human torso plus a clearance allowance between seats can be established. Thus one recent investigation specifies a minimum table width of 15 inches for knee space, plus 6 inches on each side, or a total clearance of 27 inches per user. Anatomy for Interior Designers suggests a minimum width of 24 inches for such activities as typing.

Obviously, the usual library activities such as note-taking and the spread of reference materials require more table surface than typing. The most logical measure for library use is the span from elbow to elbow with arms akimbo—that is, spread horizontally. The Damon studies of military personnel give a median span of 36.5 inches, while an earlier study by Brackett offers a median span of 39.25 inches. However, these studies were conducted solely on military males; it can be assumed that female measurements will be less.
Analysis of data from the above studies indicates the following table widths are desirable for library use: (1) discussion and seminar activities: 24-27 inches per person, (2) general library-reader use: 36 inches per person, and (3) for graduate students in academic libraries: 42 inches per person.

Statistics generally support the accepted table depth dimension of 24 inches per user. For example, the Damon studies of military males show a mean anterior arm reach of 34.8 inches; this means the distance from wall to tip of middle finger when the subject assumes forward reach with his back to the wall. Subtracting the average chest depth or thickness of 8.2 inches, a clear arm reach of 26.6 inches results. The reaching distance of women will be somewhat less. Thus we can scientifically accept a work surface depth of 24 to 26 inches per person.

The above examples are intended to illustrate the trend toward the use of the scientific method in determining standards of comfort and efficiency in library furniture design. An analytical approach to such problems is important, both to improve library furniture in its present functional role, and to prepare for unforeseeable future requirements in this field of design. These future requirements include not only the question of electronic miniaturization potentials, but the expanding scope of library services as well. Increasingly, the library is becoming a center in community or academic life, with facilities for such things as exhibits, graphic art collections, music listening, language laboratories, special meeting rooms, and the like. Library furniture manufacturers must remain abreast of these trends and be prepared to meet new functional requirements on sound principles. In library furniture, the day of hit-or-miss design is past.

References

Design of Library Furniture


9. Woodson, *op. cit.*, pp. 4-16, 4-17.
The Materials and Construction of Library Furniture

STEPHEN D. PRYCE

LIGHTNESS OF LINE, strength and durability without bulk, and utility without severity have been the theme for architecture and its furnishings over the last few years. In its wake have come revised concepts in materials, in material applications, and in construction. The trend to designer-conceived interiors, and demands for imaginative, colorful, yet practical furnishings, both technical and casual, have opened a wide field of interest. This, coupled with the expanding growth and opportunity in the library furnishings field, has resulted in a refreshing competition for the library furnishings market and has stimulated expansion of research and facility improvement programs among the manufacturers.

The result of this trend may be seen in the furniture of new libraries: in the design, shape, thickness, and materials that make up table tops; in leg design and the mechanics of leg attachment; in the design, weight, material, and construction of reading chairs; in the improvement and acceptability of plastic laminates, extruded and formed plastic parts; and in the mating of fiberglas and polyester resin to give durable, colorful seating.

The objective of this paper is to provide the librarian with basic information on the materials and methods used in the manufacture of library furniture, so that he may be better able to evaluate current trends and developments.

A library table is a functional piece of furniture which must provide a working surface at a height convenient to the seated patron. This surface must be rigid, smooth, and decorative to meet today's standards. The whole is the sum of its parts. Therefore, as we consider a table and its purpose, we study the top, its manufacture, and the nature of its support. The manner of fabrication is critical to the serviceability of the piece.

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The Materials and Construction of Library Furniture

Table top construction usually employs one of two methods: (1) solid wood (lumber) or (2) ply-construction. Solid wood construction uses solid, unmodified wood components. Ply-construction employs several layers of materials, which may be all wood, or may be a combination of wood and modified wood products, i.e., fiberboard, particle board, laminated plastics, etc.

Solid wood tops are made of lumber strips or boards edge-glued under pressure, to form a panel. When the glue is set, the panel is surfaced in a planer, cut to size, and sanded to a uniform, smooth surface. If the component strips are narrower than they are deep, i.e., narrower than the thickness of the table top, the panel is often referred to as of “butcher block” construction. If the dimensions are reversed, it is simply a solid wood panel or top. This method of construction is sometimes used for the tops of charging desks and for catalog reference table tops which are subject to abrasive wear of books or the bottoms of catalog card trays.

Wood, by nature, picks up and gives off moisture proportionate to the relative humidity of its environment. In doing this, wood shrinks or swells. In the case of a solid wood panel, the whole panel expands or contracts as an expression of the movement of each of the component strips. Although each strip has its own individual grain pattern and reacts differently to moisture, these differences are minimized by proper kiln drying, machining, and gluing methods. The inevitable small differences are, for the most part, submerged in the panel as a unit. Because movement is inevitable, a solid top must be flexibly mounted, allowing it to ride with dimensional changes in the wood. Any effort to tie it down rigidly can result in splitting of the top, or in the distortion of the top and any framework to which it is attached. A solid top, particularly one of large components, must be well made to hold up over the years. Today’s use of solid tops in libraries is primarily a matter of design, since, with the possible exception of tops for charging desks and catalog tray consultation tables, there is no use to which library furniture is subjected that requires this construction—that is, in the same sense that dictates solid wood tops for work benches.

Ply-construction, as indicated earlier, is used in multiple combinations. By definition, the term implies the use of three or more plies or layers of materials face-glued together to make up the full thickness of the panel or top. In all cases, the panel should be balanced, i.e., it should have an equal number of plies on each side of the center
ply or core. With such construction there will always be an odd number of plies or layers. A given ply-construction has specific merits, and its components, depending upon the type, have definite purposes. These will be pointed out as we discuss the basic types.

Lumber core, ply-construction employs a core, or center ply, of solid lumber strips made up in the same manner as a conventional solid panel or top. The core materials, however, should be low density, straight grained wood species, such as basswood, or yellow poplar. On each face of the core, normally with the grain direction at right angles to that of the core, are the “cross-band” veneers. Firmly glued and with the grain so oriented, the cross bands restrain and thereby minimize the movement of the core, as it naturally seeks to respond to atmospheric moisture changes. The “face” and “back” veneers are, in turn, face glued to the cross-band veneers. The grain directions are normally at right angles to that of the cross bands and in the same direction as that of the core.

Here then, we have an all wood top that has its several elements oriented to restrain the major movements of the core, and balanced to restrain it equally on each side and thus avoid distortion. Over an extended period, even when subjected to extreme moisture changes, a well made ply-construction table top will not fail because of fatigue. In addition to the physical advantages of balanced, lumber core construction, this method has the advantage of permitting the use of decorative face veneers with wider grain patterns and, consequently, more pleasing wood figures.

It is worth mentioning that there is a form of lumber core construction employing wood blocks, rather than full-length strips, for the core components. This is common practice in the fabrication of commercial exterior door panels. However, since it is very difficult to produce a permanently attractive and satisfactory top surface using block construction, the method is not suitable for use in library tables. The difficulty arises from the fact that each piece of wood has its own movement pattern, and only if block components are uniformly kiln dried and securely bonded end-to-end and edge-to-edge will the core move as a unit. Movements of the individual blocks show up through the face veneers as outlines of the separate pieces, a condition usually referred to as “telegraphing.”

Lumber core construction is traditionally and properly considered the best all-around manner of making library table tops. Properly made, such construction is stable, has good screw holding capacity,
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permits machining and edging or banding, has good tensile strength and stiffness, and is not subject to splitting through fatigue or abuse.

Veneer core construction, as implied, is that in which the full thickness is made up of wood veneers glued face to face. The grain directions of adjacent plies are at right angles. A familiar example of this type of construction is a decorative wood veneer laid up on a sheet of Douglas fir plywood. The same method, using hardwood veneers throughout, is used in producing panels and tops for household furniture. When all hardwood veneers are used, this is a quality construction, employed successfully with decorative wood veneer faces, and as an underlayment for decorative high pressure laminates.

Particle board (a term employed here to cover all types of wood flake, fines, and splinter boards) is made by mixing wood particles with glue and subjecting the mixture to high heat and pressure. This material is gaining increased acceptance as the industry improves the quality control of its products. The subject of particle board is an important one. For this writing, suffice it to say that there are many types of particle board, determined by the form and combination of wood elements employed and by the method of manufacture.

A good quality board, properly used, makes an excellent panel or top for many purposes. It has not, however, found any widespread use in the manufacture of quality library furniture and cannot be generally recommended for large tops or for structural or load bearing members until it has been improved by further research. As of the present time, particle board has been used largely for certain types of library work room furniture and for shelves in wood installations. In the latter use, it has been found to warp under loading and should not be used for this purpose.

Table tops for library use run the gamut, from small study tables for single occupancy, to large tables for general reading and conference purposes. Requirements for each type differ, based on the use and abuse to which the table may be subjected.

The strength and durability of a table top depends upon its construction. We have discussed the major types. The appearance of a top and its use as a working surface is, for the most part, a matter of the surface material and the finish. There are two major top materials: wood, either solid or veneer, and high-pressure, plastic laminates.

Wood, which is unchallenged as the material most easily and gracefully lived with, both in the home and in the library, has been the traditional material for library table tops. However, the advent of
high-pressure, plastic laminates brought a competitor, particularly in those instances where there is a need for a hard, stain-free surface.

Vast improvements in these materials, in quality, uniformity, and selection of patterns, have come in recent years and have paved the way for the laminates to take an increasing share of the market for top surface treatment. To counter the recognized advantages of plastics, yet keep the traditional values of wood, the wood finishing industry has developed both new film overlays for low pressure application on wood veneered panels, and durable catalyzed synthetic finishing materials, including the polyesters, epoxies, and polyurethanes, for spray application. These materials rival the plastics in stain and abrasion resistance. For the most part, however, these finishes are in their infancy, and because of their present high cost and difficulty of application have not found wide use in the production of library furniture.

For general finishing, most manufacturers continue to rely upon the traditional nitrocellulose lacquers applied either hot or cold. These are extremely versatile, relatively inexpensive, clear, easily maintained and repaired finishes. However, library furniture manufacturers are making increased use of the conversion varnishes (catalyzed alkyd-urea resin solutions) sometimes referred to as catalytic varnishes. Properly formulated, these synthetics are definitely superior in solvent and abrasion resistance to the conventional lacquer finishes.

It should be noted that not all finishes of the same type are equally good. Thus, one manufacturer's conversion varnish may give better (or poorer) performance than another's, depending upon the formulation and upon the way in which the material is applied. Since the most satisfactory method of evaluating finish performance is by laboratory testing, the methods outlined in Appendix I, which have been successfully used in many instances, may be useful.

Of interest because of their present vogue are the oil finishes. These are penetrating rather than film finishes, as are the lacquers, varnishes, etc. They are most pleasing when used with hardwoods such as walnut and teak, and are most practical for furniture in casual and low traffic areas. Softness, low sheen, and easy maintenance are special characteristics favoring the oil finishes.

Both wood veneer faces and plastic laminates can be made burn-resistant by inserting an aluminum foil laminate directly beneath the face element. The foil serves as a heat dissipator, and saves loss from the careless cigarette. Fabrication with inserted foil laminates is very
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exact and expensive. It is justifiable only for table tops in areas where smoking is permitted or hot elements are used.

A support-free panel would be the ideal, and almost every contemporary designer works toward this end, making every effort to give firm, unyielding support to the table top, yet trying for the effect of a top with minimum support. Answers have come in the form of slim line center pedestals and in the slim line metal leg bases, but primarily in the use of plate mounted legs, individually attached to the underside of the top. The latter obviates the need for complete base construction, and has made it possible to eliminate the apron which, in earlier designs, was required for the solid attachment of the legs.

To make a table with four separately attached legs as stable as the traditional solid design of top on a full base calls for good materials and good engineering. Three elements are involved: the top, the legs, and the tie-in between the two, the mounting plate. All three must be rigid if the whole construction is to be so. Since the legs are mounted to the top, the top must be strong and rigid. The legs themselves must not flex. Whether the legs are laminated or solid is not material to this, assuming proper lamination. The steel plate used for mounting the leg to the top is normally at least \( \frac{3}{4} \) inch in thickness and seldom less than 4 or 5 inches square. Usually the leg is bolted to the plate. A hanger bolt screwed into the leg and then threaded into the plate, although occasionally used, is the least effective method. The best type of library furniture construction uses a bolt through the mounting plate inserted into a boring in the top of the leg and then threaded into a cross-inserted steel pin or bushing. In this system, the wood is bypassed in developing strength, by tightening the leg to the plate. This system is very effective.

The plate, in turn, may be screwed to the underside of the top with wood screws, or, in better construction, with bolts that are received by steel bushings or pins inserted into the panel from the edge and parallel to the surface of the top. Using bolts and pins, the wood is again bypassed in tightening the joint. The advantage in the latter system is that in the metal to metal joint there is less concern for fatigue caused by the many cycles of racking and twisting to which library tables are inevitably subjected.

A discussion of table construction, no matter how brief, is incomplete without mention of bridging. A table top spans the distance between leg supports. When individual legs are used without benefit of stretchers or aprons, there comes a point when the natural stiffness of
the top must be supplemented by using a bridge or keel. As a general rule, the wider the span, the heavier and deeper the bridge member or keel. When table lengths exceed a certain point, it is usually more practical to use a center supporting leg than to go overboard in bridge construction.

A sharp edge is easily damaged, and in turn, can inflict damage if struck by the user. For these practical reasons, and for purposes of design, table tops are usually edged. A solid lumber top can be given an edge of any shape without supplementary edging material, but ply-construction using lumber or veneer core, normally needs an edge banding to protect the elements of the construction. Exceptions, of course, are found where the edges are tapered back and under or, in the case of wood core, are given a shape that allows the core to project beyond the face element so that any impact is absorbed by it, rather than by the more fragile veneers or plastics. Edge bandings may be wood, veneer, wood strips, densified wood, plastic, or metal. For most applications, wood edging is more elegant and imparts more warmth.

In discussing table tops, we have briefly covered general construction methods, core materials, finishes, and edgings. The points made here hold true for all types of panels, although most panels are not judged as harshly or are so demandingly used as table tops. Where the term "panel" is used, it applies to the full range of furniture components, including the backs, sides, tops, and bottoms of card catalog cases, book truck panels and shelves, magazine rack sides, wood book shelving, and similar items.

The library chair used at a table for reading or writing presents the greatest challenge to the furniture manufacturer in that it must be strong, rigid, resistant to abuse, and—most important of all—comfortable. At the same time, it must be reasonably light in weight for ease of handling.

The conventional, easily tipped, straight-back chair with its scooped seat, slats, straight posts, and straight top back rail has been largely replaced by so-called "wall-saver" designs. Here the back posts are curved, allowing the lower or leg portion of the posts to strike the floor molding, thus preventing the back posts from hitting the wall.

Equally important in the above construction is its "no-tip" feature. Tipping is so difficult in such designs that the user is discouraged from doing so. This adds immeasurably to the life of the chair. The back posts can be curved by band-sawing a solid or laminated block, or by steam-bending a straight post, and cutting to pattern after bending.
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Both methods are practical and normally perform well. However, the steam-bent post can boast continuous grain throughout its length and for this reason it is less liable to breakage or splitting than is sometimes the case with band-sawn posts.

Wall-saver designs, although less susceptible to tipping by the occupant, must nevertheless be strong enough to resist the tremendous strains put on them if so abused. When tipped backward, the major stresses on the chair occur at the points where the side stretchers join the back posts; when tipped forward, at the stretcher to leg joints. For these reasons, machining of these joints must be accurately done to assure a tight fit. Assembly calls for a strong adhesive, adequate doweling (at least two dowels per joint), and the support of well-fitted, glued and screwed corner blocks bridging each joint.

Bottom stretchers and rungs make table chairs stronger, but their use is often in conflict with contemporary design and its need for uncluttered simplicity.

Some recent designs in wood table chairs use straight back posts positioned at an angle to the floor. Although the wall-saver feature is still present in this design, as is the resistance to tipping, the seat does not extend to the back posts, thereby giving the floating seat appearance so desirable in some contemporary designs.

Molded plywood and molded reinforced fiberglass seating have also gained acceptance for library use. Properly made, such seating is useful, attractive, and normally light in weight. Each type has been extensively used for stacking chairs. The compound curve construction of these designs explains why both great strength and low weight are possible. The weakness of this design is usually in the attachment of the legs, although this has been largely resolved by the use of a rubber grommet coupling.

Molded plastic chair shells are made either by intrusion molding or by forming with fiberglass and polyester resin; the same basic procedure and materials used in making boat hulls. Of the two systems, the latter is that referred to as reinforced fiberglass. Those chairs longest in use and of highest reputation are of this construction. Color is an important factor when using plastics. In such application, however, coloring must be integral and not merely a surface treatment.

As in other products of complex manufacture, furniture is best judged by the expert. Experts, however, are not always at hand, and librarians, although otherwise trained and experienced, are often called upon to specify, evaluate, and purchase furniture.
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The criteria in Appendix II will be helpful to the librarian called upon to judge the general quality of library furniture. Such criteria, however, cannot substitute for proper specifications, the development of which is a job for an expert in wood furniture design and construction. The performance of wood finishes is more readily evaluated and for this purpose, the tests found in Appendix I will prove helpful.

APPENDIX I

PERFORMANCE TESTS FOR THE GLUING AND FINISHING OF WOOD FURNITURE

Tests which determine actual performance are highly desirable as a means of evaluating the durability and general quality of library wood furniture. Such tests are exceedingly difficult to develop, however, and as a consequence, relatively little work has been done in this area.

A few years ago, the Library Technology Project of the American Library Association instituted a study to develop a satisfactory performance test for library reading chairs made of wood. The result of this work, which was conducted by the Department of Engineering Research, North Carolina State College at Raleigh, was a procedure by which the strength of various types of chair construction could be evaluated. The method, unfortunately, is difficult to apply because of the size of the equipment required, but it does form the basis for further work that might well be carried on by the LTP to provide chair endurance standards acceptable to the industry and to librarians alike.

Despite the lack of suitable methods for testing durability and general quality of construction, there are methods for testing the finishes used on wood furniture and one accepted test for evaluating the quality of glue and the methods used in the fabrication of wood panels and table tops. These tests, which are not new, have been widely used for the purchase of institutional furniture. They have also been used in the purchase of library furniture but are not as well known as they should be. Incorporated into wood furniture specifications, these tests can help library purchasers obtain finishes with the beauty, durability, and resistance to abuse required for library furniture.

It should be realized, of course, that it is not enough to write these tests into the specifications. Nor is it enough to ask prospective bidders
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to certify that their finishes meet these specifications. Samples of the finish to be furnished by the bidder should be submitted to the purchaser who should, in turn, see that they are tested and the results certified to him by a qualified independent testing laboratory. Assuming compliance by bidders with all other aspects of the bid documents, the award can be based on the results of the laboratory evaluation. While these tests are incomplete, as regards all the performance characteristics of wood furniture, they are sufficiently rigorous to ensure the elimination of cheaper grades of furniture.

Most large cities have one or more qualified testing laboratories which may be located through the yellow pages of the telephone directory. In some cases, the city purchasing agent will have knowledge of such laboratories. Lacking other sources of information, the librarian may write to the Library Technology Project of the American Library Association for a list of testing laboratories in his area.

The cost of these tests, which must be borne by the purchaser, will be approximately one hundred twenty-five dollars per set, although charges vary somewhat from one laboratory to another. Testing costs, however, are negligible when compared with their effectiveness in eliminating poorly finished furniture.

Although these tests are in general use, variations are used by different laboratories. Usually, however, it will be better to insist that the methods cited here be used. In any case, the laboratory requested to conduct such tests should be identified and the tests discussed with the personnel who are to run them, before the specifications are completed.

In the event of non-award of a bid because of failure to pass these tests, the unsuccessful bidder should receive a copy of the certified report on his product submitted by the testing laboratory.

Samples required for these tests will vary somewhat with the number of panels to be tested for delamination. The sizes given here are those usually preferred for such tests, although this point should be checked with the laboratory conducting the tests.

Samples for testing delamination (where applicable to the specifications concerned) include:

1. Two unfinished test panels, each 6 inches by 6 inches, fully representative of the five-ply, lumber-core construction (or solid, edge-glued construction) to be used in the table tops furnished in response to the specifications.
2. Two unfinished test panels, each 6 inches by 6 inches, fully representative of the five-ply, lumber-core construction (and/or solid, edge-glued construction) to be used in the shelving or other panels to be furnished in response to the specifications.

3. Two unfinished test panels, each 6 inches by 6 inches, fully representative of the plywood veneers to be furnished in response to these specifications.

Samples for testing finish include twelve test panels, finished in complete accordance with the specifications, each 6 inches by 12 inches, plywood veneer construction. Samples should be of the same wood veneer specified, and should be similar in color to that required in the specifications.

**Performance Tests for Wood Furniture**

*(Delamination and Finish)*

**Test No. 1. Cold Soak Test (Delamination)—**This test should be conducted in accordance with procedures established and approved by the Commodity Standard Division of the General Services Administration, Test CS-35-49. Samples, (In writing specifications, a description of the exact sample or samples to be tested should be included here.) fully representative of the materials to be used in the tables furnished on this contract, shall be submerged in water at room temperature for four hours, then dried at temperatures of 70 to 100 degrees F. for twenty hours. After fifteen such cycles, no delamination shall be apparent. Failure to meet this requirement shall be cause of disqualification.

**Test No. 2. Hot and Cold Check Test (Finish)—**A sample of finished wood shall undergo ten cycles without evidence of checking or finish failure. Each cycle shall consist of exposure for one hour to a temperature of 120 degrees F., one hour at room temperature, one hour at -10 degrees F., and one hour at room temperature. Specimens for this test shall have aged not less than five days after completion of finishing.

**Test No. 3. Resistance to Stains (Finish)—**The test panel shall be exposed to the following materials:

A. Lipstick—as manufactured by Revlon under the name “Lanolite.”

B. Permanent writing ink—as manufactured by the Parker Pen Company, under the name “Permanent Black.”
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C. Carbon paper—as manufactured by Carter under the trade-mark "Midnight."
D. Coca-Cola.
E. Reclaimed rubber such as used in rubber heels.
F. Rubber stamp pad ink—as manufactured by Sanford under the name "Sanford Opaque."
G. De-natured alcohol.
H. Acetone.

Liquid agents are to be applied one-half teaspoon directly to the surface, while solid agents, such as carbon paper and lipstick, are to be rubbed on the surface. All should be allowed to stand four hours, after which the surfaces are to be washed with distilled water, followed with lacquer thinner. Any change in the appearance of the finish following this final treatment shall be deemed a failure.

Test No. 4. Resistance to Fading (Finish)—Specimen of finished wood shall have one-half of the surface suitably masked and then exposed to two General Electric 275 watt R.S. sunlamps for sixteen hours. Specimen is to be placed 24 inches from the lamp, and temperature of sample is not to exceed 100 degrees F. At the end of the test, any appreciable difference between the masked and unmasked portions of the specimen shall be considered failure and cause for disqualification. Color of the sample must match as closely as possible that submitted by the owner.

Test No. 5. Resistance to Heat (Finish)—A specimen of finished wood shall tolerate a well-lighted cigarette laid flat on the surface with the burning end in actual contact with the finish for a period of 30 seconds, without permanent damage. Inability of the finish to meet this minimum requirement shall be considered a failure.

Test No. 6. Resistance to Scratching (Finish)—Using method 6303 of Federal Test Method Standard No. 141, with an applied maximum load on the Hoffman Scratch Tester, but with only one stroke of the scratch tool across the surface, the finish must not be completely removed at the completion of this stroke.

Test No. 7. Resistance to Printing (Finish)—Using method 6211 of Federal Test Method Standard No. 141, a specimen of finished wood shall be subjected to a weight of not less than two pounds per square inch at 110 degrees F., applied over a surface 8 inches square covered with 00440B, Type III, cheesecloth, for 24 hours. Any evidence of printing shall be considered failure.
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Test No. 8. Resistance to Humidity (Finish)—The finish shall withstand 100 per cent relative humidity and 110 degrees F. for a period of 72 hours, without any permanent discoloration or softening of the varnish film.

Test No. 9. Resistance to Hot Water (Finish)—Twenty-five cc. of boiling water shall be poured on the finished surface and allowed to cool to room temperature. The water shall then be wiped from the surface and the finish examined for spotting, blushing, or softening. Any evidence of these conditions shall be considered failure.

Test No. 10. Resistance to Cleaning Compounds (Finish)—A 5 per cent solution of trisodium phosphate shall remain in contact with the finished surface for a period of twelve hours and shall cause no permanent discoloration or softening of the film.

Test No. 11. Resistance to Normal Wear and Abrasion—This test is to be conducted in accordance with the following procedure: A wood block with rounded edges, approximately 4 inches by 6 inches, faced with 1.05-54 sateen and loaded with a total weight of 10 lbs., plus or minus ½ pound, shall be moved reciprocally across the surface of the sample. The pad shall be saturated with Dutch Cleanser paste (20 grams of Dutch Cleanser in one ounce, liquid measure, tap water). Rewet with paste every fifty reciprocations. The finish shall withstand at least 100 motions in each direction without being worn through to the wood.

