PLANNING COLLEGE GEOGRAPHY FACILITIES: GUIDELINES FOR SPACE AND EQUIPMENT

Robert Stoddard
University of Nebraska - Lincoln, rstoddard1@unl.edu

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PLANNING COLLEGE GEOGRAPHY FACILITIES
GUIDELINES FOR SPACE AND EQUIPMENT

Robert H. Stoddard
University of Nebraska

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A CONSULTING SERVICES PUBLICATION
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COMMISSION ON COLLEGE GEOGRAPHY

The Consulting Services Panel of the Commission on College Geography has sponsored a series of papers designed to assist individuals and departments interested in improving undergraduate geography programs.

To date, no systematic guidelines for planning geography department space and facilities have been published. The present volume should fill a long-standing need for those contemplating new or expanded departmental programs and facilities. Further, it should respond to the on-going needs of every department especially in today's educational world of ever-changing teaching strategies, learning approaches, and innovative educational technology.

The reader is also advised to examine the complete listing of CCG publications on the inside covers of this volume to augment and complement the information presented by Robert Stoddard.

This publication and four others (Geography as a Discipline, Sources of Funds for College Geography Departments, Community Internships for Undergraduate Geography Students, and Guidelines for New Program Development) have been designed especially for those contemplating the development of undergraduate geography programs.

Consultants making on-site visits or conducting group consulting activities should find these publications useful in their work. In addition they might serve to inform the academic community of the specific and peculiar program, space, and equipment requirements for geography.

These papers are developed, printed, and distributed by the Commission on College Geography under the auspices of the Association of American Geographers with National Science Foundation support. The ideas presented in these papers do not imply endorsement by the AAG. Single copies are mailed free of charge to all AAG members.

John F. Lounsbury
Arizona State University
Project Director
Commission on College Geography

Lawrence M. Sommers
Michigan State University
Chairman, Panel on Consulting Services

Panel Members
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John F. Lounsbury, Arizona State University
Salvatore J. Natoli, Association of American Geographers
Harold M. Rose, University of Wisconsin-Milwaukee
PREFACE

Change pervades the content, organization, and technology of education. The rapid expansion of knowledge and the proliferation of tools utilized to gain understanding require continual alteration in the content of college courses. Changes in curricular organization result from varying societal demands and new approaches to education. The many technological aids available for presenting ideas to students stimulate other transformations. Added to these educational modifications are those caused by increasing enrollments of college students and the aging of existing facilities.

These forces of change exert tremendous pressure on the physical facilities of a college campus. Old walls should not restrict nor suppress new ideas. This means that proper planning of space utilization is essential if the physical facilities are to maximize their support of the educational program. Every college department is obliged to assess periodically its educational objectives and the procedures for achieving those objectives. This assessment must include the supporting physical facilities.

The necessity for program evaluation is especially great for a geography department because of the shifts occurring within the discipline. A few illustrations of recent changes are the greater emphasis upon methods for solving spatial* problems, the organizational shift to more thematic problems, utilization of computers and related hardware, and the tremendous increase in the availability of locational and environmental data resulting from satellite and remote sensing technology.

This publication is written as a guide for evaluating and planning the space and equipment available for geographic education in an undergraduate college. The objectives are:

1. to present ideas about potential facilities for various kinds of geographic programs;
2. to provide information to administrators and architects about special space and equipment needs of geography; and
3. to serve as a guide for geographers planning new (and remodeled) facilities.

It is hoped that readers may gain ideas about potential facilities for geography. No "ideal" departmental plan is presented because there is no one such plan for all departments. The use of space and equipment is a function of a department's approach to learning, curricular mix, size, relationship to other facilities in the college, and other factors (several of which are discussed in Chapter I). For example, small colleges that combine geography with other disciplines may not want to design a separate room for cartography; yet basic cartographic facilities might be provided by using portable drafting surfaces in a general room containing tables. This publication suggests kinds of space and facilities that might aid in various aspects of geographic education; each geography department must decide upon its priorities and ways to create its own "ideal" facilities.

Geography has special needs. This must be emphasized for the benefit of administrators, architects, and others who may be less familiar with the characteristics of the

*The term "space" may confuse some readers unless they think about its different usages. For the geographer, "space" normally refers to earth-space and the locational (or "spatial") arrangement of phenomena on the earth's surface (i.e., outside of buildings). For the facilities planner, however, "space" usually applies to room-space and the availability of area within buildings. Although room-space is the dominant reference in this report, both usages occur within the text.
discipline. The rapid change occurring in most facets of education makes it difficult for persons to keep informed about shifts in several fields; thus many non-geographers are unaware of the methods and equipment utilized by geographers. It is essential that geographers and professional planners communicate with each other about educational specifications prior to designing specific physical facilities.

Many geographers at some time become involved with designing new college facilities. In some cases college administrators may initiate a plan for altering physical facilities that include geography, so geographers will be asked for recommendations; in other cases members of a geography department may wish to propose the improvement of facilities. In either situation geographers with limited experience in planning and designing may be given responsibility for making a multitude of important decisions about new space and equipment for their department. Some planning procedures, sources of information, and kinds of problems confronting those who design educational facilities are discussed for the purpose of guiding geographers faced with the planning task.

Ideas contained in this publication about space and equipment originated in many geography departments in United States and Canada. Numerous geographers who have been involved with planning geography facilities volunteered suggestions and expressed a desire for collective information about planning decisions. Merle C. Prunty and C. Bradley Fay were especially generous with their time and contributions. Responsibility for reporting on specific geography facilities, however, rests with the author and does not necessarily constitute an endorsement by all contributors.

The author is grateful to J. Sutherland Frame, Richard E. Lonsdale, Salvatore J. Natoli, and Lawrence M. Sommers for their suggestions about the contents of this publication.

Robert H. Stoddard  
May 1973
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I. BASIC CONSIDERATIONS PRIOR TO PLANNING NEW FACILITIES

Several basic considerations precede the decision to construct new or remodeled facilities. One group of these pertain to the special space and equipment needed for geographic education; the other concerns a careful assessment of these needs as they apply to the local situation. Both groups are reviewed in this chapter.

The Special Needs of Geography

If one were to ask a group of professional geographers to define their discipline, several definitions might be proposed. However, most would incorporate ideas contained in the statement offered by the Committee on Geography for the National Academy of Sciences—National Research Council:

Geography (is) the study of spatial distributions and space relations on the earth's surface . . . It seeks to explain how the subsystems of the physical environment are organized on the earth's surface, and how man distributes himself over the earth in his space relation to physical features and to other men. . . . Geographers believe that correlations of spatial distributions, considered both statistically and dynamically, may be the most ready keys to understanding existing or developing life systems, social systems, or environmental changes.1

Despite varying emphases, geographers are united in their concern with spatial distributions of phenomena on the earth and with explanations for these areal patterns. These concerns produce special requirements for the physical facilities utilized by geographers.

It is obvious from this definition of the discipline that maps are essential for geographic understanding. Earth locations, the basic elements of study, occur in two-dimensional space, so the symbolization of locations also must be represented in two dimensions. Furthermore, most investigative steps taken to gain geographic understanding (e.g., collecting data by earth location, analyzing areal information, and formulating generalizations about spatial relationships) may depend upon accurate maps. It is this pervasive dependence upon maps, or areal representations, that creates distinctive requirements for geographic facilities.

Moreover, it should be noted that frequently several maps must be viewed at one time to establish relationships among several phenomena. Rather than examine a single element in laboratory isolation or relate a series of events sequentially, geographers investigate a set of occurrences in their areal situation with other sets of phenomena in their two-dimensional spaces. Reliance on multiple maps creates special space needs not encountered by other social sciences (with which geography is usually associated). In effect, some geographic activities may resemble those in other college departments utilizing visual displays (e.g., art, landscape architecture, urban design), while other kinds of activity may require the measurement and representation of the earth environment (e.g., movements of air masses, erosional action of running water) in laboratories. These similarities with the visual arts and earth sciences means that the space needs of geography usually exceed those of other social and behavioral sciences.