APPENDIX II

GENERAL CRITERIA FOR EVALUATING LIBRARY WOOD FURNITURE

In the space available here, it is possible to provide only a partial list of the criteria used by an expert in judging the quality of library furniture. Further, these criteria, depending as they do largely upon visible characteristics, cannot be fully indicative of the durability of the construction or the quality of the finish. Nevertheless, close attention to such details will help the untrained person to be a better judge of library furniture, whether it be in the showroom, in an exhibit, or in a library installation. Librarians with some experience in the purchase of library furniture are already familiar with many of these principles.

General Criteria

Stability—Subject the piece to normal use or occupancy. Shifting the weight several times will enable the user to determine if the joints
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are strong and if the elements of the piece are individually and collectively rigid.

Finish—The quality of the finish depends upon the preparation of the wood by sanding, as well as upon the finishing materials and their method of application. An experienced furniture man can judge quality with his hands, by the smoothness of the exposed edges and, more important, by the unexposed edges which are, nevertheless, subject to contact by hand or leg, i.e., by the smoothness of the undersides of the top, the aprons, stretchers, rungs, and similar parts. Smoothness of the unexposed parts normally indicates the quality climate surrounding the manufacture of the piece.

In judging furniture for library use, the finish need not be of the same quality as a piece of fine living room furniture which has been hand-rubbed many times. In all cases, however, the film thickness must be substantial and continuous. The unexposed surfaces should have a good finish, even if not of the same quality as used in the exposed areas. The back and the undersides of all panels and tops should have at least a coat of sealer.

The above follows the rule of furniture economics. Sanding and finishing are the most expensive operations in the plant. Unless required by the quality standards of the manufacturer or by the trade he solicits, these operations are not extended beyond the minimum. Keep in mind, therefore, that a reasonably well-constructed piece of furniture may not have a high quality sanding and finishing job, but rare indeed is the piece of well-sanded and finished furniture that is not of real quality in both material and manufacture.

Specific Criteria

Check chairs for:

1. **Comfort**—the chair should support the user’s legs and back when the chair is in position of normal use; **height of chair arms**—arms should not be too low or too high to be comfortable; **contour of seat**—some depression in the center makes chairs more comfortable; **slope of seat from front to back**—an excessive slope tilts body away from the surface of the table and is uncomfortable for writing or for reading with the book on the top of the table.

2. **Strength**—there should be no flex or wobble of any joints. The best construction uses a minimum of two dowels where seat rails join back posts.
3. *Finish*—feel arm rests, seat edges, and stretchers.
4. *Joints*—should be tight and well fitted.

Check tables for:

1. *Stability*—stand at one end and lean, exerting forward and downward pressure; table should neither tip nor rock. (Adjustable glides should be furnished.)
2. *Top construction*—judge for proper support and top thickness by having someone sit on the table near the center. Deflection should not exceed $\frac{1}{16}$ inch in 6 feet. No permanent deflection should be observed. Larger tables, depending upon design, may require a keel for rigidity. Poor construction can frequently be detected by the interior elements telegraphing through face veneers. Throw a beam of light across the table surface at a low angle. Poorly dried interior elements and joints will stand out in relief.
3. *Leg attachment*—turn table on side and attempt to move leg. No motion of leg at point of attachment and no flexing normally indicates good construction.

Check card catalog cabinets for:

1. *Proper fit of drawers*—they should slide readily but not be loose. Interchange several drawers—the degree of fit should be the same. Drawer runners are of solid hardwood in good construction; beware of plywood runners.
2. *Joint construction*—wide, close fitting dovetails should be used in attaching drawer sides to tray fronts. Attachment of tray backs to sides may be by dovetails or box joints, although the locking characteristic of the dovetail favors its use. Small glue blocks in the back corners add strength and help to protect the tray against damage when dropped.
3. *Hardware*—check tray pulls for rough surfaces or sharp edges. Try card compression mechanism for ease of motion.
4. *Sliding reference shelves*—shelves should slide easily, but not be a loose fit. Examine stops for sturdiness; light wood screws soon pull out or break.

Check case goods generally for:

1. *Joints*—should be tight, well fitted.
2. *Moving parts*—drawers, doors, pull-out slides, all should be smooth running and well-fitted.
The Selection and Evaluation of Library
Bookstacks

FRAZER G. POOLE

TO THE LIBRARIAN, architect, or purchasing agent charged for the first time with the selection of bookstacks for a library, the task looks simple enough. In fact, at a glance, the products of the several manufacturers are so similar in appearance that it is difficult to tell them apart. Closer examination, however, reveals variations that may be the difference between a satisfactory installation and one that fails to perform as intended. It is important therefore that the individual responsible for drafting specifications for a library bookstack installation knows the criteria of good stack design, be able to evaluate the differences in the products of the several manufacturers, and knows something of the ways by which the performance of a bookstack may be tested.

Although some form of shelving has been used for the storage of books since Biblical days, shelving design continues to evolve slowly. In earlier times, most library book shelves were of wood, a material used with very handsome effect in many modern libraries. By the middle of the last century, many commercial bookstack installations used cast-iron uprights or side panels, with wood shelves. Steel shelving first appeared toward the end of the century, and is still the preferred material. Other materials, such as aluminum, have been tried, but have not proved suitable for this purpose. Steel, of course, offers the advantages of strength, durability, fire resistance, and lower cost, as compared with wood.

Although the terms are somewhat loosely and interchangeably used, most manufacturers refer to their product as "library bookstack" rather than "library shelving" and for this reason the word bookstack will be used throughout this paper to refer to installations using steel. Wood units are usually, but not always, called shelving.

Two types of steel bookstack are used in library installations, neither

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of which is to be confused with the steel shelving sold for use in stock rooms and similar industrial purposes. The latter product is totally unsuited for library use, although the low cost sometimes makes it attractive to those not familiar with its deficiencies. Such shelving usually consists of four upright angle irons, to which the metal shelves are bolted. These units have no flexibility of shelf arrangement and are very crude versions of the more refined units to be discussed below. Unfortunately, an occasional librarian finds that his purchasing agent has been led to believe that this product is suitable for library use. Rarely, the need for cheap shelving for the storage of little-used materials may justify this product, but the librarian should be very careful to determine that such shelving will indeed meet his needs before accepting it.

Of the two types of steel bookstacks to be considered here, the first is variously referred to as case-type, panel-type, lock-shelf, or standard. Case-type is perhaps the name most frequently used and refers to a design having full backs, tops, and end panels slotted, usually for the full depth of the case, to receive the shelves. The shelves, which slide in and out of the slots in the side panels, are designed to lock in position when properly inserted. Most of the better known manufacturers of library bookstacks produce this style, as do other firms which do not normally supply libraries.

A few architects and librarians prefer case-type stacks because they believe the over-all design presents a neater and more finished appearance than the somewhat stripped-down effect of bracket-type bookstacks. Others prefer the more modern appearance of bracket-type stacks, as opposed to the rather box-like appearance of case-type stacks. Case-type stacks are perhaps most frequently used in libraries where the collections run to long sets of uniform size, so that shifting of the collection can be kept to a minimum, e.g., law libraries. The same design is also used occasionally in rare book rooms, where the closed design offers some protection against dust. For the most part, however, the lack of flexibility and the higher cost, which for case-type may be from 10 to 30 per cent more than for bracket stack, usually leads to the selection of the latter. It is interesting to note that in the Library Technology Project (LTP) evaluation, five manufacturers reported that 90 per cent or more of their sales were of bracket stacks, one reported that 85 per cent of his sales were bracket stacks, and a seventh reported that bracket stacks accounted for 75 per cent of his sales as compared with case-type.
The Selection and Evaluation of Library Bookstacks

In making a choice between case-type and bracket-type stack, adaptability for different needs is the most important consideration. Experienced librarians and manufacturers are in general agreement that the bracket stack is much the more flexible of the two styles. Case-type stacks are designed to accommodate shelves of only one depth in a given unit, i.e., an 8-inch section of case-type stack will accept only 8 inch shelves. In a bracket stack installation, on the other hand, there is, save for the fixed-base shelf, complete interchangeability of all widths of shelves in every section.

A major advantage of bracket stack is the ease with which a shelf, either partially or fully loaded with books, can be moved from one location to another. An entire shelf may be lifted from the uprights and carried to a new section of stack or it may be “walked” up or down the uprights by unhooking first one end and moving it to the new position, then unhooking and moving the other end. In a case-type installation, all books must first be removed from a given shelf, the shelf relocated, and the books shelved again.

Bracket stacks may also be rearranged more easily than case-type units, and require only one additional upright each time two sections are separated. Case-type stacks require two additional end panels when two sections are separated.

A further important advantage of bracket stacks lies in the availability of a variety of special shelves and other units. Magazine display shelves, pull-out reference shelves, inverted or flush-bracket shelves for shelving newspapers and large volumes, divided shelf units, carrels, book or typewriter lockers, coat rack units, and other features are available as standard items from most manufacturers of bracket stacks. A few such units, e.g., sloping display shelves, are available for case-type installations, usually on special order. Most of these features, however, do not lend themselves to use in this design.

There is some experience among librarians, unrecorded in the literature, to indicate that over a period of years, case-type stacks are more likely to suffer damage than a bracket installation. Careless placement of shelves may force the slotted portion of the end panels out of position, making shelves difficult to insert or remove thereafter. Designs in which the slots do not run the full depth of the shelf are less subject to such damage than those in which the slots extend the full depth. This is more likely to be a problem also, with the cheaper, case-type stacks in which relatively light gauges of metal are used.

Differences in stability of the two types appear to be negligible. In
the LTP evaluation, four manufacturers reported no appreciable differences in the stability of bracket stacks versus case-type stacks. One manufacturer stated that he believed bracket stacks should be more stable because the design is such that books are always shelved close to the center of gravity of the stack. Another manufacturer reported little difference in the stability of the two designs, if all refinements are added to the bracket stack. In the latter case, however, the only really important factor in stability is the end panels.

Aesthetics is, of course, a subjective matter. As indicated above, some architects and librarians like the appearance of the case-type design, although the majority seem to prefer the bracket stack. It should be remembered that metal or wood end panels can always be added to bracket stacks if a more finished appearance is desired.

Case-style stacks are manufactured by a large number of firms, only a few of which regularly supply the library trade. As a result, there is a wide range of quality and cost in the product. Since no performance standards for this design are available, the librarian who prefers the case-type stack is at a disadvantage. The best solution is to compare the products of the several manufacturers, noting such features as the design of the slots, the ease of inserting and removing shelves, the gauges of metal used, the presence of projecting screw heads or sharp edges that could damage books, the stability of the unit, and the ease of assembly. Evaluation from a catalog is difficult, if not impossible, and actual stack units should be examined either in the manufacturer's showroom or in a library installation.

Bookstacks of the bracket design were introduced by both Library Bureau and Art Metal just before the turn of the century. Today there are eight principal manufacturers of bracket-type stacks, and several others which produce this type but supply relatively small quantities to libraries.

The basic design of the bracket bookstack involves the use of vertical steel members (called uprights or columns) upon which the shelves are hung in cantilever fashion. If the uprights are supported at the base so that the unit will stand alone, the stack is called “freestanding.” If the uprights support the loaded shelves but must be top-braced in order to remain standing, the stack is usually referred to as “non-freestanding.” The latter is less expensive, but has the disadvantage of lacking a closed base and of being considerably less flexible. Freestanding units can be more easily re-arranged and moved from one location to another. Non-freestanding bracket stacks are usually con-
The Selection and Evaluation of Library Bookstacks

sidered less attractive than the closed-base, freestanding design. The latter, however, is a point the librarian will want to judge for himself, especially if cost is an important factor.

Bracket as well as case-type stacks are available in single-tier (one full-height unit, 7 feet-6 inches high), and in multi-tier. Multi-tier installations consist of two or more levels of stacks in which each level supports the weight of those above. In an earlier era, the spaces between vertical units were left open to allow the circulation of air around the books. These openings, however, promoted vertical drafts and considerably increased the hazards caused by fires. Today, air-conditioning largely obviates the need for this circulation of air around the books and, as a result, the great majority of libraries are constructed with continuous, solid floors, each of which is capable of supporting, independently, the full load imposed by the stacks and the book collection. Thus, most present-day stack installations are single-tier. Where multi-tier installations are made, floors are continuous to reduce the fire hazard, but are not self-supporting. Because multi-tier stacks constitute such a small part of current installations and because they present special engineering problems, they will not be discussed further in this paper.

In a bracket stack, of either free or non-freestanding design, the uprights or columns are square or rectangular in cross section and measure from 2 by 2 inches to 2 by 3 inches. They may be formed in a variety of ways, each of which is calculated to produce a rigid column capable of withstanding the stresses placed upon the unit when it is loaded with books. Most commonly, the upright consists of two pieces of steel formed in a hat-shaped cross section and welded together with the flanges on the outside and at right angles to the longitudinal axis of the stacks. Other designs have a single flange on the inside, or have the two halves of a “C” shaped column turned back to back and bolted together. Although each manufacturer claims superiority for his column design, independent studies are desirable to determine both actual library requirements and the degree to which the several existing column designs meet these requirements.

Each tubular upright contains two vertical rows of slots. At intervals, depending upon the manufacturer, these slots, which are on 1-inch centers, differ slightly in shape, to permit easy alignment of shelves. Laterally, the slots may vary from ½ to 1½ inches on centers. Adjustable shelves are hung from the uprights by means of hooks which engage the slots in the column.
The standard size of a single-faced section of bracket stack is 36 inches wide, by 7 feet-6 inches high, by 8, 10, or 12 inches deep. Two sections back to back, with the shelves on each side hung from the same pair of uprights, are referred to as a compartment, a double-faced section, or a bay. Most manufacturers will provide shorter or longer units on special order, and at least one manufacturer recently offered a standard 48-inch unit which will be discussed in more detail below. In addition to full-height (7 feet-6 inches) units, all manufacturers offer intermediate height (5 feet or 5 feet-6 inches) units, and standing height (3 feet-6 inches) units. The intermediate height is frequently used for installations in children’s rooms or elementary school libraries, while the standing height units make convenient space dividers in open stack installations, or storage and work units in library work areas.

Rigidity in the longitudinal direction, i.e., in the long axis of the stack, is usually achieved by the use of steel cross braces. Under ordinary circumstances, sway braces are required only every fourth or fifth unit, although each manufacturer has his own recommendations. However, since the use of sway braces occasionally prevents large volumes from being pushed back on the shelves so that the spines line up with those of smaller books, some librarians object to them under any conditions. The alternative, for most manufacturers, is a very rigid design employing extra-heavy cross members in the base and some form of gusset or bracing at the top of each unit. Such designs are expensive, often adding as much as 10 per cent to the cost of a given job. Where gussets are employed, the shelving problem is alleviated only slightly, since the gussets themselves hamper the proper shelving of books. Whether the limited number of occasions when sway braces prevent an oversize volume from being shelved “through” is sufficient justification for the added cost of the specially reinforced design must be decided by the purchaser.

A second solution to the sway brace problem has appeared recently with the development of a stack unit in which the uprights are welded to the top and bottom spreaders, to form a rectangular frame. This is an economical design that provides great rigidity in the longitudinal direction.

Lateral rigidity, as well as lateral stability, depends primarily upon the strength of the uprights and upon that of the base support system. Strength of the uprights is achieved by the design of the cross section in relation to the gauge of metal used. For the least deflection in the
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lateral direction, the flanges in a two piece, welded upright are always at right angles to the longitudinal axis of the stacks. Where higher strength is required, an additional reinforcing strip of steel may be welded inside the column or bolted between the two halves of a non-welded column, or a heavier gauge of steel may be used.

Base support systems are of two general types. A few manufacturers offer both in order to meet a greater variety of specifications. In the more common design, the brackets at the ends of the bottom shelves are bolted to the uprights to form wings projecting at right angles to the longitudinal axis of the stack. In the second, and more rigid design, continuous support, from one side of the stack to the other, is provided either by a heavy duty member which wraps around and is bolted to the base of the column, or by a piece of heavy sheet steel which passes through the two halves of a non-welded upright. In some designs this may be the same as the reinforcing strip referred to above. In either case, these members provide a far more rigid support for the upright than the design in which the end brackets of the base shelves are simply bolted to the columns.

No independent engineering studies of column strength or of base support systems have been conducted. However, recent testing by the University of Illinois for its stack installation in the library of the new Chicago Circle campus suggests that the usual design, in which the base brackets are simply bolted to the uprights, may not have sufficient strength to support heavy eccentric loads, whereas designs utilizing heavy gauge members that wrap around the upright, or reinforcing members that pass through the upright, can sustain such loads.

In view of the lack of accepted performance standards for bracket stacks, the author would like to suggest that the Library Technology Project of the American Library Association consider this a matter for investigation. Such a study should include a determination of reasonable performance standards for bracket stacks, as well as mathematical and engineering evaluations of existing designs, to determine their performance in accordance with such standards.

Although library floors are designed to be level, in practice it is impossible to make them so. Variations of one quarter inch or more in a distance of 9 to 12 feet are not uncommon, and in distances of 18 to 21 feet, variations of three-eighths to one-half inch or more may occasionally be encountered. It is important therefore that library bookstacks be equipped with proper leveling devices. Shims, although frequently used, are unsuitable for several reasons and should not be
permitted. In the better designs, adjustable leveling clips or shoes are provided. These are usually covered with non-slip neoprene pads or sleeves. Such pads prevent damage to resilient tile flooring and decrease the tendency of stacks to "creep" when subjected to vibration.

The matter of stability in an installation of freestanding bookstacks is somewhat complicated. Every librarian has heard of occasional instances in which rows of bookstacks have been toppled, overturning others in succession, like dominoes. Under ordinary circumstances, a so-called freestanding stack is indeed freestanding. However, installations in those parts of the country subject to earthquake tremors may require special safety precautions. In California, the State Department of Public Works requires that freestanding stacks in the public schools be sufficiently stable to withstand a force equal to 20 per cent of the dead load of the books and the stacks. Although not mandatory in other jurisdictions, many California libraries have included this requirement in their bookstack specifications. To provide an extra measure of safety, California law also requires that bookstacks in school libraries be able to withstand a force one and one-half times the overturning force. Few freestanding stacks are able to meet the latter requirement without either anchoring or top bracing.

In cases where some fastening is required, floor anchoring is preferred because, in an earthquake, the bases of a stack installation can be displaced slightly, even if the tops are held in position by the top bracing. Anchoring, however, is more expensive than top bracing and where earthquake tremors are not a problem the latter may be preferred.

Difficulties also arise when one tries to guard against vandalism. Many librarians consider this such a remote possibility that they take no further cognizance of the problem. Instances of deliberate overturning of stacks have occurred, however, and to be on the safe side some librarians, as well as some library consultants, prefer to fasten the stacks in one manner or the other. A few of the manufacturers take a less conservative view and state that their freestanding stack installations do not require any fastening. In California, some type of fastening is mandatory in elementary and high school libraries. Elsewhere, the librarian makes his own decision.

Where top-bracing is preferred to floor anchors, "U" shaped channels of at least 18-gauge steel and with at least a one-inch flange should be used. One such channel is usually installed for every three bays or compartments. Thus a group of ranges, each eight bays long, would
require three transverse channels. For the sake of appearance, channels are usually centered on the second upright from each end of the range, with other channels spaced at equal intervals along the remainder of the range, where possible. Transverse channels are located over the uprights, rather than in mid-section, to provide maximum rigidity.

Metal end panels are widely used with bracket stack installations to give a neater appearance and, through the use of color, to enhance the decor. Although normally fabricated of smooth-surfaced sheet metal, at least one manufacturer now offers a textured surface. Others offer end panels with chromium plated trim strips or wood inserts, or panels faced with fabric-backed plastics, leather, or textiles. Full, wood end panels, available in a variety of different grains, are unusually handsome, but may add from 50 to 100 per cent to the cost of each panel.

Standard book shelves come in 8-inch, 10-inch, and 12-inch widths. Some manufacturers also offer a 9-inch shelf. It should be understood that the above figures are nominal widths and represent the distance from the front edge of the shelf to the center line of the stack. The actual widths of 8-, 10-, and 12-inch shelves are 7, 9, and 11 inches respectively. In almost all bracket stacks, the upright, between the inner edges of the shelves, is 2 inches thick, so that one inch is added to the actual widths of the shelves in calculating the usable depth of the section.

Since the wider the shelf, the higher the cost, no shelves should be wider than actually required. It is usually estimated that at least 80 per cent of the books in a comprehensive collection will fit on 8-inch shelves. Some bound periodicals of course require wider shelves, as do many medical, scientific, and art books. As a rule of thumb, it may be assumed that a normal installation will require 80 per cent 8-inch shelves, 15 per cent 10-inch shelves, and 5 per cent 12-inch shelves. Some special purpose shelves, e.g., sloping display shelves, have a nominal depth of 12 inches and should be used only in units with 12-inch bases.

Shelves of the several manufacturers vary from 35 to 35½ inches in usable length. It is easy to calculate that in a stack designed for 300,000 volumes at full capacity, one-half inch is the equivalent of 583 feet, in which could be stored an additional 4,500 volumes. On the other hand, since few libraries ever reach their absolute storage capacity, the additional space of the longer shelf design should not be given undue weight in writing specifications.
Within the last few years, one manufacturer has marketed a four-foot shelf for bracket stack installations. In theory, the longer shelf requires fewer uprights and in an installation of any size would result in substantial savings. It was assumed by the manufacturer that this shelf, as originally designed, would require no further reinforcement for all normal use. However, tests of the non-reinforced shelf, conducted by the University of California at Los Angeles, showed deflections of $\frac{1}{4}$ to $\frac{1}{2}$ inch under loads of 62 pounds per square foot. Although this loading was made heavy for test purposes, it was, in actuality, only 1.1 pounds per square foot greater than the average load in many areas of the UCLA stacks. The four-foot shelf is available with a reinforcing steel channel welded to the lower surface but this reduces the cost advantage. Some librarians who have considered the matter carefully, also believe that the four-foot shelf has a functional disadvantage in that it is difficult, in a stack aisle of standard width, for the eye to encompass a span of four feet. Thus, locating a given item may be more difficult on the longer shelf than on a standard three-foot shelf. For some purposes, the longer shelf, without reinforcing, may be quite satisfactory and could result in definite economies. However, the several factors involved should be considered carefully before adopting the four-foot length.

All standard book shelves are presently designed to withstand loads of 40 pounds per square foot with no permanent deflection, and with no temporary deflection in excess of $\frac{3}{16}$ inch. While this standard is adequate for most library materials, bound copies of *Life*, for example, standing upright on a shelf, exert a load factor of 57 pounds to the square foot on a 12 inch shelf. Twelve-inch phonograph records produce a load factor of 49.5 pounds per square foot on a 12 inch shelf. Fortunately, most shelves are designed to withstand loads somewhat in excess of the 40-pound standard. This is not always the case, however, and there are recent installations in which the shelves sag to a degree noticeable to even the most casual observer. Strictly adhered to, the 40-pound standard is probably satisfactory in many situations, but the writer believes that a 60-pound per square foot standard, with an appropriate safety factor, is both desirable for the librarian and economically feasible for the manufacturer.

Although the U-bar shelf enjoyed considerable popularity some years back, such shelves are infrequent in present-day installations. They are still available, however, from at least one manufacturer. The split shelf, a fairly recent innovation, was designed to provide a more effi-
cient type of book support which slides in a track down the center of the shelf. In use, these supports always remain upright and attached to the shelf. There is an additional cost for this design and as yet it has not been widely used; only two manufacturers are known to have it in their lines.

Hinged-bracket shelves were more popular some years ago than currently. This design is still available, however, from several manufacturers, and some librarians prefer it to the slightly cheaper detachable-bracket shelf. In the hinged design, the brackets are permanently attached to the shelf and fold flat for easy storage. The detachable bracket, on the other hand, requires that the brackets be detached before the shelves are stored and re-affixed when the shelves are used. With the exception of one manufacturer who produces a bracket to fit either end of the shelf, brackets fit right or left ends of shelves only. There is little to choose between the two, except the greater convenience in storage of the hinged bracket type. Occasionally, one hears the objection that the hinged shelf is awkward to move, but this presents no problem if the proper technique is used.

A recent and very interesting innovation in shelving is known as Fold-a-shelf. Here the shelf and the end brackets are formed in one piece and the unit is slotted along the line at which the brackets would normally be attached to the shelf. In use, the brackets are simply folded upwards until they are in the vertical position. This design eliminates both hinges and loose end brackets and effects a saving over conventional shelves. If it is necessary to store the shelf, the ends are folded down to about 45 degrees, so that the units stack nicely. Although the metal eventually breaks from fatigue, it is good for at least 35 folds, if the end brackets are not bent downward more than 45 degrees. In normal use, therefore, such shelves would last almost indefinitely. This design has gained acceptance on the West Coast where it was introduced.

The number of hooks used on shelf brackets may occasionally be a matter of importance. Such hooks, formed at the top of the bracket, engage the slots in the upright and support most of the weight of the books on the shelves. Lugs at the bottom of the bracket also fit into the slots of the upright, but serve only to keep the shelf from being moved sideways; they support no weight. Two hooks, if properly designed, are entirely adequate to support all possible loads. Three hooks, as furnished by some manufacturers, may tend to bind in the slots and make it difficult to shift shelves quickly and easily if hooks and slots
are not properly sized and aligned. Sample shelves of three hook
design should be carefully checked for proper clearances.

The normal capacity of a standard 90-inch stack is seven shelves—
the fixed base shelf plus six adjustable shelves. For convenience and
flexibility, uprights should have slots all the way to the top. With a 4-
inches base, this permits separation of the shelves approximately 12\frac{\text{1}}{2}
inches on centers, thus providing a clear filing space between shelves
of 11\frac{3}{4} inches.

A variety of other types of shelves are available from the manufac-
turers, although these may not always be shown in their hand-out
literature. Among the more common special-purpose designs are slop-
ing display shelves for periodicals, flush bracket shelves for the storage
of oversize volumes and newspapers, pull-out reference shelves, di-
vided shelves for pamphlets, phonograph records, and similar items,
book storage lockers, coat racks and umbrella stands, and desk units.
Such units add greatly to the flexibility and convenience of the bracket
stack installation. One new unit, which has not yet found its way into
the catalogs, is a sloping newspaper display and storage shelf designed
for the University of Notre Dame Library and used again in the Chi-
cago Circle library of the University of Illinois. This special shelf,
which eliminates the need for the traditional newspaper stick, holds
the newspaper in a nearly vertical position under a plexiglas cover
which lifts to permit access. Although users can leave newspapers in
a state of disarray that is impossible with the traditional stick, experi-
ence at Notre Dame indicates that it requires little more staff time to
straighten an issue and replace it behind its cover than to place the
paper on the traditional stick.\footnote{5} The advantages of the new shelf are
the ease with which a given title may be located, the convenience of
access, and the ease of reading.

Although canopy tops are available for bracket stack installations,
y they are infrequently used in air-conditioned buildings. Such tops add
appreciably to the cost and serve no useful purpose except to protect
books from dust in areas that are not air-conditioned. They may occa-
nionally be selected for aesthetic reasons, but against this must be
balanced the fact that they prevent utilizing the full height of the
stacks.

Bookstack accessories include such small but important items as book
supports, range indicators, end-label holders, and shelf-label holders.
Designs vary with the manufacturer. Choice of style, where available,
rests with the purchaser, but there are some useful guidelines.

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For general use, the wire-type book support is probably least satisfactory, although it is the most economical. The principal objection to this support is that it damages books carelessly shelved, by "knifing" into the pages. Plate-type supports are of two kinds. The first, and most common type, consists of a piece of sheet metal with a portion cut out and turned under to form a base. Although more expensive, this design is no better than the wire support and is to be avoided for the same reasons. A second design is frequently called the "findable" or "non-losable" support. In this type, the two sides are formed at right angles to the main body of the support to produce a surface $\frac{1}{2}$ to $\frac{3}{4}$ inch in width. This eliminates the danger of "knifing" and makes it easy to locate the support when books are shelved on either side of the support. However, unless this type of support is provided with the proper non-skid surface on the base it will slide out of position when books are moved, and may scratch the surface of the shelf. For best results, the synthetic corks are superior to rubber-type materials as a non-skid surface. Application of these materials by pressure sensitive adhesives is unsatisfactory, and one of the solvent activated adhesives should be specified instead.

A third type of book support clips to the box edge at the front of the shelf, along which it slides as on a track. Usually known as a hook-type support, it also has a flange at right angles to the edge of the shelf to eliminate knifing the pages of books. This type of support should also be ordered with non-skid bottom.

Range finders are "V"-shaped holders for 3 by 5 inch cards. Normally placed in the center of the end panel and close to the top, they identify a range at some distance and simplify the task of giving directions to users of open stack collections. Architects and designers occasionally object to these devices because they consider them unsightly, but the convenience they afford the library user compensates for any lack of aesthetic quality. Sometimes made in aluminum, range finders are better specified in steel.

One card holder is usually furnished for each end panel of a single-faced range, and two for a double-faced range. Although some manufacturers offer double holders for a double end panel, this design is less satisfactory than two single holders.

Even such small items as snap-on label holders can be unsatisfactory if not properly designed. Ordinarily these holders are used on periodical shelves to indicate the location of unbound issues. They should be designed of light weight metal with a high degree of spring, and
it should be possible to remove them and relocate them quickly and easily, and without damage to the finish. Despite such obvious requirements, some manufacturers make these holders of fairly heavy-gauge steel with little or no spring. Better type holders are made of special aluminum alloys with sufficient spring to keep them in position but still permit easy adjustment.

A thorough knowledge of the several elements of good stack design is requisite for the development of proper specifications, but such knowledge alone does not guarantee a satisfactory installation. As with so many other products used in libraries, the development of specifications has been left largely to the manufacturers. Performance standards and specifications prepared by librarians to meet library needs do not exist. In consequence, nearly every specification for steel stacks is copied, in whole or in part, from specifications prepared by the several manufacturers for their own products. The result is often called a "nuts and bolts" specification. That is to say, the materials and methods of manufacture are specified, rather than the performance of the product. To date, the manufacturers concerned have shown little interest in developing performance standards for bookstacks.

Thus, if such specifications are to be developed, it appears that the work must be undertaken by an organization such as the Library Technology Project of the American Library Association. In fact, determination of the basic performance requirements of steel bookstacks, sponsorship of the required engineering tests, and the technical evaluation of existing designs are better conducted by an independent body. It is to be hoped that LTP will consider this a project that it might profitably undertake.

Despite the fact that carefully evaluated performance specifications are not yet available, there are tests that can be applied by the librarian, architect, or purchasing agent as a means of determining the performance of steel stacks. These tests are set forth in Appendix I.

We have not mentioned, thus far, the finishing of steel stacks. As with other elements of stack performance, finishes vary widely in quality and, unless specified in terms of performance, may not provide the durability, resistance to scratching, and other qualities desirable in a stack installation. Fortunately, performance specifications for steel finishes were developed by the LTP a few years ago and have been successfully used in some recent installations. These specifications, which deserve to be more widely known and used, are reproduced in Appendix II.
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Wood has been used for library shelving since time immemorial. With the advent of sheet metal stacks, however, wood began to be used less frequently. Today, although still a popular material, wood is rarely used in large installations. There are exceptions, of course, and custom wood shelving is not infrequently found in rare book rooms, in browsing rooms, and in other areas of the library where shelving made of fine cabinet woods is used to enhance the decor.

Aside from these rather specialized uses, wood shelving today appears to be restricted mainly to installations in school and small public libraries. Despite its higher cost (wood shelving may run from twenty to thirty per cent more than steel) and its lack of flexibility, librarians justify their use of wood on the basis of its added "warmth," and on the fact that it is "less noisy."

As with steel, wood shelving may be obtained in both single- and double-faced units. Standard high shelving is 82 inches in wood instead of 90 inches, as in steel. Intermediate height shelving is 60 inches high, and counter height shelving is 42 inches high. These measurements will vary slightly from manufacturer to manufacturer. Shelf depths also parallel those used for steel shelving with 8-, 10-, and 12-inch shelves the accepted standards. In this instance, however, the depths given are actual rather than nominal. Again, as with steel units, the standard width module is 36 inches on centers.

As in case-type steel shelving, wood shelving may be purchased with backs, although this adds appreciably to the cost. If backs are not specified, full-height, double-faced shelving requires sway braces to provide longitudinal stability. Because of its lower height, wood shelving is not ordinarily anchored to the floor, nor is it top-braced as in the case of steel shelving.

Fixed bottom shelves may be flat (standard) or tilted at a ten degree angle. Some librarians prefer the latter design because it is easier to read titles on the bottom shelves. Against this advantage, however, must be weighed the tendency of books to slide to the back of the shelf, where they are often more difficult to see than if stored on a flat shelf. The cork or composition strips employed to overcome this difficulty usually are ineffective, especially under conditions where passing traffic sets up vibrations that affect the furniture in the building.

Both particle board and plywood shelves are used in the cheaper grades of wood shelving, but are subject to warping under sustained loads. The best shelving specifies solid hardwood (northern yellow
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birch or hard rock white maple) 13/16 inches thick. Such shelves are
“built-up” by edge-gluing a number of strips together.

Wood shelving is usually adjustable on one inch centers. A common
method of providing for such adjustment uses vertical rows of holes
drilled near the front and back edges of the end panels. Threaded
brass pins inserted in the holes support the shelves, which are grooved
at the ends so that the shelves drop over and cover the pins. This
method is entirely satisfactory under ordinary circumstances, although
school students have been known to replace the metal pins with wood
pins or matches, which break when the shelf is loaded beyond a certain
limit. Other methods of shelf support include the use of small metal
hooks which fit into holes in the end brackets and at the same time
project under the shelf to provide support. More expensive, but prob-
ably the most satisfactory if properly installed, are long metal stand-
ards which are set into grooves extending the full height of the end
panels near the front and back edges. The shelves are supported on
small metal angles which fit into slots in the standards. This
system, which permits adjustments on one-half inch centers is virtually fool-
proof. It is available from most manufacturers at the option of the
purchaser.

Although less varied than the line of accessory shelves available with
bracket-type steel stacks, several special shelf types may be obtained.
Among these are sloping display shelves for periodicals, newspaper
holder racks, and divided shelves. Wood shelving is intermediate be-
tween case-type and bracket stacks in the ease of moving shelves
loaded with books. In many cases, the position of a shelf may be ad-
justed without removing the books. In other instances, such adjust-
ment is difficult if not impossible.

Wood shelving is similar to case-type, steel shelving in flexibility.
In most cases a first unit consists of two end panels with appropriate
shelves, base unit, and top. If additional sections are added, they are
inserted between the original end panels. If a range is separated into
two parts, two additional end panels are required to complete the
modification.

Finishes used on wood bookstacks are the same as those used on
other wood furniture. In general, the conversion varnishes (catalytic
varnishes) are superior to the lacquer finishes. Tests of the conversion
varnishes show that there are differences among different brands. Thus
the only method by which quality can be assured is to subject repre-
sentative samples to performance tests. Appendix I following the
article, "The Materials and Construction of Library Furniture," lists tests by means of which the performance of both the finishes and the glues used in fabricating the shelving may be evaluated. These tests have been successfully used in many library furniture installations, but should be more widely known and used in specifications for wood furniture.

References

2. Ibid., p. 896.

APPENDIX I

Performance Tests for Bracket-Type Steel Bookstacks

Although in theory it should be considerably easier to develop complete performance specifications for steel bookstacks than for wood furniture, such specifications are not now available. Before they can be made available, engineering studies of bookstack requirements and complete evaluations of existing designs are required. In the absence of such specifications, the following tests may prove helpful.

These tests are designed to evaluate the actual strength of the uprights; the lateral stability of the bookstack as measured by the strength of the base support system; longitudinal stability as measured by the strength of the sway braces, welding, or other reinforcing designed to provide rigidity in the longitudinal direction; and the strength of the shelves. In a weak or unstable unit, the eccentric loading of so much weight could cause the unit to topple sideways. Care should be exercised, therefore, in conducting these tests. A properly designed and erected bookstack, on the other hand, can withstand all such loading and still be so stable that it can be lightly rocked from side to side without danger.

These tests may be included in bookstack specifications under the heading: On Site Testing. They can be conducted in many cases by the owner, or they can be performed for the owner by an independent
engineering laboratory. In addition to ordinary mechanic's tools, a platform scale for weighing the materials used to load the shelves, a spring scale reading 100 pounds or more for measuring longitudinal stability, and sufficient weight, in the form of steel or iron scraps or small ingots of pig iron or lead, to load all shelves as indicated, are required. Most cities have foundries or iron works where such weights may be obtained for temporary use. It is recommended that each bidder be permitted to observe the testing of his product. All samples for testing purposes should, of course, be delivered before bids are opened, but the tests should be conducted after such opening.

Although the following tests have been used successfully by a few institutions, most recently by the University of Illinois at Chicago Circle, it is to be hoped that they will be replaced by more comprehensive specifications resulting from sound engineering studies.

Samples for testing and evaluation should consist of one range of two, double-faced sections with 20-inch bases, complete with fixed base shelves and 24, 10-inch adjustable shelves. Sway braces, if included in the specifications, should be required with the sample. End panels are desirable for purposes of general evaluation, but should not be installed while the tests are being conducted.

If possible, samples should be erected on a concrete floor rather than a resilient tile floor. In any case, all neoprene pads should be removed so that direct contact between the base of the stack and the floor is achieved.

**On Site Testing**

1. When the sample bookstack has been properly installed and leveled by the bidder, it shall be tested by loading first the shelves in one complete section from the top down. One hundred seventy-five pounds shall be added to the topmost shelf, adjusted to the highest position in the section, after which one hundred seventy-five pounds (uniformly distributed over the shelf) shall be added progressively to each lower shelf until the section is completely loaded with one hundred seventy-five pounds on each of six adjustable shelves and on the base shelf. The first measurements of deflection shall be made at this time. The same procedure shall then be followed on the section opposite that first tested, and the deflection measured again. Any deflection of the upright from a straight line in excess of 1/16 inch, shall be considered a failure and shall result in disqualification of the bidder. Further, any deflection of the upright from the vertical in excess of
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3/8 inch shall also be considered a failure and shall likewise result in the disqualification of the bidder.

2. The sample bookstack shall be further tested by applying a 100 pound force, horizontal and parallel to the long axis of the range, against the uprights at a point 48 inches above the floor. This test may be conducted with or without adjustable shelves, but one hundred seventy-five pounds shall be added to each of the four base shelves before testing. Any temporary deflection from the vertical in excess of 3/8 inch and any permanent deflection exceeding 1/16 inch3 shall be considered failure and shall result in disqualification of the bidder.

3. At least five adjustable shelves shall be tested, after placing them in position in the sample range and loading them with the equivalent of 50 pounds per square foot. Any temporary deflection of the shelf in excess of 3/16 inch, and any permanent deflection of any of the five shelves,4 shall be considered failure and cause for disqualification of the bidder.

Notes

1. Such deflection is best measured by stretching a chalk line along the loaded side of the upright from extreme top to extreme bottom edges and measuring the maximum deviation from a straight line. Ordinarily, such deviations will occur somewhere between 12 and 30 inches above the floor line.

2. Prior to loading the stack, a plumb line should be suspended from the top of the column so that the bob, which must swing freely, is at rest not more than two inches above floor level and in the exact center of the column. (The center line should be marked on the column as a reference point.) Deflection of the column from the vertical is measured by the distance the bob swings from the mark on the center of the column.

3. As in note 2 above, a plumb line should be suspended from the top of the column so that the bob swings freely and rests over an established mark on the floor. The necessary force may be exerted by a spring scale hooked to the upright at the proper height and pulled to the 100 pound mark by two men, or by a lever with one end fixed to the floor.

4. A nominal 10-inch shelf (actual depth 9 inches), 35.5 inches long, contains 2.2 square feet. Thus a loading factor of 50 pounds per square foot requires a shelf load of 110 pounds for testing purposes. Shelves should be loaded with the narrow edges of all weights at right angles to the length of the shelf, to avoid the "bridging" effect. Measurement may be made with a stretched chalk line or, preferably, with a metal straight edge. If desired, the sample may also include five nominal 8-inch shelves (actual depth 7 inches) which contain 1.7 square feet and require a shelf load of 85 pounds to develop a load factor of 50 pounds per square foot.
In steel bookstacks, as in the case of wood furniture, it is easier to test the finish than to test other elements of performance. The following tests for finishes on steel bookstacks were developed for the Library Technology Project a few years ago. They have been used successfully in a few instances, but deserve wider dissemination. In slightly modified form, they are included here by permission of the LTP.

In practice, these tests should be included in the specifications as a means of determining the qualifications of the several bidders. The tests should be conducted by an independent laboratory qualified to conduct tests on paints and related products.

As in the case of samples for testing the finish on wood, the samples required here should be submitted not later than the opening of bids and the award, other elements of the bids being equal, should be made on the basis of the satisfactory performance of the samples under testing.

Performance Tests for Finishes on Steel Bookstacks

1. Manufacturer's Obligations—Failure of the finish on the test samples in any portion of the following tests shall be cause for disqualification of the bid. Further, the owner reserves the right to conduct such tests, on a random basis, on stack components delivered to the job. Failure of such components to meet these specifications may result in an order to stop fabrication until the condition is corrected. The cost of such random testing will be borne by the owner, except in the event of failure of the finish to meet the specifications, in which case the charges will be assessed to the manufacturer.

2. Samples Required—Prior to the opening of bids on this contract, bidders shall furnish to the owner twelve, 4-inch by 6-inch and two, 4-inch by 4-inch panels of 20-gauge cold rolled steel for testing purposes. These panels shall have been prepared by running them through a production line similar in all respects to the procedures to be used in finishing the bookstacks to be supplied on the contract, including cleaning and rustproofing, followed by a finish coat as close as practicable to the color to be furnished on this contract. The test panels shall be fully representative of the quality of paint finish for the entire installation.

3. Testing Agency—All tests will be made by a testing engineer,
laboratory, or agency selected by the owner, and in accordance with applicable standard methods of the American Society for Testing Materials (ASTM), or by the procedures described herein.

4. Tests—The following tests shall be conducted on the test panels.
   
   (a) **Film thickness.** Thickness of enamel shall be measured by a General Electric film thickness gauge or equivalent (See ASTM Method D1005-21 and ASTM 1400-58). Measurements of less than 1.5 mil. thickness shall be considered a failure and cause for disqualification of the bidder.

   (b) **Gloss.** Gloss shall be not less than 50 nor more than 70 as determined on a 60 degree gloss meter (See ASTM Method D523-53T).

   (c) **Bend test (adhesion).** Two specimens prepared as outlined above shall be bent 180 degrees over a ¼ inch diameter mandrel, one parallel to and one transverse to the grain of the steel, as follows: place the coated side uppermost on a mandrel at a point equidistant from the edges of the panel and bend the panel double in approximately one second. Cracks occurring at either end and extending no more than ¼ inch shall be disregarded.

   (d) **Print Resistance.** Panels prepared as previously described shall be subjected to the following tests:

   **Cold print**—A piece of 2 inch x 2 inch cheesecloth shall be placed on the finished panel. A five pound metal weight shall be placed on the cloth. The contact surface of the weight shall be a smooth surface and one square inch in area. The weight shall remain unmoved in the position for 24 hours at 75 degrees F.

   **Hot print**—The same procedure shall be used for the hot print test as used for the cold print, except that the weight shall be two pounds instead of five pounds, and the temperature during the pressure shall be 110 degrees F. instead of 75 degrees F. Immediately after removal of the weights the exposed area shall be rubbed with a soft cloth and examined. Any printing discernible after rubbing shall be considered a failure.

   (e) **Impact test (adhesion and flaking).** Two specimens shall be prepared as described above. One specimen shall be placed over a 1¼ inch diameter opening. A ball of 530 gram weight shall be dropped 10.5 inches on the section of the panel over
the opening. The test shall be repeated on the other specimen on the reverse side. Cracks, hairline cracks, or chipping of the impact area shall be considered a failure of the test and cause for disqualification.

(f) **Abrasion resistance (Taber).** Two, 4-inch by 4-inch panels shall be prepared as described above. The film thickness, which shall be measured at four places equidistant from the center of each panel, shall not vary more than 0.2 mils. After weighing each panel, place one panel on the platform of the Taber Abrader using a CS10 wheel and two, 1,000-gram weights. Subject the panel to 1,000 cycles, cleaning the panel by brushing every 100 cycles. Repeat with the second panel. Loss in excess of 0.650 grams per 1,000 cycles (average of two results) shall be considered a failure and cause for rejection and disqualification.

(g) **Salt spray.** This test shall be run in accordance with ASTM Method B287-57T, using panels prepared as previously specified. After fifty hours of salt spray, specimens showing any evidence of discoloration or scratched areas showing lifting or rusting more than ½ inch outside of the scribe lines shall be considered failure and cause for disqualification.

(h) **Acid and chemical resistance to cleaning chemicals, etc.** Five wells ½ inch in diameter and ½ inch deep shall be formed on the face of test specimens with modeling clay. Into each of four individual wells, one of the following shall be poured: alcohol (95 per cent), mineral or vegetable oil, acetic acid (10 per cent), and undiluted household ammonia. At the end of fifteen minutes, a 10 per cent lye solution shall be poured into the fifth well. At the end of thirty minutes from the time the first four solutions were poured into the wells, the five wells shall be removed and the test panel rinsed thoroughly and wiped dry. Evidence of discoloration, softening, or blemish of the finished surface shall be considered failure and cause for disqualification.

(i) **Cigarette burns.** A well-lighted cigarette shall be laid on the finished panel and allowed to remain in one position for 1½ minutes. After removing the cigarette, the test panel shall be rinsed with water only and wiped dry. Any evidence of stain or blemish on the finish shall be considered failure and cause for disqualification.

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Economics of Compact Book Shelving

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Librarians are concerned primarily with the content of publications, their selection from the world's publishing output, their bibliographic organization, their efficient retrieval, their interpretation, and the stimulation of reading. Despite the primacy of these intellectual functions, library operation requires attention to many mundane tasks, one of which is the housing or shelving of the materials acquired. In libraries where space is ample and many empty shelves are still waiting to be filled, librarians tend to pay little attention to shelving methods; but when library shelves become overcrowded, as most of them eventually do, the librarian is temporarily diverted from educational and intellectual concerns and forced to focus attention on the economics of book storage. Interest in book storage systems should not be taken as a sign of predilection for gadgetry or mechanics but as a task imposed upon librarians by the requirement that they make the best possible use of the resources placed at their disposal.

Much has been written about the predicament of libraries that have run out of space for books. Various alternatives have been carefully compared by many authorities. To cite just a few of the more recent discussions, in 1954, Metcalf considered six possibilities, including innovations in shelving; in 1960, Orne reviewed all aspects of book storage warehouses; and Ellsworth briefly summarized much of what is known about book storage capacities, storage alternatives, and the economics of the situation. In 1961, Hopp succinctly recapitulated some of the most crucial policy questions relating to the handling of infrequently used books.

Also, in 1961, the preliminary edition of a study conducted at the University of Chicago, entitled Patterns in the Use of Books in Large Research Libraries, by Fussler and Simon, assumed that research collections can be divided into a more frequently and a less frequently

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used portion, and that substantial savings could be achieved by housing the less frequently used portion in a more compact manner than with conventional stack shelving. As the authors put it, "the costs of housing a large stack book collection will be substantially less if some reasonable fraction of the total collection is placed in compact storage." Weber, who reviewed the study, agreed that "the economic factors involved in housing a research collection may make it desirable to segregate books into two or more levels of accessibility." Reviewer Logsdon, in enumerating the principal findings and conclusions of the study, included among them the following: "Compact storage of books can save significant operating and capital sums, possibly ranging from 60 to 77 per cent of the costs of conventional housing." Logsdon also stated that "the carefully marshalled evidence in this study . . . offer(s) much, not only in support of lower cost of housing by compact storage of little-used material, but also in support of going further toward cooperative storage and the reduction of the number of copies of little-used books held by research libraries as a group." A third reviewer, Mackenzie, wrote similarly that "the conventional book-storage methods are no longer adequate to meet with reasonable financial economy the demands which are being made upon them in ever-greater measure."

Fussler and Simon wrote hopefully of possible savings through compact storage, but did not indicate the kind of equipment, if any, they would recommend; their sophisticated-looking, but exasperatingly inconclusive chapter on "The Economics of Book Storage" failed to come to grips with the problem in any concrete sort of way, except to say that "... some combination of book sizing, shelving books on edge, narrower range aisles, fewer main aisles, shelving somewhat higher than the usual 7' 6", and the elimination of empty shelving, will yield a capacity of at least 30 volumes per square foot." These compactions are the familiar methods advocated in 1949 by the late Fremont Rider in preference to special compact equipment. They have been used at Yale University, where a capacity of sixty-four volumes per square foot (as compared to twenty-one for shelving without gaps) was actually achieved. Yale's book retirement study, as reported by Ash, also referred primarily to Rider's methods rather than to the use of compact storage hardware, although cost computations were included for Art Metal and Ames shelving, and unsuccessful experiments with mobile stacks were referred to in passing.

Both the Chicago and the Yale studies reflected a nagging suspicion
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among librarians and the Council on Library Resources, Inc., which financed the studies, that conventional book shelving for infrequently used books may be wasteful. When expectancy of book use is low, it does not seem justified to array books in a manner that utilizes only about 10 per cent of the cubage (which as Rider pointed out was true of most conventional shelving arrangements).14 Such lavishness is presumed to be extravagant and, therefore, indefensible. Since compaction à la Rider involves no significant added equipment, it is tantamount to cost reduction; but such is not necessarily the case to a sufficient extent if equipment especially designed for compact storage has to be purchased and installed. Rider's methods involve some serious drawbacks; books are no longer displayed continuously by subject classification in the storage area (although the "ribbon" arrangement suggested by Rider may offset this disadvantage somewhat); books shelved on the long edges may cause damage to bindings; marking the call numbers on the narrow edge may also be objectionable or involve expense in the boxing of books; working in 22-inch aisles may prove exceedingly uncomfortable and annoying; and very high shelves and very long book ranges may prove operationally inefficient.

At institutions where Rider's methods have not been considered acceptable (and relatively few have resorted to it), other methods of improved cubage utilization have been explored; these methods all involve equipment especially engineered for compact book storage and, therefore, entail substantial added costs.

There are basically three types of compact book storage equipment currently available in the United States.

1. One type involves swinging or revolving hinged book cases (single or double rows), usually placed in front of, or attached to, regular stationary book cases. An example is the COM-PAC-CASE unit made by Art Metal, Inc., of Jamestown, New York, which consists of two halves of a book case that swing open like a French door. It comes in two versions: (a) one swinging book case or, (b) two swinging book cases in front of each stationary case. (The Snead compact stacks, installed in the 3,150,000-volume Midwest Interlibrary Center (MILC) in 1951, but no longer marketed, represent a variant of this type, in which the entire 3-foot book case swings out into the aisle.) A COM-PAC-CASE installation can be seen in the Illinois State Archives, Springfield. An intriguing-looking variant of the swinging type consists of convex cases on casters that are connected with struts to a center point and can be manually pulled out of their fixed storage frame.
These cases are manufactured by Pivoted Wings, Blackburn, England; the applicability of the latter equipment to libraries has been advertised but not tested.