Dependence upon maps for gaining geographic knowledge applies to several different learning situations. In lectures, the map is absolutely essential. It is almost impossible to communicate verbally facts about a large number of earth positions. To appreciate this truism, one should imagine the learning difficulties if an instructor attempted to describe the locations of all elements in a distribution (e.g., by listing the street address of each medical center in Chicago). Even if students were able to visualize mentally the areal distribution of one phenomenon, they must know the spatial patterns of several other phenomena to gain insight into reasons for its locations. Obviously this dependency upon the use of maps that actually show spatial distributions requires facilities for map displays.

Another learning situation takes place in study areas when students search for new geographic relationships through individual inquiry. Geographic research often requires the assemblage of many spatial data, so facilities are needed for comparing several maps and other representations of earth space.

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Making maps is a third type of learning activity in geography. This may involve learning basic cartographic skills of constructing base maps and representing areal data. Frequently, maps are drafted for classroom use or for term papers, reports, and other scholarly purposes. These drawing activities require special building space because maps are normally larger than the size of regular notebook and typing paper, which are the principal resources for many other disciplines.

When maps and other spatial representations are not being constructed, studied, or displayed they must be stored. Storage space must be well organized for rapid retrieval, constructed to prevent environmental damage, and varied for several sizes of maps, globes, and other spatial models. Usually there is need for the storage of (1) several series of flat maps, (2) fragile, three-dimensional relief models, (3) long, rolled wall maps, (4) bulky globes, (5) maps on slides and transparencies for projection, and (6) series of air photos.

Another special consideration when planning geography facilities is the breadth of concerns and methodologies. Rather than studying the functioning of only one group of phenomena (e.g., animals, water, societal groups, or economic activities), geographers may deal with the spatial aspects of many phenomena. Furthermore, the diversity of methodologies (i.e., direct field observations, interpretations from maps and remote imagery, statistical analysis) means a greater number of different facilities in geography departments than in many other departments. The facilities for a complete geography department include those required for the social sciences plus some essential for the natural sciences.

The need for several different kinds of facilities results from more than interests in various phenomena per se; it derives from the geographic concern with spatial interrelationships among phenomena. For example, one geographer may include the location of high quality water as an explanatory variable for the distribution of certain manufacturing plants; another may find that the location of industry influences the distribution of high-quality water. Both require facilities that allow them to study the spatial aspects of natural and social phenomena.

It is important that geographers communicate the nature of the discipline to planners and administrators so that space and equipment requirements are understood. With this foundation of general understanding, specific facilities can be planned for a particular college.

Tailoring Needs To The Local Situation

Some basic facilities are required by all geographers, but several kinds of space and equipment apply only to specific geography programs. This makes it necessary for the geographers in each college to decide what physical facilities are mandatory for their own educational program. The close functional relationship between physical facilities and the educational objectives should stimulate a periodic assessment of both the physical plant and the curriculum. As curricular revisions occur, then the use of academic spaces normally should change; thus, these assessments must coincide with the rate of change in education. It has been estimated that the use of spaces in colleges changed once every 25 years between 1900 and 1950, once every 12 years between 1955 and 1965, and from 1970 to 1980 "it appears that the space will change in use in less than seven years." No automatic procedure answers the question about the necessity of a physical renovation. Score cards and similar check lists have been developed for use in evaluating space needs, especially in elementary and secondary schools, but these have limited value for college geography departments. A check sheet tailored especially for evaluating the facilities in a specific geography department is better than copying the check sheets produced for other situations (Figure 1). Geographers should have no difficulty creating evaluation sheets for their own department after clarifying their educational objectives and reading the suggestions in this publication.

Several factors must be considered when assessing facilities. Factors, which should be evaluated in terms of the current educational activities and the anticipated program for the future, are (1) condition of the existing building, (2) the size of classes, (3) the type of college, (4) the departmental role, and (5) teaching techniques.

Condition of Existing Building

Decisions about retaining the building that houses the geography department may be made at a non-departmental level. Condemnation of a building probably would be made at a municipal level, and capital improvements that are part of a comprehensive campus plan might be made initially at an administrative level. If such is the case, the geography

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2 This interdisciplinary approach is not restricted to geography; many college programs dealing with the relationships between man and his natural environment, e.g., environmental studies, possess an important geographic component.
EVALUATION OF A GEOGRAPHY CLASSROOM USED FOR LECTURING

Building __________________________ Room No. __________ Seating Capacity __________

Each characteristic is rated by encircling one of these categories: Very poor (VP), poor (P), average (A), good (G), very good (VG), or not applicable (N).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>VP</th>
<th>P</th>
<th>A</th>
<th>G</th>
<th>VG</th>
<th>N</th>
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</thead>
<tbody>
<tr>
<td>Proximity to other geography rooms</td>
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<td>Accessibility for handicapped students</td>
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<td>Temperature control, including air conditioning</td>
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<td>Sound control: general acoustics</td>
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<td>Quality of P.A., if used</td>
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<td>Freedom from outside noises</td>
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<td>Light control: general lighting conditions</td>
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<td>Accessibility of switches</td>
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<td>Effectiveness of darkening room</td>
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<tr>
<td>Comfort of seats</td>
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<td>Quality of writing surfaces</td>
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<td>Hanging space and hooks for wall maps</td>
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<td>Amount of chalkboard</td>
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<tr>
<td>Amount of tackboard</td>
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<tr>
<td>Visual aids: variety of installed projectors</td>
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<td>(List projectors: ______________________________________)</td>
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<td>Location of stands and outlets</td>
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<td>Quality of projection screen</td>
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<td>Facilities for remote operation</td>
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<td>Quality of television reception</td>
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<tr>
<td>Other comments.</td>
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</tbody>
</table>

Figure 1: Sample check sheet for evaluating facilities.
department may not be required to make decisions prior to the planning stages.

Many times, however, it is advantageous for geography faculty to take the initiative and consider the condition of the existing facilities and their possible renovation. Renovation decisions may vary from minor space changes to major structural alterations, or they may even consist of no renovation while waiting for a new building. Usually the decision depends on a cost-benefit analysis covering a stated number of years. As a general guideline, architects have stated that buildings constructed prior to 1900 should be replaced, but those built between 1900 and 1920 may be modernized satisfactorily, and many erected since 1940 can be renovated effectively. Many exceptions to this general rule exist, for example, a pleasing and efficient modernization of a fine old campus landmark. Contemporary architectural thinking stresses making a greater effort to modernize older buildings than in the past. Many structurally sound buildings have "wasted" space in large corridors and poorly arranged rooms, all of which can be more effectively used by judicious designing. Sometimes the renovation of an existing building provides more total space in which new facilities can be constructed than would be the case when a department must justify every square foot planned for a new building. Since modernizing alterations can usually be accomplished for less than 60 percent of the costs for a new building, a department may find renovation a tempting solution. This choice may be even more attractive when construction budgets are limited, because remodeling can be achieved in stages with small expenditures.

Compared with the advantages associated with renovation, other circumstances may make remodeling an unsatisfactory solution. Existing structural constraints may prevent the optimal arrangement of new facilities. Furthermore, the initial cost of constructing new spaces, whether in new or old buildings, should not obscure the differential in the annual cost of maintaining and operating new and old buildings. The president of the Educational Facilities Laboratory said in 1967:

The million-dollar building you build today will require a total operating budget of about $1 million every three or four years (the ratio in hospitals is two to one). If you impute a life of 60 years for the building, the cost of the building itself amounts to about 6% of the total cost of rendering the services for which the building was built in the first place.8

Certainly no college wants to "save" on construction costs by renovating an old building if these "savings" are consumed within a few years by higher maintenance costs on the building and by larger educational costs resulting from inefficient use of facilities. The Research Council of the Great Cities Program for School Improvement has observed that if the estimated cost of modernization approaches 50 percent of the estimated replacement cost the old building generally should be replaced.9 Again, it should be noted that this generality, which is restricted to cost considerations, does not cover aesthetic, historical, and similar qualitative ingredients of the decision.

Size of Classes

Another factor affecting the assessment of physical facilities is the size of classes, both present and those predicted for the future. In general, as the number of students increases, the demand for space increases. It would seem that a department would always realize when a shortage of classroom space occurs, and this would indicate additional facilities are needed. However, the decision is usually more complex because space requirements for students vary greatly with teaching techniques. For example, a change from lecturing large classes to providing individualized instruction might drastically alter space needs.