2. A second type consists of a stationary frame with sliding drawers available in varying dimensions. Current manufacturers of single-headed drawer equipment include the Hamilton Manufacturing Company, Two Rivers, Wisconsin (COMPO) and C. S. Brown & Company, Wauwatosa, Wisconsin, the latter offering what is claimed to be an improved version of the COMPO, but similar in basic design. This equipment has been installed in many libraries, e.g., in the St. Louis Public Library's Compton Regional Annex and the Oklahoma City Public Library. The manufacturing of a double-headed type of sliding drawer, known as STOR-MOR, which was installed in the 400,000-volume storage building of the University of Michigan in 1954, has been entirely discontinued, except for occasional reorders to expand existing installations.16

3. The third type consists of blocks of ranges of movable cases, with only one inter-range aisle per block; the cases rest on tracks sunk in the floor and are activated either manually or pulled by a small motor connected to a continuous link chain drive or a cable, which is located at the center of the range. This type is marketed under the trade name COMPACTUS; it was invented and patented by the engineer Hans Ingold, of Zürich, Switzerland, in 1947. It has been installed in many libraries in Europe, Great Britain, Australia, etc. and has recently become available in the United States through Jackson Compactus, Los Angeles, California, which acquired the sole rights to manufacture and sell this system in the United States, Canada, and Mexico. COMPACTUS equipment has so far not been installed in any research library in the United States although early commercial installations can be found in Toronto, Canada (in the Orenda Engine Co., Canada Life Insurance Co., Trader Finance Co., and Canada General Insurance Co.), and in Halifax, Nova Scotia (in the T.B. Wing of the Victoria General Hospital). There is a semi-automatic textbook storage installation in the Anaheim Union High School, California, and a semi-automatic storage area for biological specimens at Arizona State University at Tempe; and installations are under consideration for the West San Gabriel Valley (California) Regional Library and for rare books and manuscripts at Yale University. The company does not consider itself to be in the shelving manufacturing business as such but primarily supplies the patented basic tracks, undercarriage, motor,
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etc., which can be joined to any case-type shelf unit to form a compact stack installation. It should be noted that whereas ordinary shelving requires a live floor load capacity of 100 to 150 lbs./sq. ft. (depending on shelf depth, width of aisles, height, and safety factor) and the Art Metal, Hamilton, and Brown compact designs require a minimum of 160 lbs./sq. ft., a Compactus installation has been said to require up to 287 lbs./sq. ft. (Stromeyer specifies a maximum of 1,400 Kg./sq. meter, which equals about 287 lbs./sq. ft.) Jackson Compactus, however, claims a requirement of only 180 to 240 lbs.

The COMPACTUS type of installation comes in three versions: manually operated, semi-automatic, and automatic. A semi-automatic installation contains one stationary range, usually between two blocks of several ranges each; the stationary range may or may not contain the motor and the switch panel. In an installation designated as completely automatic, all book ranges are movable. Most installations are semi-automatic. Safety devices to prevent attendants from becoming sandwiched and injured between ranges have been judged as perfectly adequate. Electric power consumption is considered negligible in the total operating picture, considering that the motor needs to be only a small one and an optional device for having the motor automatically switched off after designated intervals is part of the installation. H. Strahm, the director of the Municipal and University Library of Bern, Switzerland, called inventor Ingold the Galileo in the library field for having solved the motorization of book stacks in a most elegant manner; he expressed surprise that such stacks had not been invented by a librarian, who as a result undoubtedly would have won professional fame. The library basement at Bern has a semi-automatic COMPACTUS installation that increased storage capacity from 53,700 volumes to 130,440 volumes (octavos only).

A system similar to COMPACTUS, installed in the National Diet Library of Japan, is marketed under the trade name ELECOMPACK (Tokyo, Japan). Whether or not this equipment can be economically imported into the United States and installed here is not known. The Company president Hanichiro Naito has stated: "My staff and I should be very happy if our ELECOMPACK filing system were widely adopted in your country." Negotiations are underway. The equipment is so designed that, at the press of a button, an aisle can be created between any two book ranges within a block of nine ranges placed on each side of a single stationary book range that contains the control panel. The ranges portrayed in the company's catalog
consist of five 3-ft.-wide double-faced book cases movable on rails by means of two feeders.22

Another system of movable rolling stacks, not yet developed in the United States to the point of marketability, are laterally moving single book cases activated manually or by an electric motor. The cases are placed in the aisles of a regular stationary installation; they are suspended from a rail (like a monorail car) and move in a track on the floor. A mock-up was displayed at the 1964 American Library Association Conference, St. Louis, by the Aetna Steel Product Corporation, New York, which reports that it is still compiling engineering data.

There may well be other manufacturers than those mentioned which are offering compact storage equipment. No attempt has been made at complete coverage since the chief concern in this review is the identification of types. There are also additional book storage conceptions which have not yet been developed into marketable products in the United States and are, therefore, of only theoretical interest.

Any type of equipment not offered commercially in the United States, such as, a scheme of motor-driven bookcases that can be propelled laterally into a main access aisle, is not worth serious consideration by librarians until a manufacturer is ready to risk marketing it. It is partly for this reason (in addition to patent restrictions) that COMPACTUS was not installed in any United States institution until a franchised manufacturer was available, even though it had been successfully used in Switzerland, England, Sweden, Germany, etc. as long as ten years ago.

Several evaluative reviews of compact storage equipment have been published in the past decade. The most comprehensive and penetrating of such studies was made by the Czechoslovakian librarian Drahoslav Gawrecki in 1960.23 He surveyed all possible compact storage ideas for the purpose of developing recommendations as to the most serviceable types of equipment for compact book storage which the state-controlled steel fabricators of socialist Czechoslovakia might provide. He developed ingenious layouts to achieve maximum compaction with a combination of different types of equipment on the assumption that such equipment might be manufactured when needed. He concluded that the COMPACTUS type is best, that laterally moving cases and the drawer-type are also useful, and that the swinging type is least applicable. He particularly stressed the advantage of combination arrangements involving more than one type in a given area, and questioned the value of capacity calculations made for a single type of
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equipment in isolation. A great deal of interest in compact storage is in evidence in other countries in the Soviet orbit. This interest may stem from the overcrowdedness of the book stacks of research libraries in these countries during a period when the chances for constructing additions or new buildings are rather slim; hence, there may be a strong desire to utilize existing space to the best advantage. Capacity increase rather than cost savings has been the predominant if not the only interest in this connection. For Poland, Przybylo was offered a competent review of the literature, including developments in other Slavic countries. For the USSR, Pashchenko evaluated different types of equipment; his conclusion favored revolving book cases in preference to the drawer-type. Pashchenko claimed to have been the first to plan a compact storage installation in the USSR (Academy of Sciences, Moscow, which involved blocks of movable cases in groups of twenty-four). He regarded movable pull-out bookcases as particularly promising.

In the Federal Republic of Germany, Stromeyer’s authoritative and thorough treatise on book stack problems in 1958 contained a chapter on space saving through new types of shelving systems. This chapter offered a detailed and critical account of COMPACTUS, which the author compared, point by point, with the Snead (MILC) system; COMPACTUS was judged to be preferable despite some reservations. Stromeyer considered other systems (notably sliding drawers) less suitable and only rarely applicable, but failed to give reasons for such negative evaluation. He paid some attention to the economics of book shelving, concluding that local circumstances will determine whether COMPACTUS involved a higher or lower over-all cost (including building construction) and implying perhaps that cost considerations were not of paramount importance.

In England, ten years ago Hill presented a descriptive review of all types of compact equipment, including rolling book cases, COMPACTUS, the Snead system, the Art Metal system, Hamilton drawers, and Ames drawers. His conclusions as to the economics of book storage were exceedingly cautious and hedged with qualifications. He expressed doubt as to the applicability of compact storage in public access situations.

In the United States, Kaplan in 1960 traced compact storage developments and expressed criticism of unsubstantiated claims made in the literature; he reported that evidence of savings in cost effected by compact shelving was almost non-existent. In 1962 Metcalf pre-
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sent a lucid review of compact shelving methods as well as equipment. He recommended that "... movable shelving be regarded as a last resort, and that the library first consider whether portions of its collections might be placed in a stack with narrower shelves and aisles, shelved by size, or perhaps transferred to a cooperative storage building..." 29

Despite an abundance of information on, and attention to, compact storage equipment as well as a considerable amount of competitive advocacy, no conclusively valid and reliable data are presently available on the basis of which one can determine which type of storage equipment, if any, is most suitable for a given situation. What are lacking are rigorously controlled comparative cost-accounting evaluations of existing installations, with full data on original capital outlay, including building construction and cost of operation and maintenance. The need for this sort of information, grounded in actual operating situations rather than imagined constructs and theoretical computations, is evident; in Kaplan's words:

Savings developed by systems of compact shelving must be regarded with suspicion when presented theoretically. In any actual installation the shape of the room and other factors will seriously affect savings. The library profession would benefit from a demonstration of how these factors influence the capacity of each type of compact shelving. 30

It is possible to compute theoretically achievable savings for the combined cost of compact shelving equipment and a given building construction cost in a specific situation, as was done by Muller, 31 who showed that storage equipment becomes more applicable as building cost goes up. Studies at Yale University, 32 following a similar methodology for a specific assumed construction cost of $20 per square foot, concluded that per-volume cost for 22-inch aisles spacing would be about one-fourth of that for conventional spacing, and that compact equipment would not substantially reduce the cost per volume as compared to conventional shelves with 36-inch aisles. The Yale method was later applied by Elecompack, Ltd., Tokyo, in one of its advertising brochures, in which an illustrative block diagram implied that the combined cost of conventional stacks plus building construction cost would be about 44 per cent higher than the combined cost of ELECOMPACK plus building construction, at least for Japan: "The difference of overall cost between ELECOMPACK and conventional
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shelves widens as the value of the combined total of construction cost of conventional book shelves per unit floor space increases, which means that the overall cost can be reduced greatly.  

Lester Mattison showed that, for 23 by 23 ft. bays in a modular building, “savings effected by substituting COMPO-type compact shelving for standard bracket shelving in a $20 per sq. ft. building amount to only 4% . . . Compact shelving in a low cost storehouse building is 59% costlier than wood utility shelving and 35.4% costlier than bracket shelving.” He concluded that “cheap shelving in an expensive building and expensive shelving in a cheap building appear to be equally incongruous.”

For shelving equipment currently on the United States market, Tables 1 and 2 present comparative data on the crucial question of the economics of compact storage. The question is posed in terms of the number of volumes that can be shelved in the storage portion of a storage building for a fixed amount of money, viz., $500,000. (A constant construction cost of $25 per square foot, exclusive of equipment, is assumed although the required greater floor load capacity for compact equipment will probably involve a higher cost of about $1 per square foot to provide increased concrete slab thickness, wider column-footings, and stronger bottom structure.) Caution is in order since the figures are based on informal quotations supplied by manufacturers, and no attempt was made to determine the reliability of such quotations.

This hypothetical tabulation shows that a building with conventional shelving will house maximally about 348,000 volumes (assuming eight volumes per lineal foot). Semi-automatic COMPACTUS, although unquestionably providing the densest type of compact shelving, surprisingly yields space only for about 16,000 volumes more (4.6 per cent). It does increase capacity per square foot by about 150 per cent but provides a negligible cost advantage in original construction and equipment outlay at the prices currently quoted. It should be mentioned, however, that the quotations relate to relatively small installations and may be assumed to be lower for larger installations. Rider’s familiar adage evidently applies to COMPACTUS: “The only place where saving would be effected would be in the amount . . . of the stack building ‘shell’. . . . What we have here . . . is greater compactness of storage, but no over-all economy.” It is possible that the cost of such mobile stacks is lower abroad. A librarian who recently returned to the United States from a study tour, during which he
### Table 1

Number of Volumes that can be shelved in a $500,000$ Building with Different Types of Shelving Equipment

<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Shelving Cost Per Sq. Ft. of Area Occupied by Shelving</th>
<th>Shelving Plus Building Cost of $25 Per Sq. Ft.</th>
<th>No. of Sq. Ft. of Floor Area Obtainable for $500,000</th>
<th>Maximum Volume Capacity Per Sq. Ft. of Floor Area (Compactness)</th>
<th>Total Volumes in Bldg. Costing $500,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPO (Brown)</td>
<td>$13.98</td>
<td>$38.98</td>
<td>12,827</td>
<td>40</td>
<td>513,080</td>
</tr>
<tr>
<td>COMPO (Hamilton)</td>
<td>19.33</td>
<td>44.33</td>
<td>11,279</td>
<td>44</td>
<td>496,276</td>
</tr>
<tr>
<td>COM-PAC-CASE (Art Metal)</td>
<td>19.04</td>
<td>44.04</td>
<td>11,353</td>
<td>41</td>
<td>465,473</td>
</tr>
<tr>
<td>COMPACTUS</td>
<td>46.44</td>
<td>71.44</td>
<td>6,999</td>
<td>52</td>
<td>363,948</td>
</tr>
<tr>
<td>Conventional</td>
<td>3.02</td>
<td>28.02</td>
<td>17,844</td>
<td>19</td>
<td>339,036</td>
</tr>
<tr>
<td>Conventional</td>
<td>3.86</td>
<td>28.86</td>
<td>17,325</td>
<td>20</td>
<td>346,500</td>
</tr>
</tbody>
</table>

1. Gross area cost, including stairways, main corridors, toilets, elevators, heating and ventilating equipment, et cetera.
2. Quoted price for a layout of equipment divided by the number of square feet occupied.
3. The building cost unit price is assumed to be constant, i.e., equal for different types of equipment. Actually, a somewhat higher cost may be associated with compact equipment since greater floor load capacity must be provided for. A cost of $25 per sq. ft. without equipment is based on experience at the University of Michigan where recent air-conditioned buildings cost $23 to $26 per square foot, exclusive of the cost of land.
4. Obtained by dividing $500,000 by the building cost per square foot as shown in column 3.
5. Number of lineal feet of shelving in an installation layout divided by number of square feet multiplied by eight, since shelving is assumed to accommodate eight volumes per lineal foot. (Figures are rounded off to the nearest digit.)
6. Column 4 multiplied by column 5.
7. This capacity figure is higher than the figures computed for the Brown equipment since the theoretical layout and drawings do not show structural columns, which would reduce capacity to some extent. The drawers are 36 inches deep, 18 inches wide, each drawer having a shelving capacity of 72 lineal inches.
### TABLE 2

**Basic Reference Data for Computing Shelving Costs Used in Table 1**

<table>
<thead>
<tr>
<th>Source of Quotation</th>
<th>Type of Equipment</th>
<th>No. of Lineal Ft. of Shelving for the Project Quoted</th>
<th>No. of Sq. Ft. of Floor Area Occupied by Shelving</th>
<th>Total Cost Quoted</th>
<th>Shelving Cost Per Sq. Ft. of Area Occupied by Shelving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown &amp; Co.³ 7/17/64</td>
<td>COMPO</td>
<td>10,444</td>
<td>2,075</td>
<td>$29,000</td>
<td>$13.98</td>
</tr>
<tr>
<td>Hamilton Mfg. Co. Estimate 11/3/64</td>
<td>COMPO</td>
<td>111,720</td>
<td>20,000</td>
<td>386,635</td>
<td>19.33</td>
</tr>
<tr>
<td>Art Metal, Inc. Estimate 5/25/64</td>
<td>COM-PAC-CASE</td>
<td>32,182</td>
<td>6,255</td>
<td>119,100</td>
<td>19.04</td>
</tr>
<tr>
<td>Jackson Compactus 12/18/63</td>
<td>COMPACTUS semi-automatic</td>
<td>30,576</td>
<td>646</td>
<td>30,000</td>
<td>46.44</td>
</tr>
<tr>
<td>Art Metal, Inc. 3/25/64</td>
<td>Conventional ranges 39' long</td>
<td>14,942</td>
<td>6,255</td>
<td>18,800</td>
<td>3.02</td>
</tr>
<tr>
<td>Brown &amp; Co. 7/17/64</td>
<td>Conventional</td>
<td>5,187</td>
<td>2,075</td>
<td>8,000</td>
<td>3.86</td>
</tr>
</tbody>
</table>

8. This figure was initially computed as being 36 volumes per square foot, based on an installation involving 24 "cars," each 9.1 foot long, equipped with 12.5-inch wide shelves, each car containing seven shelves, i.e., 9.1 times 7 times 2 times 24 equals 30,576 lineal feet. Assuming eight volumes per lineal foot, the capacity of the installation is 244,608 volumes. Dividing this figure by the number of square feet (646) results in a figure of 36 volumes per square foot. The capacity, however, would be much higher with narrower shelves (eight inches) and a narrower main aisle that provides access to two stack blocks instead of only one as in this installation. Reducing shelf width from 12.5 to 8 inches allows for an increase of over 50 per cent in the number of cars. Hence to assume a capacity figure of 52 volumes per square foot for eight-inch shelves does not seem unreasonable (as against twenty-six volumes per square foot with 12.5 inch shelves). At Bern University, volume capacity was computed to be 559 square meters, or 52 volumes per square foot. (See Stromeyer, *op. cit.*, Tabelle).

9. Brown reported in a letter dated 10/14/64 that on two recent small jobs where both Brown and Hamilton submitted bids, the bids compared as follows: (1) Brown $6,043, Hamilton $8,310, and (2) Brown $8,275, Hamilton $9,914. The situation may be different in the case of larger jobs. The Brown cost figures relate to drawer units that are 48 inches deep.
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visited compact stack installations, stated in a letter to the writer in July 1964 that “What it all comes down to is simply this: if in Europe a proposed eleven-story building with conventional book stacks can be reduced in size to a four-story building, with mechanized bookstacks, then the savings in building costs alone more than compensate for the higher expenditure for mechanized bookstacks.” To which one might reply: To be sure, a 64 per cent shrinkage in building size is impressive and a source of fascination and amazement; but conclusions as to savings do not necessarily follow. If COMPACTUS type shelving were to come down in price in the United States, it would probably become the preferred type of compact equipment.

For the time being, the two other types of compact shelving seem to offer the most appreciable cost advantages. Hinged cases with two swinging cases and narrow aisles (2 ft.) result in savings that are reflected in an increase of book capacity by about 34 per cent. Savings obtainable through sliding shelves can be assumed to result in a book capacity increase of about 47 per cent, minus a correction for the higher floor load requirement. Both of these types of equipment show similar compactability, i.e., nearly 100 per cent as compared with the tightest kind of conventional shelving model illustrated by Stremeyer. Assuming that the cost quotations are trustworthy, both hinged and sliding shelves but particularly the sliding shelves, appear to be worth serious consideration in the planning of storage stacks for research collections which are to be housed in a building costing $25 or more per square foot, exclusive of equipment. (It is noteworthy, however, that even the most advantageous type of compact equipment, economically speaking, achieves only a somewhat better result, than the increase of about 40 per cent in capacity that can be achieved by reduction of range-aisles from 36 to 22 inches, which Yale University has found to be “practical.” In cases where building costs per square foot are much lower, the appropriateness of compact shelving equipment becomes increasingly questionable.

Advantages other than cost have also been claimed for compact storage; among them are lower custodial service, repair, maintenance, utilities, security, ground maintenance, overhead cost, and lower cost in book delivery and reshelving (since distances have been shortened). Although some of these advantages may appear self-evident, no studies have been found that satisfactorily quantify all these alleged operational economies. Since library budgets of universities rarely include utility costs, library administrators are not likely to be overly concerned
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about such cost factors; and the alleged economy in book delivery and reshelving is likely to be cancelled out to a considerable extent by the increased labor involved in shelf manipulation (sliding, rotating, etc.). In any case, all such factors combined probably account for savings of less than 2 per cent per year of original construction plus equipment cost. If a $500,000 building of, say, 17,500 square feet could be reduced in size to 7,000 square feet by the use of COMPACTUS-type stacks, the savings in plant maintenance would amount to about $10,500 a year ($1.00 a square foot per year). On a 5 per cent compound-interest basis, it would take twenty-five years to build up enough capital to construct another building of the same dimension. Obviously, from the long-range institutional (rather than the more narrow librarian's annual budgetary) point of view, such savings should not be disregarded. However, since all types of compact shelving installation do involve some reduction in direct and easy access to books, over-all cost savings will have to be very substantial before librarians will resort to such measures for this reason.

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33. Information in an advertising brochure of Elecompack, Ltd., Tokyo. (Translated from the Japanese.)


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Furniture for Library Offices and Staff Work Areas

JAMES V. JONES

When one reflects upon the concentration of interest concerning library buildings and equipment since 1950, and the countless words written and spoken about this subject, it is most surprising that the needs of the library staff itself have been largely ignored. There exists a dearth of material about equipping library offices and staff work areas. However the library profession need not feel too badly about this. Neither has the subject received adequate attention in office management literature.

How would a library continue to give service without an acquisitions department, a cataloging section, periodical records, physical preparation? And yet all of the building and equipment institutes, their resultant publications, and other professional literature expiate at length only about such things as modules, ceiling heights, stack spacing, and lounge furniture. In truth our attention has been given over to the public areas of libraries and the impression and impact that these will make on our public and our peers. As a result we have relegated to hit and miss methods those areas which are truly the nerve centers of our libraries.

Quite obviously, then, the author cannot draw upon a survey of existing literature in order to lay down the doctrines of good furniture selection for library offices and work areas. At the 1962 Library Furniture and Equipment Institute, at Coral Gables, Florida, Martin Van Buren adequately described the lack of references; the librarian, he said, "... is left with very little to go on other than manufacturers' catalogs and a few elemental principles." ¹

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With today's emphasis on data processing, the term "system analysis" is becoming rather common. No less than a particular routine should the entire "office" operation of a library be subjected to systems analysis. It is here that proper selection of furniture and equipment must start. Only when one is sure that he has achieved the most efficient and effective work distribution, that the work flows smoothly and without interruption, and that proper forms have been designed and useless items eliminated can he sit down to lay out the physical arrangement of furniture and equipment.

A well-done analysis will reveal the optimum number of people or positions needed to accomplish the current work load and the additional positions likely to be needed in the foreseeable future. After preparing a list of equipment used, the planner is ready for a preliminary layout plan.

The listing of equipment used is a critical point. Too often librarians have thought of their work processes as something unique with no counterpart in the business world. As a result, they have been blind to equipment innovations and improvements in business and industry. Not only the administrator definitely planning a new installation, but all library administrators should constantly be aware of new ways of doing things in banks and other business offices which they visit, even in supermarkets and drugstores. Many excellent designs of loan desks have started from the design of new equipment in other fields.

Not only have managers been relatively uninterested in their office layout and equipment in the recent past, but even the manufacturers of such equipment have made no attempt to stimulate their market. One does not have to review manufacturers' catalogs for too many years back to find the era of "Model T" desks. Happily this has now changed radically. One can now find desks designed for any ordinary use in standardized, interchangeable units. Such desks are available in wood or metal, in traditional or modern design, with linoleum or plastic tops, with any variety of drawers and drawer accessories, in colors that are standard or custom. Like comments can also be made in regard to chairs, files, tabulating equipment accessories—even type-writers now vie in design and color.

A relatively recent concept in the design of office furniture and office layout has been that of the work station. This has come about with the use of the L-return unit that is a type of credenza joined to the desk unit to form an L. The depth and height as well as the type of cabinets or drawers of the L-return is determined by the work to
be done at that work station. The variety of units available to customize work stations has led to the labeling of such units as modular units.

In planning work areas just as in the public areas, a keynote today is space economy. The modular units make possible the ultimate in space conservation while providing, at the same time, a more efficient work station than was possible with traditional office furniture. Thoroughly planned use of modular office furniture has not yet been fully exploited in libraries. It should be in the future.

In the past, perhaps as a "fringe benefit" to compensate for low pay, we have tended to be too lavish with space allocated for work stations. Every clerk was assigned to a secretarial desk no matter what his duties. The keynote of space conservation noted above no longer allows us this luxury. Even though one does not use the new modular furniture, desks should be selected to fit the job. For the typist whose regular assignment is the preparation of catalog cards, a 42-inch fixed bed typewriter desk is adequate and satisfactory.

On the other hand it is equally important to provide a large and versatile desk for the position that demands it. When space saving cuts into the efficiency and morale of a staff member, it is no longer a saving.

In any desk the selection of the proper drawers and drawer inserts is important and very often overlooked. The girl typing catalog cards finds a drawer with a stationery rack completely useless. The administrator will gladly give up two standard storage drawers to have a file drawer in which he may keep frequently used files at ready call.

Metal or wood, plastic or linoleum top, traditional or contemporary design, bright colors or office grey—most of these decisions must be left to the librarian or his consultant. One can find convincing arguments on either side and quite often the selection will depend upon one's personal taste or the location of the installation. Two hints of caution need to be mentioned. One will not find a concise explanation of the fine points of office furniture construction, and therefore one cannot base his selection of furniture on established standards. It is recommended that the planner examine carefully several grades of furniture to determine the quality that best suits him and the funds available. In general, the reputable manufacturers will be his best guide.  