The magnitude of the problem is partly a function of predictions about future enrollments. Methods for estimating student populations are not considered in this publication because it is assumed that each college has a comprehensive plan that includes projections for future student populations. Each department can estimate its anticipated size proportionally with adjustments for curricular changes and similar factors that affect student choices of classes. In any case, projection of future student numbers should be made prior to the date when existing space is filled. The conversion of these student numbers into space requirements is discussed in Chapter II.

The solution to a problem of packed classrooms may not necessarily be sought through immediate construction, though. There may be many other ways that "i" instructors can teach "s" students in "c" classes than under present conditions. Teaching more sections with more instructors is one way; teaching during hours of the day or week when

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8 Harold B. Gores, "The Crucial Years are Now," in Planning Community Junior College Facilities, eds. Parker and Smith, p. 4.

campus classrooms are less crowded may be another possibility. Reorganizing the course offerings may allow combinations and separations of former classes into ones that utilize existing facilities more efficiently than formerly.

**Type of College**

Evaluation of existing facilities and prospects for future departmental needs will reflect the total college situation. The educational facilities of a two-year college will differ from those of a four-year college, and those of four-year colleges probably will differ if graduate studies accompany the undergraduate program. Normally, the size of a college is related to its physical plant, so one would logically expect the assessment of facilities in a college of 1000 students to differ from that in a college with 30,000 students.

In addition to size differences, institutions of higher learning possess contrasting emphases. Colleges vary from residential to commuter, from tax-supported to private, and from liberal arts to professional and technical. Emphases may be manifested in the combinations of departmental divisions and courses offered. In a two-year technical college there may be demand for geographic courses in traffic engineering, regional development, and market-area analysis; in a four-year college emphasizing teacher training the geography courses may focus upon principles of spatial behavior and upon strategies for communicating geographic concepts. As the demands for the supportive facilities vary so will the evaluation of existing space and equipment.

**Departmental Role**

Compounded with the variance in collegiate emphases is the wide range of departmental roles within colleges. In some colleges geography is non-existent; in others it consists of a few courses and geographers combined with other disciplines in a broad institutional division; and in many it exists as a distinct department. Although the terminology might imply that this publication applies primarily to colleges where a separate department of geography exists, many suggestions about space and equipment are equally relevant to situations where the geography program is more limited.

Even where the department functions as a separate entity, the manner in which facilities are shared with other departments will vary. For example, are any classrooms designated exclusively for geography, or must the department adjust its educational program around the schedules of others? Is the college collection of flat maps housed with the geography department, or are maps part of the general library? Is there a separate departmental library, or are all library geographic materials kept with the campus library?

Are there audiovisual tutorial (AVT) laboratories for each department (e.g., one for foreign language and one for geography), or is there a main media center for all departments using electronic teaching systems?

Similar questions can be raised about the services the department may provide for the campus community. If the only collection of flat maps on campus is kept in the geography department, basic facilities for consulting and using the maps must be furnished. In some colleges, cartographic services are provided to the students and faculty by the geography department. Similarly, other departments on some campuses may depend upon the geographers for meteorological and climatic data. Additional special services offered by the geography department will require appropriate space and equipment, and the existing facilities must be assessed accordingly.

**Teaching Techniques**

Changes in student enrollment, college specialties, and departmental responsibilities are normally well studied by college administrators, so evidence of unsatisfactory facilities is usually easily perceived. In contrast, when changes in teaching techniques are attempted they may receive little public attention and not be realized by other college personnel outside the department. This places great responsibility upon geographers to clarify the relationship between changing educational techniques and the demand for altered physical facilities.

Because physical facilities exist for the purpose of supporting an educational program, changes in educational techniques and organization often require appropriate modifications in the physical facilities. Even new buildings with the proper number of square feet per student may become obsolete when they no longer effectively serve the educational objectives. For this reason each department must consider its basic teaching techniques as integral to its assessment of physical facilities.

Teaching techniques may vary with student backgrounds, subject content, kind of learning process, abilities of the instructor, size of space, and available equipment. A discussion about relationships between the learning processes and spaces can illustrate some variations in teaching techniques. If learning processes are grouped into three kinds (reaction, interaction, action) and space is categorized into three types (large group, small group, individual), the nine resulting combinations form a basis for considering the relationship between these two variables (Figure 2).

Reaction learning happens when a student reacts or responds to information presented by some other person. Traditionally, this occurs in an auditorium or classroom where the instructor lectures to a large group. The purpose is expository, so the space and equipment should be

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1 The term "college" in this publication applies to all institutions of higher learning irrespective of their official designation.
**KINDS OF SPACE**

<table>
<thead>
<tr>
<th>Kinds of Learning</th>
<th>Large group space</th>
<th>Small group space</th>
<th>Individual space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction</td>
<td>Observing lectures in auditoriums and large classrooms</td>
<td>Watching film and TV in small classrooms or other campus areas</td>
<td>Operating AVT equipment in carrels or at study desks</td>
</tr>
<tr>
<td>Interaction</td>
<td>Participating by using electronic response systems in auditoriums or large classrooms</td>
<td>Discussing during seminars held in small classrooms</td>
<td>Operating computer assisted instruction in carrels</td>
</tr>
<tr>
<td>Action</td>
<td>Engaging in internship program (but no special space needs)</td>
<td>Learning cartographic and map-reading skills in laboratories</td>
<td>Developing and researching projects in laboratories</td>
</tr>
</tbody>
</table>

Figure 2: Kinds of learning spaces.

designed accordingly. Students must be able to see and hear easily with a minimum of distractions. The instructor should be able to present a variety of audiovisual materials without problems in manipulating the equipment and the display surfaces. In some cases the presentation may be carefully assembled and televised on tape for subsequent use in the classroom.

Lectures can be presented to huge audiences because television and associated equipment amplify even weak sounds and magnify small objects. Technically, the lecture method can apply also to very small classes (i.e., small group space, Figure 2), but the costs of education tend to impose a minimum number of students per lecturer. Therefore, reaction learning in small groups can be achieved more economically by having a technical staff show films or television tapes to students assembled in a small classroom, a dormitory commons room, or other campus areas.

If materials are available for the student to view individually, learning space may be reduced to the size of a desk or carrel. Furthermore, depending upon the nature of the auxiliary equipment, the locations of these individual spaces need not be confined to "classroom" buildings. Although equipment involving the synchronized operation of cassettes and projectors is usually placed in well-equipped carrels, materials presented through a simple teaching machine can be studied almost any place.

Interaction learning involves an exchange of information with other persons. Normally this occurs best in small groups where each student has the opportunity to interact with any other member of the group. This is commonly achieved by designating seminars and discussion sessions as part of the academic program. For some discussion topics the physical facilities required are minimal, so a lounge area any place on campus might be sufficient. Most geographic topics, however, create a demand for examining maps, which require display surfaces.

Ideally, learning through interaction occurs in groups where the potential is large enough to generate many paired discussants but not so large that it is impossible for most members to participate. These restrictions normally exclude large-group academic discussions. However, an instructor can obtain feedback from a large class of students by using an electronic response system that permits instantaneous replies from each seat. This allows the instructor to adjust his presentation during the class period guided by student responses, so it contains some learning elements achieved through discussions.

Interaction between an individual student and an instructor may occur on a log, in the instructor's office, or over a coffee table. Educational costs restrict the amount of learning scheduled in these situations, so substitute ways must be considered. The development of computer assisted
instruction (CAI) utilizing remote terminals is one technique. In contrast to the audiovisual tutorial method that presents a single program of materials for all individuals, CAI provides the capability for adjusting or "responding" to individual learning patterns.

Action learning is acquired by doing something that produces a skill or knowledge. A variety of activities and associated spaces aid in self-initiated learning. Areas where students can develop individual projects (e.g., terrain models, computer simulations, teaching materials) and adequately equipped laboratories available for student research can stimulate and challenge the inquiring student.

Acquiring cartographic skill is usually achieved in small groups working in a cartography laboratory, although part of the instruction may be individualized. Similarly, learning to interpret maps, air photos, and other imagery is often learned in small groups where emphasis is placed upon practicing interpretive skills.

The last combination (shown in Figure 2), which deals with action learning by large groups, does not pertain to geographic needs as much as the other eight combinations. Very few geographic skills require group activity within a large room. Possibly internship programs illustrate action learning by students while serving in group environments; but these seldom require special on-campus facilities.4

Relating kinds of learning with certain building spaces should not be interpreted as restricting teaching techniques to single-use areas. Most instruction employs a variety of strategies. A lecture may be altered by the inclusion of a class discussion and followed by individual study after class. A course taught primarily by repeated showings of films or taped television material normally contains opportunities for supplementary learning through direct interaction with the instructor; the same mixture of learning processes usually applies to courses taught by AVT. A combination of several teaching techniques is illustrated by the Open University of England, which presents information through radio and correspondence materials to individuals and through television to small groups, conducts weekly seminars for persons living near each other, produces a weekly radio discussion show in which all students from across the country may participate, and holds monthly tutorial sessions.

No one can predict with certainty the future needs for a well-equipped geography department, but the trends seem evident. A decade ago Richard P. Dober stated:

... the conditions that may affect the design of campus buildings should be summarized. Three trends stand out: greater reliance on the individual to teach himself; the introduction of mechanical aids into the teaching process; and the design of multiple-function buildings ...1,2

Events have verified the trend toward more reliance upon individual teaching. In 1970 The Educational Trends Task Force of the Committee on Architecture for Education affirmed:

There seems little doubt that the majority of educators today believe that greater attention to individual differences of students is absolutely mandatory—IT WILL BE THE FOUNDATION OF EDUCATIONAL SYSTEMS OF 1980: There will probably be a variety of approaches to recognizing unique differences in young people, but, despite these variations, they hold profound implications for the school buildings as well as for education itself.13

The rising costs of education will prohibit individualized learning through an increase in the number of instructors; rather, it will be accomplished by utilizing more mechanical equipment. This is more than just a "teaching machine" replacing an instructor; it is combining electronic technology with a teacher to produce a system utilizing the special advantages of each. This trend means some former learning spaces will no longer suffice. For example, persons attending a 1967 conference on planning community junior college facilities were told: "The classroom box is busted. The ancient habit of teaching everything to a class in something called a classroom is fading away."14 This declaration about the most familiar of all teaching spaces makes it obvious that all existing facilities must be evaluated in terms of teaching techniques, both in current use and anticipated for the future.

Summary

Prior to any planning of new facilities, those responsible for the geography program should consider several basic questions. One set of questions focuses upon the rationale for constructing facilities designed especially for geography. Professional geographers agree that the concern with explaining spatial relationships among many phenomena emphasizes that geography requires distinctive educational facilities. Space and equipment that aid in displaying, constructing, and storing maps and other two- or three-dimensional representations are essential for geographic

14 Gores, "The Crucial Years are Now," p. 2.
learning. Since geography involves the spatial relationships among many different kinds of phenomena, the facilities required by geographers may be more diversified than those used by scholars in other departments.

Other pre-planning questions deal with the existing facilities and their probable utility for the near future. Costs of renovation and of a new building need to be compared for both initial construction and future maintenance. The predicted enrollments for geography classes, the type of college, and the departmental responsibilities all influence decisions relating to physical facilities. Yet all are peripheral to the main purpose of providing adequate space and equipment for the learning process. What constitutes "adequate" facilities is a function of the ways the educational goal is approached through various teaching techniques. Only by clarifying their methods of instruction can faculty members realistically evaluate the department's existing and future needs for physical facilities.
II. A GUIDE TO PLANNING PROCEDURES AND ESTIMATING TOTAL SPACE NEEDS

Once college administrators have decided to create new facilities for a geography program geographers with limited experience in designing educational facilities will probably become involved with the planning process. Familiarity with the fundamental procedures commonly followed in campus planning is an asset in interpreting departmental needs to professional planners. This chapter summarizes planning procedures and provides guidelines for estimating the total space needs for geography facilities.

Initial Procedures In The Planning Process

Three general perspectives usually merge in planning educational facilities: (1) those from the faculty members who will use the facilities, (2) those from the professional planners who provide information about the technical aspects of designing space, and (3) those from the administrators coordinating the total institutional building and financial program. A successful building project requires continual communication among these three groups.

Communication among administrators, architects, and the geography faculty should be formalized in a committee responsible for planning the facilities. An active committee can provide the framework for promoting interaction among the various perspectives and for reducing inevitable disagreements. A committee framework should insure continuity, which is important because the lapse time from the conception of a college building to its occupancy averages from four to six years.1 Even if the new facilities are in a renovated building, the lapsed time is long enough that one or more members involved with the initial planning may not be associated with the project at its completion. Without the committee structure it is too easy for early “commitments” about some aspects of the facilities to become neglected by the time the construction is finished.

A common statement made by planners is that “good school design results when a thoroughly professional architect gets together with a thoroughly competent client.”2 It is extremely beneficial to have a qualified professional who is willing to learn about the special needs of a geography department provide the complex planning services. Maximum benefits from a professional architect are achieved when combined with competency of a geographer devoted to the planning task.

Normally a geography department chooses its own representative on the planning committee. This person will be responsible for studying the needs of the department, interpreting them to the planning committee, working with the architect in designing the facilities, and seeing that the plans are fulfilled. This representative must devote considerable time to the many phases of the project, so the planning assignment should be accompanied by a reduction in other responsibilities. A small department may feel it cannot lose the teaching services of an instructor, even for one course for one term; yet the long-range benefits resulting from wise planning decisions should compensate for the short-term sacrifice. For a larger department, released time from other duties is essential.

An initial task of the planning geographer (i.e., the geographer selected to represent the department in the planning process) is the collection of ideas and information from the rest of the geography faculty. The data required will be explained later in this chapter, but in general, the planning geographer must become acquainted with the present and future ways space and equipment are and will be used by each member of the faculty. Probably all requests by all faculty members cannot be fulfilled because of conflicting priorities. Also, a change of mind and/or change in faculty prior to construction may produce a different set of requests. Nevertheless, he/she should go to the planning committee well informed about the needs of the department as expressed by all its members.

In addition to the information obtained from colleagues in the department, the planning geographer should collect ideas from as many other sources as time permits. One source is the Consulting Service of the Association of American Geographers with its advisory services, which in-

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clude this publication. Although numerous data relating to potential learning spaces and equipment for geography departments are assembled here, this is not a blueprint for the “ideal” department. Updated information and supplementary suggestions can be obtained from one or more of the following sources:

- Geography facilities in other colleges
- Educational facilities in other departments
- Work and research facilities in non-collegiate institutions
- Work and research facilities in industry
- Companies that sell educational equipment
- Students
- Secretarial staff
- Custodian and maintenance staff
- Council of Educational Facilities Planners and its CEFP Journal
- Educational Facilities Laboratories, Inc.
- Society for College and University Planning
- Educational Resources Information Center, Clearinghouse on Educational Management
- American Association of Junior Colleges
- American Institute of Architects
- American School and University
- Architectural Record
- College and University Business
- Educational Technology
- Specialized references listed in the Appendix of this publication.

Armed with ample information about the educational needs of the department and about numerous possible ways of designing space, the geographer is ready to engage in the planning process. Procedures may vary, but generally six major phases can be identified: pre-design planning, schematic design, design development, construction documents, bidding, and construction. The first phase (i.e., the pre-design planning) requires heavy involvement by the planning geographer because a document of educational specifications must be prepared. This initial task, which includes estimating space needs, is explained more thoroughly below; the other five phases are considered as a group near the end of the chapter.

Preparing A Document Of Educational Specifications

The major activity during the stage of pre-design planning is the preparation of a document of educational specifications. As explained by the Guide for Planning Educational Facilities,

Educational specifications or program requirements are the means by which the educator describes the educational activities and spaces which need to be incorporated in a proposed new or renovated facility. They are written statements that serve as a vehicle of communication between the educator and the architect. To serve their primary role in shaping the design, organizations and formations of facilities, they must, first of all, describe the learning activities that will occur. In addition, they must describe thoroughly and concisely, the number, grouping, and nature of the people involved; the spatial relations of the facilities and site; the interrelationships of instructional programs with each other and with non-instructional activities; the major items of furniture and equipment to be used; and any special environmental provisions that would improve conditions for the learning situation as well as staff efficiency. Since the emphasis should be on how learning takes place, those responsible for specification development should be members of the staff who will use the proposed facilities.