Secondly, once he has determined this grade or quality, he should purchase all of his furniture from one manufacturer. This will not
only prevent many headaches at installation time, but will provide for interchangeability as needs and functions change—which they will, all too soon. It is also the only insurance against a crazy quilt pattern when new furniture is added in the future.

For those in the library who must operate by the seat of their pants, it is very important that they be seated with maximum comfort. This demands a true posture chair; one that can be adjusted in height and depth, and which has a vertically adjustable backrest. Two other adjustments can also be provided: a backrest pitch adjustment and a spring tension adjustment. For the ultimate in comfort and thus in staff efficiency, the office equipment dealer should be contracted to check chair adjustments regularly.

So long as the chair selected is of the true "posture" type, it matters little for worker efficiency what its design, its fabric, or its base may be. As with desks, these are matters of taste, total decor, and available funds. Certainly there will be gradations of quality and certainly reputable manufacturers should set the standard.

Library offices per se will range from the private enclosed space assigned to the higher administrators, to the smaller, semi-enclosed type formed by movable partitions and occupied by various supervisors. Selection of type of furniture, its finish, supporting units, and accessories will depend upon the position of the administrator and the nature and variety of his duties.

The top administrator will ordinarily have the finest desk in the library although not necessarily or even desirably the highest quality. The modular U station is becoming the standard in executive offices. There is no end to the accessories that can be provided in a custom-built desk for the administrator. Most librarians, even if they could, would not expect their desk to be fitted with television, refrigerator, bar, etc. But executive desks of today have as standard such things as built-in dictation stations, personal files, and other convenient work organizers.

As one moves from one administrative office to another, the differing duties will dictate the furniture needs. This man uses dictating equipment, Miss S needs a typewriter, Mr. T is a regular user of a calculator, etc.

Quite often it will be necessary to custom design equipment for special needs. This will most often happen when one is planning a new library and has the opportunity to employ designers from the architect's or interior decorator's staff. Rather universally, comments
are made that these people really do not understand the work of librarians and so prepare a faulty design. More likely, the librarian is not sufficiently aware of what he needs himself and so does not adequately describe his needs to the designer. If a table is needed to carry a special piece of equipment such as a cutter, the dimensions of the equipment must be made known to the designer. Likewise if the cutter is to be used with the operator standing up, one does not want the table to be at desk height of 29 inches. The librarian should carefully check the final drawings and specifications of all specially designed equipment for just such mistakes. He should above all not be reluctant to ask for an explanation of anything not clear to him in such specifications. Far better to admit ignorance at this point than to be stuck with a $500 piece of white elephant.

Quite easy to overlook, but of great importance are many items of everyday humdrum use. What will be done with wraps, boots, and umbrellas? Will there be staff lockers? Wardrobes? Costumers? What provision is there for trash? Wastebaskets at each desk? Type? Style? Color? What of waste from incoming shipments? How to store packaging materials for interlibrary loans? Binding shipments? Where and how will everyday supplies be housed? Is there duplicating equipment in ordinary working areas, such as a mimeograph and office photo-copiers? What provision is made for housing these and their supplies? What provision is made for clocks and water fountains? Obviously all of the above items are minor. But enough minor irritants piled one on another soon lead to bad staff morale, bickering, and reduced efficiency and production.

The increasing rapidity with which larger libraries are using data processing equipment raises new problems of equipment selection. In this case, it is necessary that librarians seek the advice and guidance of those who have had such installations for some time. University libraries will likely find departments on their own campus which can advise them. Others must seek the advice of local businesses. There are companies specializing in the manufacture and sale of supporting equipment for data processing departments. As with library and office furniture, many will furnish guidance in actual layout of an efficient department based upon the data processing equipment to be installed.

At this point, one has presumably designated his personnel needs and the equipment which will be used to complete the necessary tasks in an efficient and economical fashion. Now these must be reduced to a scale model drawing fitting them into the space available.
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Not to be overlooked at this time is the location of electric outlets, telephone stations, plumbing such as sinks and running water, doors and their direction of swing (which are interior and which exterior?), conditioned air outlets—hot or cold, windows, columns, and other building details. Desks for typists using electrical typewriters should not be placed fifty feet from the nearest electrical outlet. A desk is not wanted in the natural corridor of traffic that a door will provide. All of which is quite obvious, but surprisingly quite often overlooked.

When the scale diagram is drawn, the librarian should sit down and trace the work flow through the various areas. Where are orders prepared? Where mailed? At what point is incoming mail received, unpacked, and sorted? This flow of work needs to be charted throughout the area from the time an operation starts until it is finished. When such tracing is completed, the librarian can readily see whether the proposed layout is actually the most efficient possible. Most likely it will not be. Then comes shifting, redrawing, and retracing of work flow. Eventually the optimum will be reached.

This is still not the end, however. There are certain space factors to be considered over and above the worker, his furniture, and equipment. The most obvious is the traffic flow. The need for secondary and intermediate aisles could not possibly be determined until the optimum layout for work flow was determined. Traffic flow must now be studied and adequate aisle space provided: three to four feet for secondary and intermediate aisles, five feet for main aisles, and six to eight feet for corridors to the exits.8

At this point one may ask why the worry and trouble over a few extra feet of walking. After all we do need exercise, and the entire length of the cataloging area can be walked in just one-half minute! But let us take those thirty seconds and suppose that they are lost at each of ten steps a book takes from ordering to shelving. We now have five minutes of lost time per book. Should the library be growing at 10,000 books per year, these extra five minutes total 833 hours in a year. Those 833 hours represent over $1,000, or quite a few more books that could have been added for the public’s use.

Eventually one looks at paper diagrams until no further progress can be made in bettering work flow or traffic movement. At this point there is nothing more to be done. Most likely the schematic drawing will suffice to provide an efficiently functioning department for at least the first year—that is unless Miss P happens to have her chair right below that noisy air diffuser!
References


Selecting Informal Seating For University and College Libraries

DONALD D. POWELL

The selection of informal library seating is directly related to its intended function and location within the library. It must fit the environment and achieve a character suitable for the purpose it serves. It must, above all, be comfortable, no matter what use it is required to satisfy. Within each of these characteristics, recognition must be given to varying reader demands and to the manner in which, for example, bibliographic materials, periodicals, and browsing collections are handled. Special elements, such as audio-visual facilities, lounges, typing rooms, and similar areas, are aspects of informal use in which the character of the space relates to its special function. Group study rooms and separate smoking rooms are relatively new and important definitions of specialized, informal readers' space. The use and disposition of informal furnishings develops out of the recognition of new demands created by changes in the sociological habits of readers.

Basic planning for informal furnishings should begin with a coordinated design program which will result in a selection of items which will complement each other, which will produce an environmental expression suitable for an informal readers' area in the library, and which will achieve proper harmony with the library as a whole.

Careful study must be made of the location and individual placement of informal seating. The classic lounge chair grouping around a coffee table, frequently used in libraries but so closely related to the home living room environment, encourages oral communication between students occupying such seats. In many instances this is not an appropriate use of library facilities. The desirability of using sofa units

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in these informal areas should also be carefully evaluated because of
the risk that such furniture will not be properly used. Reclining or
sleeping on sofas in lounge areas is not only inappropriate for the li-
brary environment, but results in one person using space designed
for two or three.

Today, library planning emphasizes the individual reader and his
environment. Informal seating should limit rather than encourage oral
communication and the consequent distraction of others in areas where
quiet is required. At the same time, there is a need for the design of
better informal seating. Such seating should emphasize comfort and
provide for a variety of postures and uses suited to individual needs
within that portion of the library in which it is to be placed. In in-
stances where informal seating for group use is desired, this may well
be assigned to a separate space such as a smoking room, where talking
and lounging will not disturb or distract others.

Coordinated planning, identification of proper functional designs,
and a carefully evaluated layout of informal furnishings are important
preliminaries to final selection. Here, durability and suitability of con-
struction are of prime importance.

Since adults and teen-agers can do a great deal of damage to library
furniture merely by using it, construction must be durable enough
to withstand the attacks of these users. It should be remembered, how-
ever, that it is up to the designer to provide a library environment
that will arouse both respect and affection for these items. The use
of steel legs, laminated plywood bonded to foam rubber, zippered up-
holstery, and other new methods of construction should be investigated
when choosing and selecting informal furniture for a library.

The following construction features, characteristic of well-made,
good quality furniture, should be kept in mind when selecting up-
holstered furnishings. Frame construction may be of any American
hardwood, kiln-dried to approximately 5 per cent moisture content.
All joints should be double dowelled with birch spiral dowels and
 glued.

Springing should contain approximately sixteen heavy-duty coil
springs per seating space. Spring construction should be of the type
usually referred to as “wire edge or spring edge,” or that referred to
as “tied to frame on hard edge” construction. In either case, springs
should be tied 8-ways with jute spring twine, with eight knots per
spring, using the French method (criss-cross), or the German method
(straight double tie). Covering of springs should be 10 ounce burlap
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tied through to the springs, with a one-half inch rubberized hair pad on top and a sixteen ounce cotton batting top layer.

Webbing should be used on all inside arms and backs of units, and be covered with a layer of cotton if required by style. Muslin is applied on all first class upholstering jobs before the final upholstery fabric is applied. Upholstery should be of the best standard of workmanship, neatly tailored with all joints straight, welt seams double-stitched, and sufficient returns on the fabric to prevent ripping or tearing. Exposed fabric seams should not be allowed on visible areas of the units. When foam rubber cushions are used, all corners should be mitered and hand-stitched to the covering fabric to prevent movement of the cushion within the cover.

Casters or glides should be carefully chosen for the floor finish in the area where they are to be used. Carpet protectors should be used on all bases where installation is on carpeting or on area rugs, to prevent damage to carpet and to stabilize furniture and prevent movement. Rolling casters (either wheel or ball type) may be chosen where floor conditions make them desirable. Rubber treads on casters can be used to cut down noise and prevent damage to floor surfaces. Ball-type casters are preferable for use on soft surfaces such as carpeting. Rust proof glides should be furnished where floor mopping and washing is required. Glides should be of proper size to support the weight of the furniture units to prevent imprinting and marking of floors.

Where fire-resistant upholstery is mandatory, the choice of fabric is between vinyl or vinyl-coated fabrics, and tightly woven mohair. Other fibers may be acceptable if they have been given suitable fire-proofing treatment. The choice is predicated not only on the initial cost of each unit but on other factors. For example, in temperate climates, under high soil conditions, the vinyls may be acceptable. In warm climates and non-air-conditioned buildings, the vinyls can be uncomfortable and are usually not to be recommended. Under low soil conditions, where the interval between cleanings may be long, woven fabrics may be suitable. Here the choice is between fiberglas fabrics and treated fabrics of natural fibers. Fiberglas fabrics, however, although easy to clean, are highly vulnerable to abrasion and wear. Fabrics woven from one of the better synthetic fibers, such as nylon, possess excellent wearing qualities and are available in a good color range. Where soil conditions are sufficiently bad to warrant the choice, removable cushions or zipped-on covers may be used. Special fabric treatments such as “Scotchguard” are recommended where furniture
may be exposed to food and liquid stains, or where general soil should be kept to a minimum.

Fabrics should be selected to complement the design of the building and to harmonize with the character and design of the furniture. Fabric texture, print, color, weight, and weave should be carefully selected for each item or type of item in the library. Some fabrics show good wear characteristics when used on a flat surface, but when used on a curved surface, such as the edges of an upholstered seat pad, they split and tear, exposing the inner fibers of the material to abrasion and thereby reducing durability. Other fabrics, when stretched on a tight fitting, upholstered unit reflect light in such a manner that they give the appearance of a stained or soiled fabric. Furnishings which will normally be occupied for relatively long periods at a time should not be covered in vinyl, leather, or other hard-coated surfaces since they become too warm and too moist for comfortable seating. Under such conditions, textured and plush fabrics of woven construction should be specified.

The color scheme should be carefully thought out in planning fabric use. Natural, undyed yarns mixed with dyed yarns in textured fabrics take washing, wear, and soil with little loss of vitality. Synthetic fabrics, such as nylon, should be used where frequent maintenance, such as repeated cleaning, is likely. The type of weave and the color of the fabric are important factors in the durability of the fabric under conditions where constant maintenance is required. A natural colored yarn, for example, is much less subject to discoloration by repeated cleaning than is a dyed yarn. Similarly, the dye characteristics of a loosely woven fabric are superior to those of a tightly woven fabric.

The cost of the labor required to maintain any item of furniture is a valid factor in evaluating its worth. Informal furnishings must stand up not only to the eye, but to the hardest usage, to dust-laden air, to moisture, smoke, grit, chemicals, stains, spills, friction, and other attacks on their integrity, attacks both frontal and insidious. The specifications, implied by the popular word “functional,” include both ease of maintenance and the ability to survive the damages inflicted by soil and wear on the one hand and those inflicted by cleaning agents on the other. The most important motivation of the reformation in furniture design which we call “contemporary” was the need to improve maintenance characteristics. Today, institutions should demand interiors that are easy to keep clean and in good repair. The high cost of labor places an enormous financial benefit in the hands of any
institutions whose premises have been so planned and designed that cleaning and repair are kept to a minimum, both in labor and in time.

The interior designer must provide for the soundness of the interiors he designs, in the fabrication and detailing of the materials he selects as well as in the cleanability and ease of repair thereof. The librarian's responsibility is to provide information about those areas in which wear and tear and soil will occur, and about the equipment, personnel, and work schedules available to maintain them. Proper upkeep in libraries requires both daily care and periodic repair to keep an interior looking its best within the usual amortization period, or until it is more profitable to replace it than to continue maintaining it. Initial investment versus running expense is a major concern in selecting all furnishings for libraries.

In budgeting funds for the interior of a library, the librarian and designer usually have a choice between a high investment in quality materials and workmanship balanced against low maintenance costs in the future, or a low initial investment balanced against higher maintenance costs. The known immediate costs of the furnishings are weighed against unknown future costs consisting largely of labor expenses.

In the present article, it is not possible to treat all the details of this subject. However, the check-list that follows poses a series of questions for which the librarian must have answers before making a final selection of the informal furnishings for the library. For additional information, he should seek the assistance of the architect or interior designer responsible for the building.

1. The cleanliness standard—what is the desired level of cleanliness?
2. Invasion of dirt—what is the location of entry of dirt and traffic?
3. Heating and air-conditioning—will high soil and coating residues affect furniture maintenance?
4. Maintenance versus obsolescence—can the wearability and life of furniture be estimated?
5. Redesign of furniture—must furniture be redesigned to meet changing library needs and requirements?
6. Contingencies of climate—what effects will climate have on maintenance schedules?
7. Fire code requirements—will this affect treatment of upholstery fabrics?

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8. Interior structure—what are the limitations on placement of furniture?
9. Lighting fixtures—what will be the relamping and cleaning cycle?
10. Floor cleaning hazards—how and by what type of cleaning equipment will floors be cleaned, what type of baseboards should be specified, what type of legs on furniture should be detailed to resist marks from vacuum cleaners, waxes, and mops? (Fabrics should be out of the way of solvents used on floors. Heavy furniture should be on casters.)
11. Furniture materials and finishes—to what conditions of wear and soil will furniture be exposed?
12. Types of windows and doors—are dust-catching installations and light control devices required to prevent fading of fabrics?
13. Furniture materials—what are the relative advantages of oiled, lacquered, varnished, and painted finishes on wood furniture and where is metal furniture preferable for low maintenance requirements?
Furniture for the Children’s Area

DORIS K. STOTZ AND NANCY C. WALKER

“CHANGE—RAPID, RADICAL and often beyond our comprehension—is the keynote of our time.” 1 This change, reflected in the use and growth of libraries, has resulted in a great activity by both school and public librarians to create a new look manifested in sizes, shapes, colors, materials, and total atmosphere. Concomitant with the more obvious technological changes is a subtler one, an attitude, long-growing, which considers children to be not diminutive adults but individuals who are physically, intellectually and emotionally different from their elders. This attitude is reflected in the attempt to furnish children’s rooms in both school and public libraries with dignity and spirit.

Recognition of differences between adults and children does not condemn each to isolation. Although a children’s area serves specifically the library needs of childhood, it also provides a link, both physical and visual, between childhood and the beckoning world of adulthood. Although children constitute the largest audience in the children’s area, adult use by those seeking its services for work with children or for personal needs is becoming an increasingly important factor, particularly in public libraries. Gone, for example, are the picture book characters floating flamboyantly in great murals across the room, creating a confining atmosphere and appealing only to the youngest children. Some librarians complain that we have replaced gewgaws with sterility and have robbed our children’s rooms of the individual objects that related the world of books to other cultural media. Perhaps this is occasionally true. But the real individual personality of a library is created only after the original tone is established, and more by the staff and books than by objets d’art.

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Like today's modern house, the children's area of a library is re-defined in zones where equipment, design, and decoration reflect the use: pre-school areas, story hour locations, places for individual study and reference, browsing, audio-visual sections, and areas for group use.

This attitude is shared by both elementary school and public libraries. But running parallel to this is a difference, partly determined by their difference in use and purpose, partly in their relation to a larger organization that distinguishes the trend in each. Because school librarians are working constantly and simultaneously with whole classes of children, with small groups engaged in one project, and with individuals, the maneuverability of library furnishings is number one in importance. Tables that can be combined for large gatherings, then separated quickly into smaller units accommodating three or four children or used as individual carrels, and chairs that are lightweight enough to be shifted into various group patterns by even young children are being sought, sometimes at the cost of appearance.

Since furniture for the school library is sometimes purchased at the same time as equipment for the rest of the school, or included in non-separable bids, style is affected and money for any individual piece of furniture often severely limited. Frequently, too, the person responsible for choosing the furniture and for writing the specifications has many other diverse tasks to perform and consequently can allot only a small portion of his time to sifting through the literature from manufacturers, listening to sales talks, examining products, or visiting other libraries. Hence the prevalence of the traditional all-wood birch or maple institutional furniture, or the newer tubular metal and plywood combinations which may be more practical but can hardly be called more beautiful.

Certainly the need is obvious for a consultant's services in school library planning when renovating or building. Probably because of this there is a current trend among library furniture manufacturers to sell what is called a "package deal" that provides all furniture and offers the special services of a consultant. Perhaps this results in a more coordinated, better styled appearance, but in the future it probably will also result in a new kind of stereotype. Critics and evaluators of school libraries have noted that "most often the library is too formal, too institutionalized, devoid of pleasant furniture . . ." and have offered innumerable excellent suggestions for the establishment of conditions contributing to the relaxed and comfortable, invitation-to-learning atmosphere that the library should provide.
Furniture for the Children's Area

Public libraries, on the other hand, having had a long courtship with eternal oak and later with opaque birch, are in many ways freer and readier to experiment. Seeking primarily to encourage browsing and the individual pursuit of reading for a multitude of personal reasons, and competing for the time and attention of its patrons with other organizations such as community centers, recreation councils, and religious organizations, the public library places particular emphasis on attractiveness, good taste (for so often the decor of the library may be the only example of quality in design that a child experiences in his daily life), warmth, comfort, and other factors which tend to promote an inviting atmosphere conducive to reading. And sometimes this is at the expense of durability.

To be sure, they too are often severely restricted in their pursuit of the beautiful by bid restrictions or by governmental stipulations requiring furniture and fittings to be purchased from the lowest bidder regardless of appearance, or produced by state prisons and similar institutions. There are many libraries committed to life sentences with such furniture, for while it is often cumbersome in appearance and almost unmoving, it is frequently totally indestructible. Occasionally, however, when such requirements are confined to the permanent fittings such as shelving, one finds libraries with the warmth and noise resistance of wood shelving, well-constructed, and nicely finished at a reasonable cost. In general, however, public libraries have both the initiative and the freedom to experiment with high-styled furniture in a variety of woods, metals, and plastics which are related to the structure as a whole. The children's area is no longer isolated but visually and physically connected to the rest of the library. Since resources beyond the scope of the children's department are made available to patrons of all ages, the area is aesthetically related to the rest of the library.

Today's furniture—lightweight, adaptable, adjustable, durable, and maneuverable—but less frequently beautiful in children's sizes, in many ways satisfies the desire to have form follow function. Unlike librarians of the past, purchasers of this furniture no longer limit themselves to the traditional manufacturers of library equipment, perhaps because of the influence of modern design on all aspects of our personal life, because of the building boom of business and industry which has made more people on all levels aware of new materials and their uses, or because established library manufacturers have not kept pace with their colleagues in allied fields. The fact is, however, that more and
more libraries, especially public libraries, turn to manufacturers and designers of other institutional furniture in an effort to avoid the stereotype, to add flair and imagination, and to achieve coordination between adult and children's areas at lower costs. One librarian, commenting on the use of non-library furniture in children's areas, says: "We feel that these have decided advantages over the more traditional manufacturers as they have been cheaper, equally functional and, we feel, avoid the stereotype created by much traditional library furniture." 3

That library furniture manufacturers are beginning to recognize this search on the part of librarians is evident. They have become more conscious of aesthetic design and are beginning to offer more variations on basic styles. The irony is that manufacturers who provide excellently designed furniture in adult sizes, such as the new, beautiful oiled finishes and metal combinations, have not followed suit in children's sizes. It seems as if there is an unhappy combination of library equipment manufacturers who have not recognized the importance of developing good taste early, and have consequently provided children with durable but unimaginative furniture, and librarians who have in theory recognized the importance of these impressionable years, but who have not been willing or are unable to pay the cost.

The problem of furnishing seating and tables in children's areas is four fold: the need to provide the right variety of chair and table heights to suit a great variation in age, physical size, and interest of the patrons; the search for taste-developing style and warmth or color in keeping with the spirit of childhood; the need for durability that will be challenged not so much by intentional misuse as by inexperienced use; and the intent on the part of the public libraries to coordinate the children's areas with the adult and young adult reading rooms.

Children served in libraries constitute three main age groups: preschool through second grade, third grade through fifth grade, and sixth grade through adult. Of these, the easiest to satisfy is the youngest. Both school and public libraries tend to seat children of this age at slope-top picture book tables either single or double sided (depending on space available), approximately six and one half feet long and seating three to four children to a side on accompanying benches or stools. This type of table, a specialty item, is fairly expensive, and libraries rarely purchase more than one to an area. The picture book tables are available in solid wood, in wood with metal legs, and in wood or

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metal bases with plastic laminated book surfaces; some of the newer ones have a handy book slot between the two sides. They range in style from simple, stolid, and adequate, to simple, high-styled, and desirable. Because of the limited number of such items in any one area, the less handsomely styled do not become as much of an eyesore as they might.

Bench versus stool preference is highly individual. More children can be crowded onto a bench, but stools provide convenient access to the center of the table and can be shifted around easily to be used for other purposes. The fact that very young children can move them is a factor sometimes not in their favor. One recently renovated library purchased individual stools for its new picture book table and abandoned the old benches. Adult protest, however, forced them to resurrect the benches, not for child use at the table, but for parent use at the picture book shelves. They permitted the adult to slide back and forth easily from one section of the shelves to another. Benches are obtainable in solid wood or with metal legs and a Naugahyde upholstered cushion.

Stools are not as readily available from library furniture manufacturers, although at least one company lists an attractive one with metal legs and Naugahyde upholstery. Sometimes suitable stools can be purchased from local furniture houses or interior decorators, or even made to order. Librarians have found three-legged stools, especially those on which the seat extends over the legs, undesirable because they tip easily when climbed upon by very young children.

Some libraries still use one small round table with chairs in place of, or in addition to, a picture book table for the youngest group. Most frequently used sizes are twenty-two to twenty-four inch tables with twelve to fourteen inch chairs. Libraries that use these are limited in choice, particularly if they intend to coordinate this furniture with other pieces in the library. Other libraries, with limited space or a limited budget, have capitalized on the fact that many children under six prefer the floor to any other seating and use small Naugahyde cushions which can be scattered around the picture book shelving and also double as pre-school story hour seating. Some supplement these cushions with small stools at the shelves.

One library installed a two-foot wide strip of carpeting in front of the picture book section—easy on adult knees and children's bottoms. Another library set the top of the standard slope picture book table directly on the floor where small children could kneel or sit tailor-fashion on cushions. Perhaps the trend toward carpeting in libraries
will eliminate more seating in this youngest area, although such a trend would make it more difficult for parents who come to help their small children select books.

In seating the next two groups of library patrons in the children's area, there has been a definite trend away from either a multitude of sizes in one area or a preponderance of small sizes. Increasingly both school and public libraries use only one size of chairs and tables in addition to whatever furniture is purchased for the youngest group. The most popular size is a sixteen inch chair with a twenty-seven and one-half inch table. A few libraries, primarily those in schools, will combine this size with a much smaller number of twenty-five inch tables and fifteen inch chairs. Still others, principally public libraries, which serve adults and great numbers of junior high school students in their children's area, are supplementing the twenty-seven and one-half inch tables with the regular adult twenty-nine inch table and eighteen inch chairs. Some children even below junior high age prefer adult furniture, although whether physically or psychologically is undetermined. Those libraries which mix adult and children's furniture in one area are quite restricted in their choice. It is difficult enough with the existing furniture styles to coordinate the two groups within the library building. To coordinate them within one area requires either astonishing ingenuity and knowledge, accessibility to diverse furniture outlets, or a blind eye.