The educational specifications should emphasize how learning is expected to occur. The architect utilizes this information supplied by the geographer to create a specific design. It is apparent that the educational specifications must clarify the departmental characteristics and its ideas about teaching techniques (as emphasized in Chapter I) so they can be manifested in the architect's design for new facilities. Specifying the exact learning spaces needed for all aspects of geographic work, both present and future, is frustrating; nevertheless, a department must decide its fundamental goals and methods of geographic instruction. These background decisions must be summarized in a form helpful to both the architect and others unfamiliar with the geography program. The written document should begin with a general statement about the characteristics of the department, its primary emphasis, its goals for the future, and how the new facilities will aid in achieving these goals.

Another section of the document should include a summary of the total space in square feet, or meters. The total space figure may be subdivided into the major use categories (e.g., classrooms, offices, library), but information about the area measurements for specific rooms can be reserved for the more detailed descriptions of each identified space. This portion of the document will be convenient when the planning committee discusses space allocations and costs per unit area.

3See additional comments about planning organizations in the Appendix.
The body of the document should contain the following information for each identifiable space: (1) objectives, (2) activities to be housed, (3) persons to be accommodated, (4) space requirements, (5) spatial relationships, (6) equipment to be housed, and (7) special environmental information for each identifiable space: (1) objectives, how the space will be used, including number of persons. The amount of floor area is a necessary item because it is a basic measuring unit used by many planners. Information about the functional relationships of learning areas aids the architect in planning the spatial arrangements of these areas. The original set of educational specifications need not include all the equipment, furniture, and instruments ultimately planned for each identified space; however, the more detailed the information about equipment, the fewer the subsequent adjustments. In many respects, the inclusion of equipment necessary for each area verifies the statements about objectives and activities for those spaces. Combined with requests for equipment should be notations about special requirements for the control of light, sound, and other environmental conditions.

Estimating Space Needs

Estimating the area needed for various activities and uses of space is basic for planning facilities, and the planning geographer must include these data in the educational specifications. Early in the planning process the planning committee must decide on a figure of total floor area for the geography facilities; and subsequent decisions about size, shape, and arrangements of rooms must necessarily fit within that total space figure. Therefore, the geographer must attempt to predict space needs valid until a specified future date. This section deals with methods of calculating floor area using standards common in college planning.

One approach to estimating future space needs is based entirely upon current use and predicted growth. The usable floor area for each room or identified space is measured and compared to the number of persons presently using that space, then the area designated for new facilities is increased by the same proportion as the predicted increase in population. This approach assumes no change in the way space is utilized; it merely expands areas for a greater population.

Another approach to predicting space employs standard values for converting kinds of uses into floor area. This allows the geographer with limited experience to make reasonable estimates about floor area for new kinds of teaching spaces. The standardized figures may be based upon generalized national norms or the college modifications of such national figures. They can serve as a helpful guide for the geographer, but also they may create barriers to proposing teaching spaces that require more area than allowed by college guidelines. In either case, the representative geographer should obtain information about local college guidelines and be prepared to justify major deviations from those standards.

A procedure and a set of standards developed by the Central Office on the Use of Space at the University of Illinois, under the primary directorship of Professor Harlan D. Bareither, form the basis for the recommendations on calculating floor area discussed in this section. The procedure for determining space requirements commences by categorizing space into "building blocks," which are applied as follows:

For each "building block," there exists an index which will generate the space requirements. The total amount of space required at an institution for each "building block" is dependent upon the number of FTE (full-time equivalent) students, the level of student, the fields of study, the institutional philosophy pertaining to scheduling patterns, size of library, etc. . . . The actual value of the proposed standard may not be adaptable to every institution due to differences in philosophies; however, if a different standard value is used, the logic and procedure can still be applied.8

Categories defined by Professor Bareither include the classroom, instructional laboratory, office space, research space, archive and storage space, commons space, library space, and non-assignable spaces.

Classrooms

This category includes all those spaces normally called classrooms, lecture rooms, seminar rooms, and the auxiliary support facilities such as storage and preparation areas. The amount of area devoted to this kind of teaching space is calculated from data about the number of students, the area per student station, and the usage per station. The number of students is usually expressed in terms of full-time equivalents (FTE). Each institution may define an FTE student differently, but normally a student is considered full-time when registered for 15 credit hours.9

"Student station" is defined as the total facilities necessary to accommodate one student for a given period of time, usually one hour. The number of square feet required per

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8 Bareither, University Space Planning, pp. 1-2.
9 For example, a 3-credit-hour geography class with 105 students is evaluated as 21 FTE; similarly, 400 FTE students generate 6000 credit hours.
station will vary inversely with the size of the room, e.g., from 9 in an auditorium to 20 in a seminar room. As a general guideline, 15 square feet for each station is recommended.

The measurement of station usage is by weekly student hours, which represents one hour of occupation by one student in one week. This is obtained from the room period usage, i.e., the number of hours per week a regularly scheduled class occupies a room multiplied by the percentage of time each station is occupied when the room is in use. The room period usage will vary with institutional policy, but a common standard is 30 daytime hours per week. The percentage of time each station is occupied when the classroom is in use varies greatly because the number and size of classrooms available at a given time rarely matches the class size. An average of 60 percent is a reasonable standard for calculations; thus, the standard weekly student hour for most colleges is 18 units (30 x .60).

When the area per student station (15 sq. ft.) is divided by the weekly student hour (18), the resulting quotient (0.833) produces an index of square feet per weekly student hour. The product of this index and the number of student credit hours yields the total floor area required for classrooms. Stated otherwise, the floor area (A) is a function of credit hours per FTE student (H), number of students (N), area required per student station (S), room usage per week (W), and the rate of occupancy (R) in the following relationship: 

\[ A = \frac{HNS}{WR} \]

WR figure states the total quantity of floor area required in all classrooms; it does not answer questions pertaining to size and number of classrooms.

Instructional Laboratories

This category is similar to the one for classrooms, but it deals with rooms containing equipment or arrangements that restrict their use. Much diversity exists in the area per student required for various kinds of laboratories and their auxiliary spaces, so standard values are established for different disciplines. Standards, expressed in square feet per station, used by the University of Illinois for geography and related subjects are the following:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Area (sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropology</td>
<td>50</td>
</tr>
<tr>
<td>Astronomy</td>
<td>50</td>
</tr>
<tr>
<td>Economics</td>
<td>32</td>
</tr>
<tr>
<td>Sociology</td>
<td>30</td>
</tr>
<tr>
<td>Geography</td>
<td>68</td>
</tr>
<tr>
<td>Geology</td>
<td>68</td>
</tr>
<tr>
<td>Urban Planning</td>
<td>65</td>
</tr>
<tr>
<td>Landscape Arch.</td>
<td>65</td>
</tr>
</tbody>
</table>

Normally a laboratory is used fewer hours per week than a classroom because it is less flexible, but the student stations are utilized better during occupancy because of more uniform class sizes. Station usage in most colleges ranges from 20 to 24 hours per week with 80 percent student station utilization. An index of 4.25 square feet per weekly hour results from using the values of 68 square feet per station, 20 hours per week, and at 80 percent capacity. When the number of FTE students planned for geography is multiplied by their 15 credit hours and the index value, the total floor area needed for laboratories and their auxiliary rooms is calculated. For example, 125 FTE students using laboratory facilities that are 80 percent filled during 20 hours per week and requiring 68 square feet per station need a total of 7968.75 square feet:

\[ A = \frac{HNS}{WR} = \frac{15 \times 125 \times 68}{20 \times 0.8} = 15 \times 125 \times 4.25 = 7968.75 \]

Office Space

This category embraces faculty offices, reception areas, conference rooms, and administrative space. It also includes the administrative and clerical work areas as well as related storage areas.

The recommendations by Professor Bareither are based on FTE staff members requiring office space. Decisions must be made about the fractional FTE equivalency of part-time staff personnel such as emeriti professors, graduate teaching assistants, and secretarial workers on hourly wages. The total office space is calculated by allocating 135 square feet per FTE staff member. More than 25 FTE staff members allows 120 square feet for private offices, a larger office for the chairperson, conference rooms, reception areas, and file and work rooms for the departmental office. If there are fewer than 25 FTE, then the planner should consider the following guidelines:

For 1-5 FTE, the 135 square feet per FTE will be adequate for private offices and a larger office for the chairperson, which may double as a conference room; but 120 square feet should be added to allow for a reception area.

For 6-15 FTE, an additional 200 square feet should supplement the 135 per FTE so a small conference room can be included.

For 16-25 FTE, 50 square feet should be added to the 135 per FTE value.

These guidelines pertain to college offices in general; they are not adjusted for the special needs of geographers. The geographer's heavy reliance upon maps requires extra area for storing and studying them. In contrast to scholars...
in other disciplines who work with materials seldom exceeding 8½ x 11 inches, geographers study maps that frequently are larger than 20 x 26 inches. A table (a standard 3' x 6' table, a drafting table, or a tracing table) on which several maps can be spread with a 2-foot working space in front consumes approximately 30 square feet. A map case with accompanying room for a person to stand by an open drawer necessitates 19 to 20 square feet. Consequently, combined with the 120 square feet allocated for a “standard” office, a geographer needs an additional 50 square feet, which means a recommended minimum of 170 square feet for each geography office. Consistent with this area requirement for individual faculty offices, the total area for the office-space category should be adjusted to 185 square feet per FTE faculty member.

Research Space

This “building block” is difficult to define, but it relates to academic investigative work. Some colleges because of size and/or level of instruction do not provide research facilities for faculty, so there may be no allocation of space for this category. In other institutions the geography program may include research activities for undergraduate students as well as for faculty and graduate students.

Estimating space needs for research activities commences by allocating 15 square feet for each FTE faculty on full research appointment and for each advanced graduate student. For each FTE faculty member with approximately 20 percent research activities and for each beginning graduate student only 3 square feet are allotted. The total research area so determined is then multiplied by a “demand factor” assigned to each discipline according to the amount of space deemed necessary for its research activities. Some of the demand factors used at the University of Illinois are as follows:

<table>
<thead>
<tr>
<th>Area</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Studies</td>
<td>0.5</td>
</tr>
<tr>
<td>Economics</td>
<td>0.5</td>
</tr>
<tr>
<td>History</td>
<td>0.5</td>
</tr>
<tr>
<td>Political Science</td>
<td>0.5</td>
</tr>
<tr>
<td>Sociology</td>
<td>2.0</td>
</tr>
<tr>
<td>Geography</td>
<td>5.0</td>
</tr>
<tr>
<td>Geology</td>
<td>25.0</td>
</tr>
<tr>
<td>Physical Environment</td>
<td>25.0</td>
</tr>
<tr>
<td>Urban Planning</td>
<td>20.0</td>
</tr>
<tr>
<td>Landscape Architecture</td>
<td>20.0</td>
</tr>
</tbody>
</table>

According to the recommendations cited above, a geography department with 18 FTE teaching faculty with 20 percent research duties generates 270 square feet of research space (18 x 3 x 5). Although a total of 270 square feet for research activities appears small, some ameliorating conditions may exist. One of the conditions depends upon the departmental emphasis. If geographic research concentrates on the physical environment, the demand factor, as proposed by Professor Bareither, should be 25 rather than the 5 suggested for “general” geography.

A second ameliorating condition is the potential for multiple utilization of spaces. The additional space recommended for map work in a faculty office may serve also as a research area. Also, if schedules are arranged with “open” periods, various teaching laboratories and workrooms may provide research space for students and faculty.

Archive and Equipment Storage

Most departments require space for storage of supplies, equipment, and seldom-used records. If the department has been occupying an old building for many years, some of these items may be in basements or attics and not remembered until it is time to move into new facilities. Undoubtedly, some long-forgotten items should be discarded, but rock and soil specimens, field equipment, specialized maps, and other items used only occasionally need space elsewhere than in prime working areas. Professor Bareither recommends that the area added for this category be approximately 1 percent of the total space in instructional laboratories, office, and research areas in geography. This percentage may vary with departmental specialties, e.g., with emphasis in physical geography the storage may approach the 5 percent recommended for geology.

Commons Space

Many institutions encourage commons space in academic buildings in addition to the facilities in a campus student union building. These lounges will provide space for students between classes and encourage students and faculty to meet informally. It is recommended that ½ square feet per FTE geography student in colleges with residence halls and 2½ square feet per FTE student in institutions with many commuters be assigned for a departmental commons room. The additional space allocated for commuting students permits locker space, even though lockers may not necessarily be located in the commons room itself.

Library Space

The guidelines used by the University of Illinois for
other campus facilities cannot be converted easily to departmental planning. For example, the campus guidelines include a "building block" for library space, but this can not be applied to a departmental library without qualifications. A departmental library may be restricted to selected geographic documents and/or maps; on other campuses policy may prohibit any library space in the geography building.

The general standards used for campus library spaces at the University of Illinois are as follows: (1) stack space with 0.1 square foot per bound volume and 0.01 square foot per map, (2) reading area with 7.5 square feet per FTE student and 3 square feet per FTE faculty member, and (3) service space based on approximately 20 percent of the reading space. It is difficult to convert these standards to departmental facilities because of the important variable of FTE student numbers; nevertheless, they provide one method for estimating space needs for library materials and activities. Another guide for estimating the space allotted to the map portion of a library system is implied by the Geography and Map Division, Special Libraries Association: approximately 0.2 square foot per map for those libraries containing from 5,000 to 500,000 maps.

Nonassignable Spaces

The sum of all areas on all floors of a building assigned to an occupant, which includes all categories discussed above, is called "net assignable area." In addition, there are nonassignable spaces necessary for the functioning of a building. When these other spaces are added to the net assignable area, the total of all floor areas within the outside faces of exterior walls is called the "gross area." Professional planners may refer to the total of these nonassignable spaces as the "add factor" because it is the amount added to the net assignable area to make the building functional. Others speak of the "building efficiency," which is the ratio of net assignable area to the gross area. Obviously, a planner attempts to minimize the add factor or maximize the building efficiency to achieve the greatest amount of usable space for the least cost.

Seldom will the planning geographer be asked to estimate nonassignable spaces. However, knowledge about reasonable area estimates should aid this person when commit-

tee discussions dwell on building efficiency. Circulation space, which refers to corridors, stairs, and elevator shafts, normally should not exceed 16 percent of the gross area. Mechanical areas will range from 3 to 14 percent of the gross area with the upper part of this range more probable when air conditioning equipment is necessary. Restrooms average 1.4 percent of the gross area, and custodial space approximates 0.4 percent of the gross square footage. Construction area, which includes all walls, will consume approximately 14 percent of the gross area. Thus, the sum of these nonassignable spaces may vary from 35 to 46 percent of the gross area.

Design Development and Fulfillment

Six major phases in the planning process were identified earlier in this chapter. Considerable emphasis has been given to the pre-design planning because this is the stage when the geographer carries a major responsibility for providing information. Nevertheless, important decisions associated with the other five phases remain for the planning geographer.

Schematic Design

The schematic design stage is when the architect translates the educational specifications into a graphic representation of a building plan. Part of this plan may consist of a diagram showing the spatial relationships of the various areas. The architect will position mechanical and construction areas, especially for their efficiency and adherence to building codes. Also, the architect should propose relative positions for assignable areas consistent with the educational specifications.

The planning geographer will be expected to react to the architect's plans. The geographer may have limited reactions about possible construction materials and about the positioning of certain construction areas, but should have fairly definite ideas about arrangements of assignable spaces. Alternate suggestions by the geographer about spatial relationships should be made as soon as possible.