A good looking, durable, light weight (in appearance and structure), comfortable, inexpensive children's chair is the most difficult item to procure either from library or non-library manufacturers. And it is in this field that wide experimentation in use is being done on the part of libraries. This seems to be less of a problem to school libraries in which chairs and tables normally measure up to the standards of construction and taste of the rest of the school furniture and in general are quite stolid and institutional looking, than it is to the public libraries in which the quest for the "living room look" has become so fervid. Chairs in children's sizes with upholstered backs and seats (usually in Naugahyde), of which only a small variety is available, tend to be the most comfortable, offer an easy way to add a touch of color, need little maintenance, and can be easily recovered. But some schools have restrictions prohibiting upholstered seating for student use because of possible vandalism.

Libraries have experimented with the unusual looking steel wire mesh chairs (in some cases the wire mesh split under heavy use),
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molded plywood (in some cases the plywood split, and the back of the chair wore where it rubbed against the table edge), and adult size molded, reinforced fiberglas cut down to proper height by using fifteen inch legs. The latter has the advantage of color and easy maintenance but has proven unsatisfactory because the backward slope of the seat makes it uncomfortable to use when writing at a table. Too when occupied for any great length of time, this impervious material can become uncomfortably warm, although this is not as much of a problem in air-conditioned buildings.

Traditional wooden chairs are still used extensively for a variety of reasons, including preference and availability. Some librarians believe that the warmth of wood adds a tone to the room which cannot be achieved with any of the newer materials, such as metal and plastic, even when they are used in color and have design advantages, and that this warmth out-weighs the disadvantages of wood. Cane backs on regular wooden chairs, a recent innovation, lighten the look considerably and offer a pleasant variation. Some librarians maintain that wooden chairs are as low on maintenance and repair and are as durable as any of those using new materials, despite the reported superiority in strength of a welded over a glued joint. Other librarians disagree, particularly where finish is concerned, and suggest that re-finishing is a problem in time, labor, and money. Perhaps Edward G. Stromberg's suggestion of oiled finishes on walnut furniture, now available in adult sizes, will provide one solution, if the cost is not prohibitive. What is obviously needed is a larger assortment of children's high-styled, well-designed, and well-constructed chairs in metal, wood, plastic or a combination of these which will satisfy a variety of good tastes and avoid monotony, sterility, and an institutional look.

Tables do not present as many problems as do chairs. Since their design is considerably less difficult, one might expect a swifter solution. Part of the difficulty is that manufacturers often offer only some of their lines in children's sizes, and the high-styled table chosen for an adult area cannot then be matched in the children's area. This is particularly awkward when both adult and children's tables are used within the same area. One manufacturer, for example, offers an exceedingly handsome style in picture book table and adult size reading table, but according to the catalog does not provide an equivalent in an intermediate size. But, in general, an acceptable number of shapes and finishes are available. Some companies suggest in their catalogs that unlisted tables for special needs can be obtained.
The most common table size in use, twenty-seven and one-half inches high, is also the most readily available. In general, schools tend to use a rectangular table sixty inches long and thirty-six inches wide, which seats four children. This shape easily combines into larger units when necessary, and a child can spread out materials conveniently without interfering with another student's activities. Rectangular and the newer hexagonal tables offer the greatest possibility for rearrangement into individual carrels.

Round tables, forty-eight inches in diameter, seating four, are frequently seen in children's areas of public libraries where their informal appearance softens the tone of the room and contrasts nicely with the more formal rectangular tables frequently used in the adult areas. Often a combination of rectangular and round tables are used to break up the pattern. Forty-two inch square tables, now available from several manufacturers, present another possibility for variation. They are more "conversational" in tone than the rectangular tables but less informal than the round tables. Many librarians feel that in spite of rounded corners on square and rectangular tables, the round tables provide the safest solution, particularly in public libraries where toddlers are likely to roam or rush about the children's areas.

Table tops are made of either wood or plastic laminate, the latter taking precedence. Since both wood tones and colors are available in low-glare surfaces, most tastes can be satisfied and librarians can indulge happily in the easy maintenance of plastic laminate, without losing too much of the warmth of wood. Many libraries which use wood tones in adult areas turn to colored table tops for gaiety and contrast in the children's area. Some libraries that have experimented with plastic laminate edges on tables have abandoned them in favor of wood edge bandings, because the plastic edges are exceedingly vulnerable to buttons, belt buckles, and the crash of chair backs.

One of the most interesting concepts in the current furnishing of children's areas concerns the use of lounge furniture. Thomas McConkey, of the Free Library of Philadelphia, says: "Many libraries . . . are moving toward the increased use of lounge furniture in children's reading areas as well as the adult and young adult areas." In the last five years, we have noticed only a slight trend toward such use, but many more librarians are talking about it, particularly in those public libraries which serve junior high children in the children's area. A number of junior high school libraries have small lounge areas, often in browsing corners or in magazine sections. Their
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use in elementary school libraries is quite limited partly because of space, but mostly because the average length of stay of any one child is fairly short and his purpose, which is most frequently curriculum oriented, is served more efficiently by formal seating.

If the trend toward lounge furniture in children’s reading areas is to blossom, it will be in public libraries. If the growth of school libraries reduces the use of the public library for specific school related assignments, then perhaps the increased use of the public library for browsing and the individual pursuit of reading and learning will result in a greater need for comfortable, informal lounge reading areas. Up to now, since public libraries often have to substitute for the needed school libraries, every possible square inch is devoted to table and chair arrangements that can serve all purposes. Thus McConkey pointed out that to his knowledge only one company produced lounge furniture in children’s sizes and we know of no additional furniture in small sizes. Some librarians who have felt the need for such furniture have used the molded reinforced fiberglass arm chairs, either with or without the foam padded cover, on fifteen inch legs—normal “cocktail” height as opposed to dining height. These chairs have served the purpose well, since they are comfortable and light weight enough to make reductions, enlargements, or rearrangements of the lounge area easily possible and may also be grouped around small tables for library programs involving informal discussions. Librarians seeking lounge areas as another possible place in which to add color and an informal touch find these chairs quite suitable.

In general, librarians think regular adult size lounge furniture, most of it quite low anyhow, suitable for use by children. Very small children prefer the floor, small stools, or picture book tables, and anyone browsing in areas other than picture books is large enough to be accommodated by adult size lounge furniture just as he is in his own living room. As far as expense is concerned, one and two seater furniture can sometimes be purchased more cheaply than the equivalent formal table and chair seating. However, lounge furniture takes up more space, and space costs money. The trend in the future will be determined probably not so much by money, or by availability, but by the nature of children’s use of the library.

In contrast to typical seating, special library furniture for children is not only similar but frequently identical to that used in young people or adult areas. Although there are some special applications, the most important differences are usually in size. In the choice of charging
desks, for instance, there is a sharp distinction in size between those used in school and public libraries. Thirty-two or thirty inches, referred to as sitting height, is the size used most frequently in elementary school libraries. Although thirty-two inches is not uncomfortably low for adults, and is accessible to most children, public libraries tend to use a thirty-nine inch counter, providing a real barrier to many children.

The children's card catalog is another furniture item that is distinguished from that used by adults only in size. Since children below the third grade rarely make use of the catalog, the most convenient height has been found to be a seventeen and three-quarter inch base with no more than four drawer units in height above. Additional drawer space is then provided by a whole supplementary catalog unit rather than by drawers stacked higher on the original base. As the trend toward book catalogs gains momentum, the card catalog cabinet may be on its way toward obsolescence. To date this is likely to be true more in public libraries than in schools. As book catalogs become more prevalent, no doubt special tables or stands will be devised for them. In the meantime, it has been suggested that they be placed on regular tables, at counter height on shelves, or interspersed among regular book shelves in several areas.

Dictionary and atlas stands which usually appear in adult reference sections are used sparingly and seem to be considered of questionable value in children's areas. A contributing factor to such limited use is the uncomfortable height for children of most of the available stands. But in addition, only a few of the reference tools used in most children's areas are oversized enough to require special storage. Normal reference size shelving adequately houses the bulk of children’s materials. Most libraries use revolving dictionary stands placed on reading tables, ledges, or low counter-height free-standing book shelf units for their unabridged dictionaries. Such stands used for a large atlas or other oversized reference books bring the volume within easy reach of children. Librarians who observe students using large reference books at the picture book table often wonder whether or not a similar table placed close to the reference section might not provide more adequate work space for examining these tools than the flat reading tables.

The use of study carrels has become quite prevalent in secondary school libraries. If the present trend continues toward individualization of instruction and emphasis on independent study, there is every rea-
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- Son to assume that carrels will soon have their place in elementary school libraries. Curiously, their extensive use in children's areas of public libraries seems highly remote. They are ideal for individual use of audio-visual materials. Carrels are available in almost every furniture line or they may be built to specification. The School Library, a report from Educational Facilities Laboratories, Inc., contains specifications for many types of carrels as well as ingenious suggestions for their placement in the library area.

- Since the pattern of school libraries as instructional materials centers was firmly established by the 1960 Standards for School Library Programs, most school libraries are being designed with this in mind. In planning a new building or renovating existing quarters, it is possible to arrange for built-in storage cabinets to accommodate films, filmstrips, phonograph records, maps, and charts as well as the equipment needed for their use. There are detailed specifications for filmstrip and phonograph record cabinets in the manual which accompanies the filmstrip, Remodeling the Elementary School Library.

- Cabinets for the storage of maps, charts, and large display materials are available from art supply houses. Regular filing cabinets have proven satisfactory for pamphlet and picture files although experienced librarians warn that care must be taken to select cabinets with drawers easily movable even when heavily loaded.

- Magazines are currently a part of most children's collections in school and public libraries. Since the variety of magazines available within the children's area of public libraries is often limited because of accessibility to files in the adult area, these libraries sometimes tend to house the magazines in free-standing racks, often as part of the lounge area. In school libraries, where magazine collections are self-contained and can therefore be expected to be larger, regular wall shelving is often provided for their storage.

- Display and bulletin boards are most frequently provided in original construction. They usually consist of glass front cases in the corridor outside the library in the case of schools, or within the children's area in public libraries. If these are not available, there are free-standing glass cases of both vertical and horizontal types. Children's eye-level height is usually the major consideration in their selection.

- Book trucks are available in wood, steel, and wire. In school libraries, where the shelving is usually done by children, the lighter steel trucks have proved most maneuverable. Since a large part of the
circulation in any children's area is in oversized books, flat rather than sloping shelves are more frequently used.

The wide variety of wood, steel, and plastic shelving available offers more leeway for the imaginative use of color and materials than is often possible with furniture. Each type has its advantages. Wood offers softness, silence, and durability, while steel and plastic provide color and the opportunity for greater flexibility. To date there seems to be a predominance of wood in school libraries, while public libraries tend to use steel. There are several possible explanations for this tendency. School administrators are usually most interested in durability. One purchasing agent suggested that school libraries were too poor to economize on permanent installations. Since a larger portion of the furniture budget must be devoted to shelving in public libraries and steel is much less expensive than wood, except for State use system installations, most public library administrators feel that the initial outlay for wood shelving is too great and hope that excellent acoustics will alleviate the noise problem. Public librarians, too, in their search for sparkle, often find the available color range in steel shelving a boon.

In addition to wood and steel, some experimentation has taken place in the use of plastic laminate shelves. Apparently the success of this type of shelving depends upon the core materials on which the plastic surface is laminated. In cases where particle board core is used, the shelves are subject to warping. Plastic surfaces are durable, even easier to care for than wood and less noisy than steel, all decided advantages if the tendency to warping can be overcome. Shelving for children is usually the same as for adults except for the size factor. Generally, shelving in children's areas is no more than sixty inches in height. In school libraries, where the use of the non-fiction collection is likely to be more specific than in public libraries, it has been possible to use seventy-two inch shelving in this area. Step stools are then a necessity. The kick-stepstool which is on wheels and moves readily is most satisfactory.

Picture book shelving has more particular characteristics than other types. The usual maximum height is forty-two inches, which allows for two shelves with a sixteen inch clearance, as well as toe space and top. Most picture books require twelve inches in depth, and this is necessary despite the tendency for some small books to fall behind. Upright dividers at least every eight inches along the shelves make it possible to keep the oversized books in order. The thinness of the
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Steel dividers have been found to be a book hazard. Picture book shelving in libraries using steel units is adjustable, but frequently permanent wood installations meet the same requirements without such adjustability.

That librarians are seeking to provide the best that contemporary creativeness has to offer is indeed laudable. However, the zealot may, in his eagerness, rush headlong after an unnecessary goal. H. K. Gordon Bearman remarks: “It would seem to me that in our chase after modernity and variety, we are in danger of overlooking the basic requirement that furnishing should be related to the use for which it is intended. In simple terms the task is to furnish a library and not to create a library showroom.” Perhaps the following succinct statement in *Standards for Children’s Services in Public Libraries* best sums up the goals of all librarians concerned with furnishing children’s areas whether they are in school or public libraries: “The physical facilities of a children’s area should be conducive to efficient and economical library service to children and adults. They serve as a symbol of library service, inviting children of all ages to enter, browse, read, and listen.”

References

Display and Exhibit Cases

H. RICHARD ARCHER

Judging from the amount of information on this topic located in the literature of librarianship, anyone searching for specific details about exhibit and display cases will find it difficult to obtain. Library Literature (1952-1963) contains fewer than a half-dozen references that relate, even cursorily, to the subject. It is apparent that librarians who are concerned with equipment for displays and exhibits must rely upon their own experience or on catalogs from manufacturers and on interviews and correspondence with other librarians and planners.

No doubt much of what is known about the advantages or disadvantages of different kinds of exhibit cases has been learned from those administrators who work in museums and galleries, or in libraries. The duties of an exhibition officer are more varied in some of our large privately endowed libraries than in the smaller tax-supported institutions where a staff member may be in charge of exhibits as one of several duties. There may be certain exceptions to this generalization, but from this writer’s observation, those libraries with important holdings and the best exhibition equipment generally have the advantage of trained people who manage and plan exhibitions.

Few libraries have found it possible to imitate either the Pierpont Morgan Library in New York or the Beinecke Rare Book and Manuscript Library at Yale University, with regard to the elaborate and appropriate display cases installed and the exhibition techniques employed in these institutions. For the many smaller and less affluent libraries, any recommendations that might seem necessary where a Beinecke, a Morgan, a Lilly or a Huntington is concerned, would certainly extend beyond what could be accomplished in a majority of our colleges, universities, and local municipal libraries throughout this country.

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Few museums, historical societies, or special libraries, not counting certain industrial concerns, have the funds needed to acquire the desired exhibition cases for displaying their own valuable and prominent collections. Nevertheless, there are some institutions where modern and approved exhibition cases have been installed in older and less splendid quarters. A good example is the Newberry Library, on Walton Place in Chicago, where improvements were made after costly remodeling and redecorating of a structure that is now more than seventy-five years old. The exhibition cases, as well as other accouterments, now in use complement the attractive and practical interior of the library and provide readers and visitors with more than the usual comforts found in many of our older established libraries.

When planning an entirely new building, it should be possible to specify suitable furniture and equipment which will be appropriate and workable according to the needs and functions of the institution. One established architect, recently expressed his views as follows:

It is my opinion that the types of library equipment acceptable for use in the new building should be determined in conjunction with the early planning of the required areas. This enables the architect to project equipment into his preliminary design. At the same time he is considering rooms, spaces, orientation, and functional traffic flow. . . . This information, combined with the knowledge and flexibility of the selected equipment, permitted much greater freedom of design analysis. . . . Our next thought should be to design all of the equipment spaces to fulfill these functions in the manner best suited to the particular project.¹

For those institutions in the fortunate position of being able to redecorate and refurnish, certain matters relating to exhibit cases must be considered in a different manner. The recommendations presented in this article are based on personal reactions to problems encountered and sometimes solved, by a librarian who has spent over twenty years working in rare book libraries and special collections, industrial, tax-supported and privately endowed on the Pacific Coast, in the Middle West, and in New England. Many of the points treated here have been prompted by inspections of exhibits and exhibition cases in various countries during the past decade, particularly in England and western Europe, as well as in institutional and private libraries from Cambridge, Massachusetts, to San Marino, California. After considerable reflection on the conditions noted for this informal survey, certain factors were identified which may be helpful to anyone interested in

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the problems of ordering and installing exhibition cases and displays. It is apparent that many curators and librarians have made compromises (intentionally or not) in the matter of displays, with the unfortunate result that valuable and irreplaceable documents, printed books, and manuscripts have been damaged beyond repair, or lost for future generations. The common infractions contributing to deterioration of materials on exhibit are discussed briefly in the paragraphs that follow.

Cases that are too small and poorly ventilated, with inadequate or improper lighting (whether incandescent, fluorescent, or natural sunlight) are to be avoided. Direct sunlight, excessive heat, and humidity (or the lack of heat and humidity) are important factors in the control of the rate of deterioration in books, manuscripts, drawings, and other artifacts on display. The evidence collected and studied in our own generation makes it clear that sunlight, strong artificial light, polluted air, dust, and chemical wastes have always had ill-effects on paper, vellum, cloth, and leather. Direct sunlight causes fading and disintegration of fibers in cloth and leather, as well as in paper. One of the chief responsibilities of a curator in the library or museum, as well as of the knowledgeable staff members, is to be aware of the hazards of light, too much heat, excessively dry air, high humidity, and unclean or polluted atmosphere. For a more detailed discussion see W. H. Langwell's book, where many of these matters are discussed.²

With regard to vertical or horizontal cases, the governing principle should be, how are the books and other objects to be displayed. Prints and drawings, properly matted and protected, or framed items, naturally show to advantage in vertical cases, although a strict rule cannot always be applied, for some variations are acceptable, provided of course certain necessary precautions are taken.

At the present time, and for some years past, most exhibit cases are constructed of metal, rather than wood. Special installations have often included wooden bases and frames for the glass, but a majority of the exhibit cases manufactured during the past two decades are made of metal. Strength, permanence, and neatness seem to be qualities required for the better exhibit cases. The metals used are usually bronze or aluminum, although chrome-plated, or even painted, metals are much in favor. There was a period when the technique of applying paint with a wood grain effect simulated wooden cases, but this method is not often used today.

The costs of wood versus metal will depend upon the type of wood
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used and the quality and gauge of metal specified for frames and bases. It is difficult to present comparative costs without some special knowledge of materials. Expensive and exotic woods, beautifully finished, enhance an exhibit case in certain surroundings, but the librarian will need to consider the over-all decor of a building and the other furnishings before specifying the more elaborate designs for an exhibition area. The matter of maintenance is also to be taken into consideration, as wood and metal require different treatments for finishing and cleaning.

It is also necessary to consider, at an early stage in the planning, what will be used for lining the cases as background material. One recommended material is a coarse fabric, but different cloths may be used, provided the matter of resistance to fading and dust is kept in mind. Certain synthetic fabrics developed in the past decade or so may be good solutions in particular instances. Bare metal, and painted metal have been used, although such surfaces show scratches and prevent the use of pins and tacks, which are necessary in many installations. Cork backgrounds are often suitable, as are fiberboard, felt, velvet, cardboard, and paper. All have been used with varying degrees of success.

Although this writer has never worked in a library where light fixtures were installed inside exhibit cases, it should be mentioned, in view of the number of these now in use, that certain problems exist as a result of overheating in these cases. With the development of the cold cathode tube, as well as fluorescent lighting, the amount of heat given off is less than in former times. However, unless they are hermetically sealed, exhibit cases should provide thin vents, properly placed, to allow for circulation of air. If the cases are in an air-conditioned exhibition area or building, there are few problems. However, any vents admit dust and polluted atmosphere, even when the system is working properly, and in the best systems an equipment failure sometimes has had a bad effect on materials displayed in the most modern cases, under what might appear to be ideal conditions.

The use of thumb tacks or glass-headed pins stuck through manuscript letters or fine prints seems indefensible, but trained curators have solved this problem in various ways, and find that vertical displays may be effective when properly placed at a position nearly eye-level, with neatly mounted captions describing the items. In recent years, the availability of non-reflecting, or tinted glass for manuscripts and prints, has proved to be a boon for many galleries and private col-
lectors; and for those libraries that can afford it, such glass is recommended. Although it is more expensive than the usual glass, the importance of this technical improvement is being recognized by many of our best-trained curators.

Those institutions with both horizontal and vertical cases are fortunate, and such libraries as the Morgan and Huntington (among others) find that this combination allows for variety and makes it possible to arrange exciting displays without great inconvenience and with the result that the exhibitions are enhanced and made more attractive to visitors. Libraries with permanent exhibit and display cases may find them inconvenient at times, especially as such factors as narrow width and insufficient depth, as well as insufficient height, contribute to the problems already indicated.

Tall folios, fragile bindings on books and manuscript codices should not be displayed vertically, unless they are properly supported by brackets or leccterns which will prevent further injury to the hinges or loose leaves. Wherever possible, such items should be placed on wooden (or moulded plastic) bases used as cradles, so as to prevent tension and additional spreading. The use of glass weights, or silk ribbon (or acetate cord) for tying the books open, is recommended, but rubber bands, thin silk thread, or paper clips are never to be used for this purpose.

Perhaps the ideal exhibit case cannot be easily described—although anyone who has seen the recent installations at the Beinecke Library at Yale University will agree that the ultimate seems to have been achieved, at least for this great University library. At the same time, experienced librarians will realize that it is not always possible to achieve the ideal, without a consideration of costs; and where public funds are limited, the administrator must usually be satisfied with something less than the most expensive and desirable materials.

There are those library buildings (all too many of them) without air-conditioning, whose exhibit cases are placed in large hallways and corridors with high ceilings and without adequate natural or artificial light. Under these circumstances, it is necessary to devise some suitable way to light the cases. Temperature may be difficult to control in such large rooms, and therefore the ventilation as well as temperature and relative humidity in the cases cannot be controlled automatically, with the result that the materials on display may suffer irreparable damage caused by excessive dryness, too much humidity, or lack of air circulation.
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When books and manuscripts are displayed in exhibit cases without proper ventilation or air-treatment, it is often advisable to place small flat dishes of water in the corners of the cases, as inconspicuously as possible, so as to add necessary moisture to the air in the cases. If the case doors are tight-fitting, it is wise to open them occasionally, to prevent mustiness and to allow for the circulation of fresh air. It may be necessary to clean the glass dishes and add fresh water from time to time, especially where excessive dryness is noticed, due to overheating in the exhibition gallery or the library itself.

Among the necessary and useful props, which can serve as aids to displays of certain materials, are photostats or photographs of reverse sides of letters or printed pages, mirrors for reflecting the backs of objects, bindings, vases, etc., magnifying glasses placed over detailed matter on a map or leaf of manuscript that requires emphasis, and strips of colored paper, ribbons, or small arrows to point to a place in the text or to aid the viewer in locating some specific detail in a book or manuscript page.

With regard to locks on cases, many varieties have been used. It is not necessary to recommend any one type of lock, but certain qualities must be kept firmly in mind if the library is to prevent thefts and annoying problems of tampering and vandalism. The best method by which to prevent tampering is to install small firm locks, hidden at the back of the case or in a concealed position. Manufacturers of exhibition cases for libraries and museums have introduced several varieties of locks, and any one planning to purchase cases for the display of valuable and irreplaceable materials should consult experienced authorities about the best means for preventing loss. Such able administrators as Frederick B. Adams, Jr. at the Pierpont Morgan Library in New York City, Robert L. Feller at the Mellon Institute in Pittsburgh, or Herbert J. Sanborn, exhibits officer at the Library of Congress are men with considerable knowledge on this subject. Of course there are others, and librarians should be in touch with persons of similar experience in their own regions, so as to discuss the best means of specifying proper equipment before the orders are placed.

There is sufficient reason for concern about the matter of thefts, especially in recent years; to avoid embarrassment, as well as financial loss, it seems to be good sense to make certain that every precaution is taken. The matter of proper locks and surveillance is of prime importance to libraries, as well as to museums and galleries. The exhibition officer or administrator should have only a few keys and
H. Richard Archer
distribute them only to reliable and trustworthy assistants. The experiences of some libraries have been disastrous, especially when unsupervised use of keys is permitted by certain professional, as well as by untrained clerical and janitorial help.

As a final warning, any curator or librarian worthy of his calling will observe certain rules, and never permit himself to rely entirely upon mechanical and automatic equipment. It has come to the attention of the writer, during the past six years, that mechanical (and automatic) equipment is not infallible; and from the instances observed at first hand, it is obvious that the librarian charged with the administration of rare collections must be alert to this possibility. Remedies are few, but where the problems are recognized, the disaster of overheated volumes, mildewed bindings, and dust-covered pages can be avoided, if the curators responsible for exhibitions are cognizant of mechanical and human weaknesses.

References


Additional References


Map and Atlas Cases

J. DOUGLAS HILL

In the last twenty-five years there has been an enormous increase in the production of maps, partly because of wars and the continuing requirements of national defense, but also because of a rapidly growing use of maps in many other fields—economic and social planning, engineering construction, earth sciences, etc. The resulting flood of cartographic materials has created a new storage problem for libraries, of which few if any had space or equipment for the purpose.

As Ristow\(^1\) reported ten years ago, many libraries were forced by depository programs of government agencies to do something about their map collections, and some were able to purchase special equipment to house them. For those librarians whose map collections are already large and are preserved in cabinets obtained at considerable expense, this discussion may be of little interest. They may be committed to a particular type and size of map case, since there are obvious advantages in uniformity. The custodian of the small or inadequately housed collection and the librarian who may be debating the question of accepting maps as part of his stock in trade may be saved some effort and expense by the following brief report on available equipment and the opinions of some authorities concerning the various types.