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15 The value of 3 square feet applies to departments with high research requirements, i.e., with a demand factor exceeding 1.0; otherwise 15 square feet per faculty member are allocated.
16 Catherine Bahn, "Map Libraries—Space and Equipment," Bulletin, The Geography and Map Division, Special Libraries Association, Vol. 46 (1961), p. 4, reveals that the conversion of map numbers to library floor area varies with size of map collection. She suggests 400 square feet for a library holding 10,000 maps (i.e., 0.4 square foot per map) and 216 square feet for one with 100,000 maps (i.e., 0.2 square foot per map).
because of their importance to subsequent decisions. The architect and planning geographer will usually propose and react to each other’s ideas several times until a satisfactory schematic design is created.

Design Development

When the schematic design has been approved by the planning committee and any other authorities involved with building plans, the architect proceeds to develop the basic design. The design may be represented at various scales and perspectives so the visual characteristics of the facilities can be anticipated. Also, the architect prepares more specific information about construction materials, equipment, and costs. This stage of the planning process is completed when the planning committee and proper authorities again review and give approval.

Although some changes in the design may be added at a later stage, it is more difficult to make alterations after the design has been finalized; thus the planning geographer needs to examine the design carefully. Each educational activity should be reviewed to see if it can be accomplished with the facilities planned. Certainly this includes a review of the equipment (sometimes referring only to “fixed” items) and furniture (“movable” items). Fundamental information about equipment and furniture should have been included in the educational specifications, but a thorough examination of the allotted area and expected use of each item at this time insures a complete review of the entire design.

The planning geographer may also question the effectiveness of the architect’s plans. For instance, problems with sound control and inadequate electrical outlets are common enough that the geographer should inquire about these aspects of the design, although the answers may be somewhat technical. Other illustrations of general facilities affecting specific aspects of the geographic program are considered in Chapter III.

Construction Documents

During the next stage final working drawings and construction specifications are prepared by the architect. These detailed drawings and written specifications consist of many pages covering all aspects of the architectural, structural, mechanical, and electrical components of the project. These documents culminate the translation of educational specifications into explicit directions for constructing the physical facilities.

Bidding

The geographer probably will not be involved with the bidding stage because normally other college personnel handle the financial arrangements. However, a few comments about costs in general should be mentioned. The topic of costs will seldom be omitted from any stage of the planning process, whether it concerns the initial proposals for new learning spaces or requests for modifications in the completed construction. Although the geographer is primarily responsible for representing the educational perspective, this should be done with financial awareness. When the architect is submitting various designs that cut costs but differ from those proposed by the geographers, it is helpful if the planning geographer understands something about the costs of space and various construction materials.

The planning geographer should assist in cost estimates by making specific equipment recommendations and by supplying specific information about specialized equipment. Some recommendations can be based on the catalogs supplied to architects and college purchasing departments by companies selling equipment. Information about more specialized equipment, though, may depend upon the initiative of the planning geographer. An invitation for company representatives to show samples and to demonstrate their wares to the geography faculty aids in making decisions. These decisions are greatly simplified if the department and individual faculty members have maintained files on potential suppliers of equipment. In addition to cost, selection of equipment and furniture should be made on the basis of availability, safety, comfort, appearance, durability, flexibility, guarantees, building codes, and maintenance.

The department may be allotted a budget total for all equipment. Again, the planning geographer and the architect will need to propose, discuss, and revise the list together. A priority rating for each item is helpful so budget overruns can be reduced rationally. The planning geographer should consider placing a “correction” item in the priority rating of equipment items because, no matter how carefully the planning process is executed, frequently some “bugs” appear after the building is nearly completed. When the appropriated funds are exhausted the department may have to live with some irritants for several years. If, however, a “correction” item is included, funds should be available for rectifying the mistakes. If, perchance, when the construction is completed and no errors are detected, then the lower-ranked equipment item can be obtained.

Construction

During the construction stage the architect must verify

\(^{18}\) The continuing costs for maintenance contracts will be a significant factor in future operating budgets.

\(^{19}\) The advantages of this proposal rely upon flexibility in spending the appropriate funds. If all money must be budgeted prior to completion date or if funds are rigidly categorized by type of expenditure, the proposal is less beneficial.
that the construction contracts are being honored. The architect should make periodic checks at the site of construction, although the daily inspection is usually performed by a project inspector employed by the architect. The architect will report to the planning committee on the construction progress and about alterations resulting from unforeseen circumstances.

The ultimate occupants of the new facilities are the most concerned about the accurate conversion of educational specifications into physical facilities, so visits to the construction site are essential. These visits should be more than casual walk-throughs; they should be the geographer’s own inspection tour.

Summary

A primary ingredient in a good design is the information supplied by the eventual occupant. Both the college spending money to construct good educational facilities and the geographers who will use those facilities should be eager to maximize the quality of information produced for planning purposes. Selecting one geographer to carry the planning responsibilities will improve the quality of inputs from the geography department. This planning geographer should study the needs of the department, interpret them to the campus planning committee, work with the architect in designing the facilities, and check on the fulfillment of the plans.

The needs of a department are a function of numerous variables, including present and future size, topical emphasis, and teaching techniques. The planning geographer must determine the departmental needs and study ways they may be transformed into physical facilities. Next, these ideas must be interpreted to the planning committee and architect, usually in the form of educational specifications, which are written statements explaining the purpose, and method of achieving that purpose, for each identified space. Other duties involve working closely with the architect as a design is developed and translated into tangible facilities.
III. DECISIONS ABOUT GENERAL BUILDING CHARACTERISTICS, SPACE AND EQUIPMENT

The facilities in a geography department vary in their degrees of generality or specialization. An architect familiar with educational facilities can propose a general classroom design that should satisfy most of the needs for geographic learning. In contrast, the design of a map storage area is more distinctive to geography, so the architect may depend upon the recommendations of the planning geographer. This chapter concerns general decisions about space and equipment; the following chapter deals with specific recommendations for geography.

Spatial Relationships Of Learning Areas

The spatial relationships among rooms and other identified areas are an important part of the basic design. After an estimate of total floor area for each kind of space is calculated, but prior to designing the details of each identified area, the size, shape, and position of each room should be considered. This section focuses on these spatial characteristics plus their interrelationships with space flexibility.

Arrangement

Several factors should be considered when planning the arrangement of learning and work areas. An obvious reason for positioning rooms is that they belong together functionally. A cartography teaching laboratory, a cartography work area, a photographic processing room, and an office handling cartographic services might form one functional grouping. Likewise, the secretarial office and work areas, chairperson’s office, and conference room normally cluster around a reception area. It is understood, of course, that storage space for items to be used in a specific area should be in close proximity to the area served.

Some rooms need to be positioned so the control of their environments is simplified. A photographic darkroom and a room for reading imagery from remote sensors should not have window areas. The noises produced by some calculators, key punches, and instruments used in computer graphics, as well as the sounds from the reception area, need to be isolated from classrooms. The structural support requirements for a map library may be easier to solve if it is located on a ground floor. Measurements of atmospheric conditions are available only from instruments that are located on the roof or some other position outside the building.

Classrooms should be arranged to reduce conflicts in the flow of student traffic. The major traffic routes from the building entrances to the major classrooms and laboratories should be estimated and mapped to detect potential bottle-necks and congestion. Most faculty persons prefer that their offices are away from major paths of student movement and separated from building entrances.

Student traffic patterns are related to the accessibility of rooms from outside the building. If possible, those geography areas that provide services for persons outside the department should be located near building entrances. A map library serving the entire campus should be located on the ground floor. Less disruption from deliveries and visitors occurs if the reception area is not too remote from major entrances. In fact, some delivery companies do not serve areas more than a stated number of feet and/or flights of stairs from the main entrance of a building; e.g., the U.S. Postal Service normally does not deliver above the second floor.

Security and safety are important in arranging rooms and other areas in a public building. As an illustration, if the map library remains open longer than other parts of the geography department, it should be situated where other portions of the building can be locked while it is being used. The security of rooms containing expensive equipment and instruments can be improved by locating them where accessibility is restricted but observable.

Safety regulations restrict the number of options in arranging some rooms. Fire codes prescribing the maximum distances between an audience and exits tend to reduce the locational choices for large classrooms and lecture halls. Although the planning geographer may not know the constraints established for the campus or city, the architect should supply this information during the early stages of the design development.