Skelton says that “The tactical objective of a sound method of storage is the preservation of the face of the map and the elimination of factors tending to cause strain, fracture or decay in its material.”\(^2\) Compared with books, maps are relatively defenseless against damage. Their great variation in size and their flexibility and low tear strength in relation to surface area make special handling and equipment necessary for their preservation.

Lamination with acetate and cloth backing can all but eliminate the possibility of tearing and protect the face from moisture, acids, and abrasion, but there remains the problem of protection from dust and

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from creasing or curling. When we add to this the requirements of accessibility in a working collection, of providing for ease of expansion and possible relocation, and of making economical use of available space, all at a reasonable cost, it is not surprising that few map collections are satisfactorily housed.

Before discussing the principal methods of storing maps, we should discard two which are not suitable for a permanent collection: the cross-folding of maps to fit letter- or legal-size vertical filing cabinets, which results in deterioration of the paper at the corners of the folds, and storage in tubes or in "roll-files," which wastes space and makes the maps difficult to use because of the curling of the paper.

There are three acceptable types of equipment for map storage, each of which fulfills most of the requirements already mentioned. These are the shallow, horizontal drawer (three to five in a case, of wood or steel); vertical filing equipment of two types, both of steel; and the tied portfolio filed on closely-spaced wood or steel shelving.

Most map librarians now agree that the first of these offers the best combination of protection, accessibility, and ease of expansion. There is also nearly unanimous agreement that cases should be of steel for durability; that drawers should be no more than two inches deep because of the difficulty of pulling and refiling sheets near the bottoms of piles of greater depth without damaging them; that drawers should be mounted on rollers; that they should have a "lock-out" feature to hold them in the open position while contents are being handled; and that they should be equipped with fabric "dust covers" that hook at the front of the drawer, not only for protection from dust but to prevent maps from catching or rubbing on the underside of the drawer above or being pushed out at the back, and to minimize sliding by exerting some downward pressure.

Drawers with metal "hoods" at the back and hinged "compressors" at the front will control sliding and prevent the escape of sheets at the back, but do not offer adequate protection from dust, and cannot be as fully loaded, especially with small-sized maps, as those with fabric covers. In any collection, some drawers may be temporarily over-loaded, and the smooth, treated fabric stretched tightly over the maps will compress them and at the same time withstand the friction that would otherwise damage the map or jacket at the top.

Five-drawer units handling sheet sizes from 24 x 18 to 74 x 46 inches are available from several manufacturers. All of them produce cabinets in the middle of this size range, suitable for the general map collection.
Some of these companies produce horizontal-drawer cabinets of other types, such as ten-drawer units with three-quarter-inch drawer depth and special "lifters" in each drawer, useful for large thin drawings or tracings of uniform size; three- or four-drawer models with drawer depths up to nearly four inches; and wooden cabinets in several styles and sizes.

The fact that horizontal cases can be stacked as high as space shortage may dictate and floor strength permits has undoubtedly contributed much to their popularity. Starting at the two-case level, the collection can grow for many years on the original floor space.

As long as the tiers (or some of them) remain at that level, there is also the advantage, not shared by the other two storage methods, of having work space at the convenient height of about three feet. Even with cases stacked three high, it is possible to use the tops for some kinds of processing or reference work. Four cases rise to just above eye level for a man of average height, and the top can be used for storing globes, reference books, very large atlases, etc.

As Ristow\(^3\) says, a drawer with inside measurements of 43 x 32 inches seems most practical for a general map collection. It will contain, without folding, most of the topographic and other map series published in this country and abroad, while the next larger size, 50 x 38 inches, will not permit double stacking of a sufficient number of these series to make it worth the additional cost and floor space involved. However, larger cases will more efficiently house sheets of large size (e.g., nautical charts) which may constitute a separate collection.

Some confusion seems to exist regarding the capacity of drawers of this type, probably resulting from misinterpretation of manufacturers' statements. For example, Hamilton Manufacturing Company recommends 100 sheets per drawer for active files, but this refers to full-size drawings, tracings or blueprints, for which this kind of equipment was originally designed, and which are usually on thin or fragile materials. As many as 300 map sheets can be placed in one stack in a drawer of 2 inches depth. Even if the sheets are laminated, and are filed in a half dozen heavy folders for ease of handling, the drawer will still hold 250 or more sheets.

Collison objects to horizontal cabinets on the ground that they have "...as much space devoted to partitions as to actual map space."\(^4\) This was true of the older type of cabinet with drop-front drawers and a partition above each drawer. The modern five-drawer case, with a

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fabric dust cover but without the partitions or drop-fronts, has ten inches of filing space in a 15% inches vertical measurement.

Of the two types of vertical filing equipment, the one more frequently used for map collections is the Art Metal "Planfile," with a hinged top, in which strong pockets are suspended, sliding on rails at the sides. Each pocket can contain several folders, which may be of different depths. The contents are compressed by sets of springs between the pockets. These cabinets measure 31 inches from front to back and vary from 43 to 63 inches in width and 35 to 45 inches in height. Their capacity varies from 3,000 sheets for active use to 6,000 sheets for dead storage.

In the second type, the maps are suspended from long metal clamps or binders in groups of up to 100 (as in those made by Hamilton or by the Plan Hold Corporation) or individually by plastic clips fastened by pressure adhesive to the map itself (as in the Globe-Wernicke "Cello-Clip" file.) In the Hamilton and Plan Hold types, the rack supporting the binders slides or swings forward to allow easier access to the groups in the back. This type of cabinet varies from 52 inches to 72 inches in height, with capacity running from 1,200 to 2,600 sheets of large size (up to 36 x 65 inches) on floor areas of from seven to ten square feet.

The Art Metal Planfile offers maximum protection from dust, water, and fire and requires somewhat less floor space than do ten to twelve horizontal drawers for the housing and use of a comparable number of maps. The suspension type of cabinet will accept much larger sheets, without folding, than any of the others. None of the vertical filing cabinets require any stooping or ladder climbing, as do horizontal drawer cabinets. But they are much more expensive than the latter for equivalent capacity, they cannot be stacked one on the other, and their tops cannot be used as work space. (In practice, it has been found that the hinged tops are very often loaded with work or debris, putting the cabinets out of commission at crucial moments.)

Collison prefers a vertical filing method because "... it is easier to extract and replace a map from a vertical than from a horizontal position. ..." 4 This is true of the suspension type of cabinet so long as it is only loosely occupied, and it is true of the Art Metal type except for well-loaded folders toward the back. On this point, LeGear says that "... to slide out the back dozen folders ... is backbreaking work, especially for a short person." 5 Men of average stature and strength, including this writer, have found this to be true. Collison also says

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that "... maps of different sizes can be filed together vertically without any danger of the smaller maps being overlooked." This is a definite advantage over horizontal filing, but it is offset in the Art Metal cabinet, by the danger of some sheets sliding downward and being crumpled at the bottom unless they are strengthened by mounting or lamination. It may even become impossible to remove the folder because of the resulting bulge.

One of the vertical filing methods may be highly satisfactory for engineering or architectural drawings, which are usually larger on the average, and show less variation in size, than is the case with maps; they are also often on thinner or weaker materials, are often used in groups of associated sheets which will not be added to and can be clamped together without inconvenience, and are frequently of greater value, irreplaceable, and therefore deserving of extra expense for protection from fire and water. But for active and growing map collections, stackable drawer units, with their much greater potential capacity in relation to floor area, are undoubtedly the wiser choice.

The use of portfolios or boxes on closely-spaced shelving is preferred by some librarians, particularly in Europe. Jong describes the use of flip-top buckram boxes on wooden shelves constructed to fit them, so that the boxes slide into the shelving like drawers. This system may be relatively inexpensive if "free" carpentry is available, as may be the case in many university or corporation libraries. But wooden shelving may not be sufficiently durable and may prove to be more expensive than steel drawers in the long run.

Foncin says that horizontal drawers were considered when the Département des Cartes et Plans of the Bibliothèque Nationale moved to new quarters in 1954, but were rejected in favor of the current system of filing in portfolios. Steel roller shelving has, however, replaced the former wooden shelves, and the cost, including durable portfolios, may be nearly as high as for steel drawers. The former are, moreover, more difficult to disassemble should it become necessary to move them.

The portfolio provides excellent protection from dust, the map's most persistent enemy. If the portfolios are full, or if some filler material is added, they can also prevent sliding and the consequent tearing or curling of the edges. But unless the entire portfolio is carried to the reading table, some space must be provided where it can be opened and the desired sheets extracted. Added to this is the inconvenience of retying tapes, which increases the labor of searching, pulling, and re-filing.
Cartographic forms other than flat sheets deserve some mention, because they represent a much greater investment per unit than maps in the general collection, and because they require special treatment. Wall maps kept on rods are usually an important part of school and university collections. Several librarians have discussed their solutions to the problem of housing them, always with equipment designed and built on the premises. Most often the map is hung from a hook by a screw eye in one end of the center rod, the hooks being mounted either on the ceiling or in a tall cabinet.

Plastic relief maps are becoming more numerous and, although still expensive, may take the place of the paper wall map for decorative and instructional purposes. Since they cannot be piled one on the other without permanent damage, the most practical answer to the problem of protection and accessibility appears to be the placing of a metal grommet in the center of one of the short sides and suspending them from fixed hooks or from wires, using S-hooks. Since their surfaces are washable, they need no further protection.

Atlases, being books, are not looked upon with the same distaste as some librarians have felt toward maps. The standard double-faced, ten-inch book shelving will accommodate most of them, either standing or lying flat, depending upon their size and construction.

Where large atlases are frequently used, they are best protected by keeping them on roller shelving to minimize wear on the covers. Art Metal, Inc. offers counter-height steel cabinets in 35- and 22-inch widths, 28 inches deep. The adjustable shelves are steel frameworks in which a number of rollers are mounted, rising slightly above the level of the surrounding framework. Similar cabinets are made by the General Fireproofing Co., 413 Dennick Avenue, Youngstown 1, Ohio.

References

3. Ristow, op. cit., p. 133.
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12. LeGear, op. cit., p. 17.

Furniture and Equipment:
Sizes, Spacing, and Arrangement

KEYES D. METCALF

Equipment layout is not an exact science. “Circumstances alter cases.” Compromises are inevitable due to financial and space limitations. The architect's training and experience enable him to visualize and determine equipment as well as space relationships; in library planning, in which the equipment fulfills such an important function and is so closely related to the lighting, ventilation, and structural concepts, the architect should generally be responsible for the first proposals. However, a library building consultant or a librarian with knowledge and experience in the functioning of libraries can almost always make valuable contributions.

The following requirements should be kept in mind in preparing library layouts:

A. They should not give an appearance of congestion. This is important, since a library's use is inevitably affected by the first impression received by a newcomer.

B. The reader who is occupying his chosen seating accommodation or who is consulting the catalog, the reference and bibliography collections, or working at the shelves, should not feel that he is in an unpleasantly crowded situation; he should not be interfered with unnecessarily by his neighbors, and he should not interfere with them.

C. The reader should have satisfactory seating accommodations with suitable privacy, an adequate working surface, and a comfortable chair. At the same time it should be remembered that square footage is the greatest single factor in building costs, that it should be utilized to the full, and that unused space rarely adds as much to the general effect as does quality equipment.

D. The areas required for furniture and equipment include both the space occupied by the equipment and that used for access to it.

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The latter takes more than the former. Six square feet may be generous for a working surface for one person, and a good-sized chair occupies less than four square feet, but to provide one suitable accommodation in a reading area may take twenty-five square feet, over sixty per cent of it for access purposes. Book shelves rarely take more than thirty per cent of the total stack area. The same is true for catalog cases in the catalog room.

This article will confine itself to three types of library equipment: seating accommodations, shelving, and card catalog cases. Between them they present an opportunity to discuss basic layout principles:

1. The size of the equipment to be used must be determined.

2. Aisles, as already stated, are the greatest users of square footage. They should be considered with the same care as the equipment. Most access aisles should be used on both sides in order to obtain full value from them. An aisle along a wall used from one side only is generally wasteful. The width of an aisle should depend on appearance and on the amount of use it will receive. Aisles and corridors with solid walls on both sides, feel and look narrower than those of the same width which are completely or partially open on one or both sides at table top level, or even anywhere below eye level. A cross stack aisle with book stack ranges at right angles, seems wider than one of the same width between two parallel stack ranges.

3. In planning layouts watch for visual and auditory distractions. Acoustic protection is as important as visual protection. Seating accommodations adjacent to heavily travelled traffic arteries are generally unsatisfactory in both of these connections.

4. Long and much used corridors should generally be kept straight, although many architects very properly like to introduce visual barriers in them. Often this can be done with light as well as by equipment, walls, or doors.

Long rows of regimented tables and chairs in a large reading area tend to make the room look like a railroad station. One possible exception may be the use of carrels along a wall. This arrangement will seem like part of the structure, rather than equipment, but even here it may be desirable to break up the rows by the occasional use of a small lounge chair in place of a carrel.

6. Wall shelving around a reading area is not economical in space use because of the wide adjacent aisle that is required. Moreover, if the books are heavily used, consulting them will disturb unnecessarily the readers within the area.
7. Curved walls and acute or obtuse angles waste between ten and twenty-five per cent of the floor area, even with the most careful layout.

Seating Accommodations

These basic principles for equipment layout apply to seating accommodations in a library. The problem has become more complicated than it was a generation ago, because seating is no longer confined almost entirely to standard library chairs at long tables placed in parallel rows. Academic libraries are being planned today with up to eighty-five per cent individual seating at tables for one, in carrels in a wide variety of positions so arranged that the user has no one sitting immediately beside him, or in lounge chairs—sometimes with tablet arms—separated from each other by an aisle or a small low table. This change has stemmed primarily from two facts.

1. Most readers today come to academic libraries primarily to read and study, and prefer a reasonable amount of visual and acoustic privacy.

2. Methods have been developed in the past ten years that make it possible to provide adequate individual quarters which use little if any more square footage than was formerly involved in multiple seating at long tables, and thus individual seating has become economically feasible.

This article cannot go into detail in regard to all possible types of seating, but will outline some of the requirements that make them satisfactory for academic readers. These involve adequate working surfaces, space for comfortable access without interfering with or disturbing others, a comfortable chair, of course, and a desirable amount of visual and acoustic privacy.

At a table for two or more persons without partitions between the different accommodations, at least six square feet for each reader is desirable, preferably a surface three feet wide by two feet deep. These dimensions can be reduced in a reserve book room or in an undergraduate library for women to 33 inches by 21 inches if necessary, but the smaller size is not recommended. The shorter dimensions, that is, 33 inches by 21 inches, are as adequate, however, for individual quarters which are cut off from others as the larger ones are at multiple seating tables, because no other reader can overlap onto the space. For advanced and graduate students a table 3 feet, 6 inches wide is preferred, and for one writing a doctoral dissertation, four feet in width
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is not excessive but is not necessary. If there is even a narrow shelf over the back of the working surface, a depth of 27 inches is recommended, because the shelf tends to interfere with overhead lighting. (Fluorescent tubes placed under a shelf tend to result in unpleasant reflection and glare because of the angle at which the light reaches the book page. It is sometimes preferable to place shelves over one end of the table instead of at the rear, or to assign a shelf in an adjacent stack section for books wanted for use later.

Access to seating accommodations involves two problems: space for cross aisles and that for direct access to the chairs. Twenty-six inches would seem to be the minimum width for the latter if no other chair is in a position to back into the same space and no other reader needs to pass. This gives 18 inches beyond the front of the table for the chair itself, and 8 additional inches to push the chair back in getting into it. With only 26 inches available, the chair itself should not be overly large, should not have arms, and the corner leg of the table should be set back some 6 inches.

Twenty-six inches of access space is inadequate, however, if one has to pass another’s chair to reach his own; here, thirty-two inches should be the minimum, and even then the tables or carrels can well be staggered as shown in Figure 1. Thirty-six inches of access space is generous for carrels staggered in this way.

If carrels or tables for multiple seating have chairs backing into an aisle from both sides, five feet in the clear should be available between the tables; and if the tables are long and passing is frequent, an aisle of six feet is preferable.

Figure 1. Double Staggered Carrels
Cross aisles, which are not used for seating and are at right angles to tables, should preferably be not less than three feet wide, and a wider one is desirable if long tables are on one or both sides. Main cross aisles in a large reading room can well be up to as much as five or six feet in width.

A third requirement for seating is suitable privacy, both visual and acoustic. Partial visual privacy can be obtained by not placing readers so that they face each other over a table; tables with readers on one side only and all facing the same direction will help. A table with chairs on both sides should be four feet across, if possible.

If a table for one can have a partition at its back, it becomes a carrel, but the back should be high enough so that when a reader sits up straight he cannot see the top of the head of the person in front of him bob up from time to time, as that is more distracting than seeing the full torso continuously. An intermittent appearance is as distracting as an intermittent sound. A partition to be adequate should be at least fifty inches high for women and at least fifty-two to fifty-four inches for men.

Partitions can also be placed on either side of a reader, as well as in front, but preferably not at both sides. Many readers shut off on both sides feel like a horse with blinders. If partitions are used on both sides, it is suggested that they be omitted in front or held down to ten inches above the table top, as in the triple staggered carrels shown in Figure 2.

Acoustic distraction is increased by hard surfaces, floors, table tops,
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ceilings, and walls which reflect undesirable noise. Breaking up hard surfaces by projections or indentations helps. Resilient floor coverings, such as cork or rubber tile, will be beneficial also. Carpeted floors and acoustic tile on ceilings are the most useful in this regard. Watch out for noise from wood, vinyl asbestos, and asphalt tile on floors, or from formica on table tops. Occasionally, acoustically treated walls are indicated and one should remember that books themselves have acoustical properties. Heavy traffic in a reading area increases the chances of both visual and acoustic distraction.

Lounge chairs have been increasingly popular in libraries in recent years, and some have used them for twenty-five per cent of all the seating. Others find that lounge chairs are not occupied as much as those in carrels or even those at tables for multiple seating. It depends somewhat on the seriousness of the students. Lounge chairs are most useful in browsing and in periodical rooms; they may desirably constitute five to ten per cent of the total seating in a library, and very rarely over fifteen per cent. Properly placed and selected, they should not increase equipment costs or square footage used.

Many different varieties of carrels have been devised in recent years. They can be in single rows along walls, screens or partitions of any kind. Double rows that are staggered can be very satisfactory with the

Figure 3. Double Carrels in Stack Area
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readers sitting in opposite directions, as shown in Figure 1. Triple rows of staggered carrels can be used in a large reading area with fairly good-sized aisles on each side as shown in Figure 2. Double rows of carrels all facing the same way, with the partitions at the back of each table and on one side, can be placed in a reading area or substituted for two stack ranges (see Figure 3). Tables for four with partitions running in both directions can be used in a reading room or a reading alcove, as shown in Figure 4. In an alcove the clear space for this arrangement should be at least 10 feet, 6 inches wide and 9 feet deep. If it is 12 feet deep, a pinwheel or swastika arrangement can be used, as in Figure 5. Double carrels 5 feet wide are sometimes used in co-

Figure 4. Reading Alcove, with Table for Four

Figure 5. Reading Alcove, with Pinwheel Carrels
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educational institutions for couples, and this may help to make the areas quieter, rather than otherwise.

Small areas in a book stack called oases have been used in Princeton University and elsewhere, but unless individual seating with partitions is arranged, they may become trouble spots. Large stack oases, occupying the space of the full module or perhaps more, can be used to advantage in a very large stack to break the monotony. Individual seating, special lighting, and perhaps a carpeted floor may be indicated.

Shelving

The volume capacity for a book stack can be estimated only roughly because of irregular volume sizes. Leaving that factor out of consideration, it depends on the square footage required for the average single-faced standard size section three feet wide overall and 7 feet, 6 inches high. (This height will give space for a protective base four inches high and seven shelves twelve inches on centers, plus an extra two inches at the top to make it easier to withdraw and replace books there.) The square footage required depends on these several factors.

1. The non-assignable space for stairs, lifts, and entrances should not exceed more than ten per cent of the total area, except in a very small stack, and in a large one less than that. It is not considered further in this statement.

2. Section or shelf depths with the commonly used bracket shelves are generally seven or nine inches "actual" or eight or ten inches "nominal." With the two inches left vacant in the center of a double-faced range, this means sixteen inches or twenty inches overall depth. The writer prefers in most cases to use eight-inch "actual" shelves with eighteen inches overall depth, and with the bottom shelves no wider than the upper ones. The bottom shelf is the critical point for light, for book trucks, and for squatting or kneeling users. Each additional inch depth of shelves, including that for the base, reduces the capacity by two per cent. A twenty-four inch base in a double-faced section reduces capacity by approximately twelve per cent below that for an eighteen-inch base, if aisle widths are uniform. The narrow base requires safety precautions to insure stability, but these are relatively inexpensive.

3. The stack aisle width should depend on the amount of traffic and the length of the ranges. The longer the range, the more often two persons will have to pass each other. A twenty-six inch aisle width is possible for closed access storage, and one of thirty inches is generous
even with very long ranges with closed access. Thirty-three inches with thirty foot long ranges will be adequate in a university library with large collections and access restricted to advanced students and faculty. Thirty-six inches can be called standard for a heavily used stack.

Range length is also of importance, and like aisle widths should vary according to use. Nine to fifteen feet may be long enough for ranges in a heavily used reference collection, and fifteen for an undergraduate collection. Thirty feet in length has generally been considered the maximum for university libraries but, with limited access and collections of one million volumes or more, can be extended to as much as forty-two feet. Great national libraries with closed access stacks have used ranges up to sixty feet in length satisfactorily when proper labeling is provided. Remember that range spacing with long ranges in a modular stack must be based on column spacing.

4. The final factor to be considered is the frequency and the width of the cross aisles at right angles to the ranges. Three feet (minus two inches for the uprights on each side) should ordinarily be considered a minimum; if the stack is large, a main cross aisle should be not less than four or four and a half feet. An aisle of five or six feet is generous, and the latter may be extravagant in space use. Remember that three feet is ten per cent of thirty feet, and an extra three-foot aisle cutting a thirty-foot range in two reduces capacity by ten per cent, and a six-foot wide aisle where a four-foot one will do is a factor worth keeping in mind.

In a modular stack the distance between column centers should be an exact multiple of the distance between the range centers. Of less but still of considerable importance, the clear distance between columns in the direction of the ranges should be a multiple of three feet, plus four inches to allow for any irregularity in the building columns and for the adjacent stack uprights.

In laying out a stack, remember to provide a simple arrangement for the books and the traffic. Avoid what might be called blind areas that interfere with the regular order of book shelving, and if small areas behind stairs or in corners are necessary, use them for special collections rather than for parts of the main collection.

Avoid odd-length sections as far as possible, as they will always be a nuisance. If, because of columns, odd length sections seem to be required from time to time, it may be preferable to use lecterns or consultation tables in their place.

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Narrow aisles reduce the available light on the backs of the books on the lower shelves. If fluorescent tubes are used and the ceiling height permits it, the intensity on the lower shelves can be increased by placing the light tubes at right angles to the ranges.

Watch out for places used to house oversize books; they may require deeper shelves and the aisles will be unduly narrowed. Suitable locations can often be found along walls, stairs, or elevators.

Remember that carrels, placed along a wall adjacent to a three-foot cross aisle, or used in place of the last stack section, are space savers.

With the above in mind, it should be repeated that the square footage required per single-faced stack section depends, if non-assignable space is omitted, on the depth of the shelves, the width of stack aisles and of the cross aisles, and the length of ranges. Figures 6 and 7 show examples and indicate also the effect of carrel seating along walls. Changes in square footage requirements result from a change in any of the dimensions. But it is fair to state that if non-assignable space is left out of consideration, 8½ square feet per single-faced section is adequate with what can be called standard university library spacing, but it is better to use between that figure and ten square feet for smaller libraries with heavy stack use. In figuring volume capacity per single-faced standard section, 125 books should be considered as working capacity, but that is another story which cannot be dealt with here.

Card Catalog Cases

In most libraries, the primary problem in arranging catalog cabinets or cases is the provision of adequate space for the readers at the time of peak load, rather than space for the cards, although this is too seldom realized. It is possible, in a very large library with millions of cards, to provide for 4,000 of them for each square foot of floor space in the catalog room. On the other hand, in a large university with a small collection 1,000 cards to a square foot is often all that should be installed. There are three space users to be kept in mind in connection with catalog case layout: the cases themselves, the consultation tables, and the aisles for access required by those who consult the cards. These will be considered in that order.

The cases vary widely in overall dimensions. The Widener Library Building at Harvard University has catalog cases holding over 500 trays, but these can be called "white elephants." In order to obtain flexibility, cases today are generally constructed in units 5 or 6 trays
Figure 6. Stack Layout
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Figure 7. Stack Layout

337.5 NET 30 SQ. FT. PER 40 SECTIONS 8.44 SQ. FT. PER SECTION

5'-0" SPACING

30'

287

270

CROSS AISLES = 1/5 AREA • HALF OF SIDE AISLE CHARGED TO CARRELS

[499]
wide and measuring from just over 33 inches to approximately 40 inches in width. The depths may vary from 12 inches up to just over 19 inches, although 24 inches is used occasionally, but the generally considered standard length is 17 inches. Whatever the overall depth of a tray, approximately 3 inches should be subtracted from it, because of the unusable space at the front and back, and then between 70 and 75 per cent of the remaining space will represent that available for storing cards before the drawers become so full as to be more or less unmanageable. One hundred cards to an inch of usable filing space is a safe figure to use. This will mean that a tray 17 inches long will house comfortably 1,000 cards \( (17" - 3" = 14" \text{ and } 14" \times 72\% = 1008) \), and one 19 inches long will house 1,150 cards \( (19" - 3" = 16" \text{ and } 16" \times 72\% = 1152) \).

The height of the case does not affect the floor space it occupies, but is an important factor in the amount of floor space required to house a given number of cards. Standard cases in the United States have generally been 10 to 12 trays high, but many colleges and universities have used and are using successfully cases 14 or 15 trays high. One with 15 trays will give 50 per cent greater capacity in the same area than one with ten. It is possible to buy cases in units, and those 10 trays high can be installed to start with and a 5-tray high case placed on top of it later. This may not look as well and will cost more per tray, but with careful design should not be too unsatisfactory.

One decision that must be made in connection with catalog case arrangements is whether or not there should be a sliding reference shelf in them at a suitable height for consultation. This is rarely to be recommended because its use will block the access to a good many trays above and below and at each side, and it will tend to be a space user, rather than a space saver.

Consultation tables on which the user of the catalog places the tray that he wishes to consult are almost always desirable. Again, there is the problem of their height, width, and length. Tables should rarely be more than 6 to 8 feet long, because it will make it too difficult to go around them to reach the trays on the other side. The width can be anywhere from 20 inches (or even less) up to 3 feet. Tables 3 feet wide can be used to better advantage from both sides at the same time than narrower ones, and sometimes should be selected if the use anticipated is very heavy. Thirty-nine inches used to be the standard height for consultation tables, but many libraries have found that 41 inches or 42 inches is preferable, as it prevents a tall person from leaning over the
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table or having his feet stick out behind him so far as to cause trouble. Experience indicates that persons no less than 5 feet tall can use a table 42 inches high with little inconvenience.

The third and greatest user of space in a catalog room is that for the aisles, those between the cases and the consultation tables, and also the cross aisles at right angles to the case ranges. The former can be as narrow as 2 feet, 6 inches where the cases are available only to the staff. Aisles up to 5 feet, 6 inches wide are not uncommon, but are unfortunate as they result in unused space and, of equal importance, the reader and the filer often object to carrying the tray to the consultation table and will often try to use it at the catalog where they will get in the way of others. For such aisles, 4 feet, 6 inches is generous, 4 feet, 3 inches is adequate, and 4 feet will not cause congestion if the consultation tables are not over 6 feet or 8 feet long.

In trying to arrange spacing for a large catalog in a modular building, note that two full ranges of catalog cases will fit in a 25 feet, 6 inch column spacing, giving 12 feet, 9 inches on centers for the cases. Thirteen feet, six inches, or two to a 27-foot column spacing, is generous; but two ranges of cases in a 22 foot, 6 inch bay will result in congestion, and it may be better to place three double-faced ranges in two bays of this size, giving 15 feet each. Twelve feet and nine inches will provide for the two cases that are each 18 inches deep, two aisles,

![Figure 8. Catalog Case Layout](image)
each 4 feet wide, and a 21 inch-wide consultation table (see Figure 8).

There is still the problem of cross aisles to be considered. There must, of course, be an adequate cross aisle at at least one end of the case ranges and preferably at both, if space is available. To two parallel ranges, it is possible to add a third range at right angles, making a three-sided alcove which will give larger capacity. Double rows of alcoves with cases on three sides and with one cross aisle are possible and provide the greatest space utilization (see Figure 9). However, this is recommended only with very large collections which have limited use.

![Diagram of catalog case layout for a large library](image)

Figure 9. Catalog Case Layout for a Large Library
Choosing Audio-Visual Equipment

WENDELL W. SIMONS

Great diversity and a rapidly changing technology make the evaluation of audio-visual equipment a difficult task for the average librarian. Most of us have neither the skill nor the means to conduct definitive tests on equipment being considered for purchase, so we must depend upon published specifications, a little common sense and, when available, the reports of organizations such as the Library Technology Project and the consumer services. The problem is compounded by a tendency among manufacturers toward planned obsolescence. This is more prevalent in the home-oriented product than in the education-oriented product, but where these markets overlap, for instance in tape recorders, record players, and slide projectors, the buyer will find a bewildering array of glamorized equipment. Fortunately, in these areas the buyer will also find the greatest amount of advice from the professional evaluators.

We are familiar with written programs for buildings. An expensive piece of equipment should also be "programmed" before purchase, if not formally on paper, at least mentally. Programming is the process of delineating what the equipment is to accomplish, what functions it must perform, and how its use is related to the general library operation. The next step, that of drawing specifications, is concerned with detailing the dimensions, the consistency and quality of materials, and the technical capabilities of the equipment. In planning buildings these two steps are distinct and each results in a formalized major document. In buying equipment we rarely formalize these steps but often merge them into a single mental process, perhaps giving too much attention to the manufacturer's specifications and neglecting the very important process of thinking out what we want the equipment to accomplish and why.

In programming a piece of equipment, one should consider such

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things as how large and how discriminating an audience it must serve, who will operate it, how often and in what surroundings it will be used, and how often it must be moved. Failure to consider these questions may result in equipment woefully inadequate or wastefully overadequate. Advertising claims are usually based on operation under ideal conditions; in programming try to allow for the least favorable conditions that might be encountered.

The need for portability should be considered carefully; the trend in the schoolroom is against it. A machine installed in a fixed position will last longer and give more trouble-free service than one subjected to constant moving. Fixed equipment means smoother operator performance as well. Power and sound connections will be properly in place; focus and volume levels will remain set from previous uses; spare and accessory parts will be near at hand. It is all too common in using portable equipment to discover at the last minute that some vital element, such as the power cord, has been left behind. However, a fixed machine that stands idle represents a wasted investment. While rule of thumb cannot cover every conceivable case, a machine used daily in one place deserves to be fixed if another can be acquired for portable work. Even two or three uses a week may be justification for fixed equipment.

Certain signs of quality design and manufacture are apparent even on the surface of a machine. Although perhaps akin to kicking the tires of a used car, a few simple observations of external detail can give a fair clue to what is within. Look for a carefully finished case. The halves should fit together properly, and the latches should meet and engage with accuracy. A metal body is certain to outlast a plastic one, and turned or cast metal parts will generally outlast those stamped from sheet metal. Try the control knobs and power switches; they should have a firm, smooth action. Power switches are notorious as the first part of a machine to break down. Use of a cheap part here may indicate shoddy design and workmanship elsewhere where it is less easily detected. There should be easy and obvious access to lamps and tubes. Motors should run smoothly and quietly. Projectors should always be wired to prevent the lamp being on without the fan. Better projectors will allow the fan to run while the lamp is off. Any projector will heat up during operation, but it should not become so hot that you cannot lay your hand on the lamp housing, at least momentarily.

When considering a machine to be operated by the public, or by a number of untrained staff members, simplicity of operation must be
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a primary determinant. If only trained operators are involved, then more elaborate, sophisticated, and delicate machinery can be considered. But added gimmicks and gadgets generally result in added operational difficulties and maintenance problems. Given two machines of comparable ability and quality, one with four controls will surely create more operator confusion and consequently require more maintenance than one with three controls. In fact, if you have a machine with an unnecessary control, you would do well to remove the control and blank off the hole.

In almost every case, some compromise must be accepted in the matter of quality. Few libraries can justify the finest theater-quality projection equipment or the finest broadcast-quality sound equipment. Rather a level of quality must be chosen that will most nearly satisfy the needs and expectations of the particular patronage within the limits of the particular budget.

These generalized considerations boil down to three basic rules of equipment selection which should be applied in this order:

1. Seek out a machine that will fulfill the particular requirements of your program.
2. If you find a choice, then choose the one that will be most durable and easy to maintain.
3. If there is still a choice, then choose the one that is simplest to operate.

Listening and Recording Equipment

Listening is the most common of audio-visual activities in libraries; certainly it has been most thoroughly covered in the library literature. In the establishment of a listening facility, several very basic programming decisions must be met head-on. Shall the equipment be phono or tape? Monaural or stereo? Turntable or changer? Loudspeaker or earphones? Staff-controlled or listener-controlled? Ready-made or components? Fixed or portable? A very carefully conceived program and specification for a language laboratory has been published by the U.S. Office of Education. This may serve as an excellent guide for the detailing of technical requirements in a complex facility, but be sure that the real needs of your particular users are being properly met.

There is an apparent trend toward more staff-controlled facilities, highly sophisticated machinery—ultimately becoming automated dis-
tribution systems featuring not only audio but also video material. Some academic libraries are taking the lead in developing such systems for the self-instruction of college students. A session of the 1964 Library Equipment Institute was devoted largely to this topic. The effectiveness of this electronic carrel approach has been well demonstrated in language laboratory operations, but it is not yet apparent that this degree of automation is the best approach to all study, nor especially to listening for pleasure. One sometimes suspects that staff convenience has taken precedence over users’ needs.

Mary Pearson has written a chapter on conventional listening equipment that contains a great deal of practical programming advice. In 1962 the Library Technology Project (LTP) published a definitive report on fourteen earphone record players. Although most of these models are no longer on the market, the testing methods described and the performance standards outlined remain very pertinent. A second study to evaluate a more current crop of players is under way. The most valuable portion of the LTP report may be, for many librarians, the clear, readable explanations of the various components that make up a record-playing system. A summary of the report appears in Consumer Bulletin. Other articles in the same magazine as well as in Consumer Reports are written in the language of the layman and cover the technical ground very thoroughly. It is interesting to note one recurring theme in the reports of all the professional evaluators—the quality of audio equipment is directly related to cost.

Tape recorders have not received as much attention in the library literature, but excellent articles can again be found in Consumer Bulletin and Consumer Reports. Cartridge-loaded tape systems are gaining favor; libraries contemplating a permanent collection of pre-recorded tapes would do well to investigate cartridge equipment. Cartridges are easier to handle and store than reels, tape wear and breakage are reduced, and the possibility of mix-up of reels or rewinding wrongside-out are eliminated entirely. Reel-to-reel operation is still the only practical mode for original recording and editing. Seven-inch reels are standard, but in working closely with a radio station you may find need for a professional model recorder accommodating ten and one-half inch reels.

A recorder used by the public for playback purposes should have its erase and record heads disconnected to eliminate the danger of accidental erasure. This is a simple operation, and the reconnection can be made at any time.
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In tapes, a bargain brand can be a bad bargain. In some cheap tapes, the oxide is poorly bonded to the plastic base and the result is rapid wearing of the oxide coating. This not only decreases the effective fidelity of the tape but, more seriously, damages the heads of the recorder. Recording heads must be kept clean and oxide accumulation watched closely. One recent development that overcomes this problem is "sandwich" tape, a tape with a thin layer of plastic over the oxide coating as well as behind it.

In both phonographs and tape recorders, do not be fooled by claims of "stereo." Some so-called stereo phonographs have only the wiring for a stereo cartridge but require a new cartridge and an additional amplifier and speaker to become a functioning stereo player. Similarly, some tape recorders have two sets of heads but only one amplifier and speaker system. A stereo machine must have two of each electronic component.

A good article on stereo headphones is found in Consumer Reports.\(^17\) In either monaural or stereo facilities, some listeners will prefer headphones to loud-speakers because of the aid in concentration or because they enjoy the heightened binaural effect possible through phones. With many headsets of good fidelity and great wearing comfort now on the market, a library need not be apologetic for providing headphone listening stations in lieu of sound-proofed loud-speaker rooms.

Developments in the electronic world are promising relief from that most despised of all technological monsters, the screeching public address system. Unidirectional microphones, at one time a luxury item, are becoming more and more available in the moderate and lower price ranges. Directional column speakers have been recently introduced that direct more sound into the audience area allowing less to spill back into the microphones. Use of these two directional elements is the best defense against acoustical feedback. Amplifiers featuring anti-feedback devices have not been particularly effective since the problem is essentially physical rather than electronic. The characteristics and proper placement of microphones and loud-speakers are the important factors.

Another new approach to loud-speaking may offer a solution to feedback. A small transducer, similar in structure and function to the driver of a loud-speaker horn, can be attached directly to a wall or ceiling thus making a speaker diaphragm out of the entire wall or ceiling surface. Sound seems to emanate evenly from the entire surface and can therefore be kept at a very low volume level. This device
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is barely out of the developmental stages and not yet proven but should bear watching.

Omnidirectional microphones are most useful for recording purposes where recording is not ancillary to a public address operation. They normally pick up from a hemispherical pattern and are ideal for musical ensembles or groups around a table. A technical explanation of microphone impedances is not in order, but generally speaking, low impedance microphones are higher in quality, fidelity, and price. They are appropriate for real high fidelity work and in situations where microphone cables run longer than fifty feet. High impedance microphones are more common and prove adequate for most purposes.

Visual and Projection Equipment

The trend in slide projectors is definitely toward remote-controlled, cartridge-fed equipment, yet the old hand-operated standards are still useful. If one 2" by 2" slide projector were all that the budget would allow, then a hand-operated model would be the only practical choice since tape-bound slides will jam any automatic and most cartridges will accept only a limited choice of the many metal and plastic mounts now available.

Excellent help can again be found in Consumer Bulletin \(^{18,19}\) and Consumer Reports.\(^{20,21}\) Explanations of the several levels of automation and the various common slide sizes are included along with technical evaluations. A fully automatic, that is a timer-activated, projector is probably of little use in a library or school situation. Remote control is of limited value unless focusing and reversing can be accomplished from the remote position.

If a library has a permanent slide collection which is organized and used in fixed sets, then the collection may lend itself to being stored in cartridges ready for use. In this case the cost of a large number of cartridges would become significant. If, on the other hand, slides are selected individually and used in differing combinations, storage in cartridges would be most impractical. Two styles of furniture are made for individual slide storage, vertical display racks and drawers resembling card catalog trays. The latter are standard items with some of the library supply houses. The display racks are designed to allow visual scanning of up to 120 slides at one time and this can be a distinct advantage over the drawer method. However, sliding the racks in and out of their cabinet tends to jiggle the slides behind one another or on to the floor. Drawer storage demands more detailed cataloging
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and marking; rack storage allows more casual organization of the collection.

Any slide projector intended for institutional use should accept a variety of lenses. A very desirable feature to look for is a provision for preheating the slides before they are fed into the optical path. This prevents the slides from popping out of focus. Although its use is becoming more rare, a well-equipped audio-visual service should have a 3¼" by 4" lantern slide projector. The larger format of the old-fashioned slide makes it well suited to homemade transparencies, such as silhouettes or cellophane cutouts, typewritten slides, or pencil and crayon drawings on ground glass. Slidemaking kits are available commercially.

Filmstrip projectors commonly come in combination with slide projectors. This is the one exception to the generalization that projectors which combine two functions usually do justice to neither. Filmstrip projectors are available as separate units, but unless a great deal of use warrants the single-purpose machine, combination with a hand-operated slide projector will prove more useful. The newer automatic slide projectors do not lend themselves to such combination. A filmstrip projector should be equipped to show both single and double frame images. Double frame is the size of the familiar 35 mm slide; single frame is half that size and is oriented across the width of the filmstrip rather than with the length of it. Commercially made filmstrips are always single frame, but it is very easy to make double frame filmstrips of your own simply by taking a series of pictures with a standard 35 mm camera and specifying that the exposed film be developed but not cut.

Be sure that the image area of the film, in passing through the projection gate, is not scratched or rubbed by any part of the projector; film guides and advance mechanism should touch only the perforated edges of the film. The advance mechanism should have a positive action, moving the film accurately one frame's length at a time. Some filmstrip projectors can be equipped with remote controlled advance; some can be controlled automatically by a tape-recorded signal.

Any kind of reader for 35 mm microfilm can be used as a filmstrip viewer. Conversely, a typical filmstrip viewer or projector, which is equipped with a sprocket advance, can show perforated, but not unperforated, microfilm. There are table-top filmstrip previewers with friction wheel advance that will accommodate any variety of microfilm.
Motion picture projector design has enjoyed many years of relative stability, but some radical changes are now occurring in the field. Xenon projection lamps have been developed that yield a light intensity and quality comparable to that of carbon arcs. These can be adapted to some standard movie and slide projectors for auditorium usage where the common incandescent lamp has been found wanting. While the equipment cost of a xenon installation is comparable to that of carbon arc, the operating techniques are far simpler and the safety requirements less stringent. A seventy-foot throw is recommended as the maximum for the best incandescent projection systems; xenon promises to solve the problem of amateur projection in larger spaces.

Eight millimeter has the potential to do to the sixteen millimeter market what long play records did to the 78 r.p.m. record. A sound-on-film 8 mm movie camera and companion magnetic playback projector have brought sound to the more economical film size. The spread of the medium has been slow because of the chicken-and-egg positions of the equipment buyers and the film producers. Neither party cares to move until the other has committed itself. However, the 8 mm field is sure to mature in time, and many schools and libraries will find a greater wealth of filmed information available within a smaller budget. Another interesting development in 8 mm is the cartridge-loaded automatic projector. This has already been put to good use in a library situation for self orientation. The cartridge is sealed, snapped into place with no threading, and has been demonstrated to be even child proof. The system, thus far, is limited to silent film in four minute repeating clips.

Standard 16 mm projectors are now available with self threading. This should prove extremely useful where many inexperienced people must handle equipment. If you are considering a manually threaded machine, check the complexity of the threading path and the clarity of the instructions. An automatic loop-setter is an essential accessory if not supplied as a standard fixture. Projectors come in two basic reel configurations—both reels overhead, front, and back; and both reels in front, top, and bottom. The latter type must be used at the front edge of a table and may be difficult to set up in a booth situation.

All major makes of sound projectors will show silent film as well as sound film so there is little need to consider a silent 16 mm projector unless time-and-motion-study, stop-frame features are required. Both optical and magnetic sound systems are available from most manufacturers. Commercially made sound films have optical sound tracks,
but with a magnetic projector you can add and edit your own sound track on specially prepared film. Many projectors come equipped to use as a public address system; for this purpose they will probably be inferior. You will definitely want a speaker that can be separated from the projector case for all but the very smallest audiences.

Of all projector types the opaque is the least efficient, since light is reflected from the surface to be shown rather than projected through a transparency. Because of this inefficiency, room darkening is a very critical problem and a 1,000 watt bulb is mandatory for good results. So intense a heat source can curl or scorch a book page, particularly the hard-surfaced papers found in expensive picture books. Cooling systems must, therefore, be looked at rather carefully. Opaques are large, bulky, and awkward to handle; attempts to make them more compact have not been notably successful. With a reducing attachment, an opaque can be a tremendous aid in copying pictures, maps, and charts for display purposes.

Overhead projectors are coming into widespread use by lecturers in education and industry. The trend has been boosted by the development of "instant" transparencies made on many standard photocopy machines. By means of photocopy, the overhead can now do much of what only the opaque could formerly do. The growing popularity has brought a wide variety of good machines on the market, which are more compact, simpler to operate, and lower in price. The most useful size is the ten inch by ten inch. Smaller sizes should be considered only if ease of portability is really important.

The chief advantages of an overhead projector are that it is operated by the lecturer at the front of the room and that it can be used without regard to room darkening. It is commonly used as a "blackboard," and colored inks, overlays, and motion gadgets have been developed for it. Attachments have been made for showing slides and filmstrips on an overhead, but these are not as satisfactory as the standard slide and filmstrip projectors. Overheads generally are focused by raising and lowering the lens head by means of a rack and pinion gear. Try this focusing adjustment for firm, sure movement and check its ability to hold its position on the rack without slipping.

Four kinds of projection screen surface are in general use: matte white, beaded, plain aluminized, and lenticular. Matte screens are a flat white color on an untextured surface and give extremely even reflectance over a very wide angle. Beaded screens will deliver up to twice the brilliance of a matte in the axis of the projection, and a plain
aluminized or silvered screen up to three times. Both these types, however, fall off rapidly in brilliance as you move away from the center line. At about thirty degrees, they are the equal of a matte and beyond thirty degrees both continue to fall considerably below the matte standard.

Lenticular screens are characterized by geometric patterns impressed in a fabric surface. These spread the reflected light over a wide horizontal angle while reducing the wasted reflectance toward floor and ceiling. While somewhat less brilliant on the center line than the best beaded screens, a good lenticular will outperform any other type from twenty degrees and beyond. A screen performance test is easily conducted; line up sample screens or fabric swatches together so that a common image can be projected on all of them simultaneously. With the naked eye you should be able to judge which produces the best result across the width of the particular room as you walk back and forth in front of them.

For general audio-visual use, a square screen is far better than a rectangular. Opaque, overhead, and the smaller slides require the square format, and these media should be considered even when equipping a large hall primarily for movie showings. Motorized roller screens longer than fourteen feet are normally available only in non-flameproofed material because the added weight of flameproofing causes the longer rollers to sag. For large installations, a flat screen mounted in a pipe batten is the easy solution if there is loft space above the stage. If not, then the problem should be taken to a theatrical supply house rather than to an audio-visual dealer.

The use of rear projection screens is becoming widespread in installations such as the central projection facility at the University of Miami. A comparison of rear and front screens indicates that the rear screen offers many operating advantages. (Staff convenience again?) Rear screens, however, cannot be viewed from as wide an angle and it is much more difficult to attain a large image. Both of these factors limit the effective audience capacity. Subjectively, at least, rear screen projection seems harder on the eyes. A design team of the Battelle Memorial Institute summarily rejects the rear screen as inferior in microfilm readers.

A long-time standard for projection screen sizes, one-sixth as wide as the maximum viewing distance, has been reaffirmed by recent research. Interestingly enough, projector manufacturers have never standardized their lens sizes to this ratio. Normally, 16 mm movie pro-
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jectors are supplied with a two-inch lens; this produces a six-foot picture at thirty feet, a five-to-one ratio a little better than the standard. At the same distance a 2" by 2" slide projector requires a seven-inch lens, yet the lens commonly supplied is four or five inches. Under the same conditions, filmstrips require a five-inch lens, 3½" by 4" slides a fifteen and one-half inch lens, and 2½" by 2½" slides a twelve-inch lens. Proper choice of lenses will obviate the problem of placing projection tables in the middle of an audience. Overhead projectors, of course, are intended for use at the front of the room and opaque projectors must be used somewhat near the front. A lens of incredible length would be needed to use an opaque from the back of a normal classroom or lecture hall.

Related to image sizes, the Army uses a minimum standard of one-inch lettering to be viewed from thirty-two feet, two inch lettering from sixty-four feet, etc. This is supposed to allow for less than perfect vision.

Projection carts are of two major types: the four-wheeled table and the two-wheeled hand cart. The choice depends on local geography. Travel over longer distances, up and down stairs, curbs, or ramps calls for the hand cart. These will have larger wheels (and the bigger the better) and may be tipped for easier maneuvering over vertical obstacles. The table type will be more useful within a building with even floors and elevators. Either should be capable of carrying two major items of equipment at one time plus accessory items in some kind of rack or shelf. Table carts can be purchased with a dual electrical outlet and extension cord built-in. This is a real convenience, and could be added to the hand cart variety rather easily. No rolling stand is better than its wheels. Check them carefully to see that they turn and swivel easily.

In designing facilities for projection, be sure that images will clear the heads of the front-row audience. Include conduits front to back to carry movie sound and slide changer cables; other conduits may be desired for public address wiring. In a stepped or raked hall, under-floor conduit is an absolute necessity; cables cannot be strung down stairs. Light and screen controls should be duplicated front and back. Any hall rating a sloped floor also rates an electric screen. Specify the type that has an automatic cutoff at the full-up and full-down positions. Enclosed projection booths are not particularly appropriate or useful until audience capacity goes beyond 200 or 300. They often become a nuisance in a small situation, especially if portable equipment is
moved in and out frequently. There are some excellent recent studies on designing audio-visual facilities.31-34

Librarians, historically, have had little hand in the development of audio-visual equipment; they have adopted standardized equipment from the schools and industry. Humboldt Leverenz and Malcolm Townsley, writing separately on the topic The Design of Instructional Equipment, came to the same conclusion—there needs to be closer communication between the user and the designer of audio-visual equipment.35 By analyzing program requirements carefully, librarians may be in a position to inform manufacturers of the shortcomings of ready-made equipment and perhaps shape the development of more useful machinery.

Among the dozens of texts and handbooks in the field of audio-visual education, James Finn's Audio-visual Equipment Manual36 is recommended as most useful for understanding the functioning of optical and electronic devices on a quasi-technical level. The diagrams of particular makes and models are now outdated, but the basic information remains valid. A more up-to-date text by James W. Brown, Richard B. Lewis, and Fred F. Harcleroad has an appendix treating the same kind of information in briefer form.37

The best guide to current equipment is the Audio-visual Equipment Directory,38 an annual publication. It covers every conceivable category of audio-visual device, even to television and teaching machines, with a photograph, performance specifications, price, weight, and accessory list for each item. Appendices list furniture items, graphic materials, miscellaneous accessories, projection lamp specifications, and trade names. New equipment is described each month in a special section of Educational Screen and Audiovisual Guide,39 and free literature is also noted. Some of these new items may appear in the “Products and Equipment” department of Library Journal40 or the “Goods and Gadgets” department of the ALA Bulletin.41

The audio-visual press is full of evaluative information on films, filmstrips, recordings, and all varieties of materials. Reams have been written evaluating the usefulness and importance of various A-V devices, but there is virtually nothing in print evaluating equipment per se except in the popular consumer magazines and the Library Technology publications. Use these as a guide and then kick the tires.
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