No simple method for calculating the optimal arrange-
ment of spaces exists. If the new facilities are being planned for a renovated building, the total number of possible arrangements is much smaller than when planning a new building but still large enough to create planning problems. Procedures for searching for an optimal arrangement with a computer are available, but the nature of the problem is one that most geographers can handle more directly. The spatial manipulation of symbolized rooms over a floor "map" produces satisfactory results for most arrangement problems.

Size

Guidelines for estimating the total area in classrooms, instructional laboratories, offices, and other assignable space are described in Chapter II. The focus of this section is the subdivision of those spaces into identified areas. For example, assume that the total allotment of classroom area will accommodate 400 students. Does the department want an auditorium scheduled for 400 students each class hour, or 4 classrooms each with 100 students, or 16 rooms each large enough for 25 students, or 400 individual carrels? Frequently, classrooms are shared with other departments, so this permits more flexibility in using areas of contrasting sizes during a weekly schedule. Under shared conditions the choices for the 6 hours per day might be: an auditorium seating 400 for 3 hours per day and 4 rooms each holding 100 students for the other 3 hours, or an auditorium with 400 seats for 4 class periods and 8 rooms each with 50 student stations for the remaining 2 hours, or other combinations accommodating 400 students for 30 hours per week. As discussed in Chapter I, the best mix for a department depends largely upon the teaching techniques used for geographic instruction.

Room size normally refers to the floor area, but the height of a room can affect its utilization for geography. Many wall maps are more than six feet tall, so the bottom portion of the maps are difficult to see in a classroom with ceilings lower than nine feet. Therefore, the ceiling height for geography classes is more critical than it is for most other college departments. Also, the storage room for rolled wall maps needs a ceiling higher than nine feet if maps are hung and higher still if they are lifted vertically from storage racks (see Chapter IV, Storage for Classroom Visuals). One frequent advantage in a renovated building is a ceiling height exceeding that proposed for most new buildings.

Shape

The traditional classroom box sometimes simplifies fitting rooms together, but it is not necessarily the most suitable shape for many purposes. The rooms conducive to good acoustics are those without parallel walls, i.e., non-rectangular rooms. Also, in large-group rooms designed for reaction learning a non-rectangular shape encourages focusing upon the area of presentation. Reduced construction costs can be achieved by minimizing the length of exterior walls relative to the enclosed area, which suggests a circular building with appropriate interior division (e.g., fan-shaped rooms) or a polygonal building with more than four walls.

A variety of non-rectangular shapes can be designed for learning areas in college buildings (Figure 3). A fan-shaped room possesses an internal shape that focuses on the vicinity of the lectern, and it can be part of a combined set forming a semi-circular unit (see the three combined rooms in Figure 3-A). A modification of the fanshape consists of only straight walls (Figures 3-B and 3-C). Placing the lectern in the "point" of the room (rooms 1 and 3 in 3-B and rooms 1 and 2 in 3-C) may create problems for mounting a projection screen and other display surfaces, but it has the potential for flexibility (as discussed under Flexibility). A hexagonal room achieves the merits of minimizing wall length for floor area and combining well with other hexagonal rooms and a central projection and storage area (Figure 3-E). An octagonal room (Figure 3-D) retains most features of a traditional arrangement with several added audio and visual advantages (see Chapter IV, Basic Classroom).

The merits of various shapes cannot be evaluated without consideration of the intended educational use of each room. The hexagonal shape (Figure 3-E) may "waste" the "sides" of the room when it is used for a large lecture hall, but for a discussion area it is well suited. Conversely, an octagonal shape is worthy of a classroom seating 70 to 90 students, but it presents difficulties when lining walls with a series of carrels.

The opportunities for designing non-rectangular shapes are greatly diminished when new facilities are constructed in a renovated building. The structural constraints and exterior walls limit the spatial choices, so usually shape is

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2 These choices are not exactly equivalent because, as stated previously, the area per student station varies with room size.

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5 The classrooms in Figure 3 illustrate shapes for lecture rooms, but non-rectangular shapes are appropriate for many other learning areas.
Figure 3: Shapes and arrangements for classrooms. Nonrectangular shapes may be more effective for many learning areas (including the lecture halls, as illustrated) than the traditional rectangular rooms. Adjoining rooms can be adjusted for varying functions when separated by operable partitions (e.g., X-Y and X-Z).
sacrificed to achieve size and arrangement priorities. Also, if geography is to be housed with other departments in a new building, the opportunities for non-rectangular geography rooms will be extremely limited if no other departments want these shapes.

Flexibility

Those attending a 1967 conference devoted to improving the planning processes for community junior colleges were warned: "Such is the speed of change these days that the most we can do is to make sure we get out of the way of our successors." This does not mean the planner should abrogate responsibility for making difficult decisions about the design of new facilities, but rather seek ways to retard rapid obsolescence. Flexibility within an existing design assures a department opportunities for changing uses of space in the future.

The concept of flexibility has received considerable attention by planners of school facilities as well as by educators who utilize the facilities. This wide diversity of interest in the topic tends to confuse the meaning of the term "flexibility." Architect William Caudill has suggested employing the following surrogate terms:

- expansible space, which can allow for ordered growth;
- convertible space, which can be economically adapted to program changes;
- versatile space, which serves many functions; and
- malleable space, which can be changed at once and at will.

Each of these aspects of flexible space should be considered when designing geography facilities.

The amount of floor area allowed in a design for future growth depends largely upon college guidelines and projected enrollments, but the kind of expansible space reserved for future growth probably can be influenced by the planning geographer. As a general rule, expansible space should not be divided by inflexible load-bearing partitions that cannot be removed without endangering the building. If the space reserved for future expansion must be divided initially, this can be done by traditional non-load-bearing partitions or demountable partitions that can be removed without being destroyed. The costs of some types of removable partitions are expensive; but they provide a high degree of potential flexibility.9

Some geographers who have had considerable experience

planning and living with new facilities have stressed the importance of convertible space. For example, when planning facilities for the Department of Geography at UCLA, Joseph E. Spencer insisted on including some areas that provided for "the inevitable change of direction and new programs never visualized by the staff on hand at planning time." Within a short time after completion of the new facilities the wisdom of this decision was apparent when a gift of a large air-photo collection necessitated converting an extra laboratory-display room to an air-photo library or else losing this rare gift.

It is difficult to decide the degree of versatility to design into facilities. The more versatile the rooms or identified areas, the easier it is to gain the efficiency of multiple uses. However, very generalized or versatile rooms may be less satisfactory for certain geography classes, e.g., a general classroom is less suitable for cartography than a room designed for this specialized instruction.

The purpose for designing malleable space is to provide continual flexibility with the facilities. Easily operable partitions that can be opened or closed quickly without special tools permits altering rooms whenever needed (e.g., operable partitions X-Y between rooms 1 and 2 in Figures 3-A, 3-B, and 3-C and partition X-Z between rooms 2 and 3 in Figure 3-B). Certainly the easy conversion of three small rooms into a large lecture area (Figure 3-B) augments the variety of teaching techniques supported by the physical facilities. However, the advantages in altering the interrelationships among size, shape, and arrangement may be gained by sacrificing sound control and display surfaces, so a decision about partitions must be based upon thorough study (additional comments under Sound Control).

General Building Facilities

Learning is affected by the environment in which it takes place, so it is worth the geographer's time to consider the environmental conditions of the building. Most environmental conditions should be proposed by the planner, but some decisions about materials and services will depend partly upon recommendations from the geographer. A few of the possible decisions are considered here.

Air Control

The most important mechanical system in a building is the equipment controlling the thermal environment.11 Only a qualified engineer can properly design the systems

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8 Gores, "The Crucial Years are Now," p. 4.
9 The merits of this kind of flexibility can be observed in the new geography facilities at Dartmouth College where demountable partitions are used in all exterior space.
10 Comments by Joseph E. Spencer, 12 April 1972.
11 "What Went Wrong?": Maintenance and Operation Errors to Avoid in Educational Facility Planning (Columbus, Ohio: Council of Educational Facility Planners, 1968), p. 35.
for heating, cooling, and ventilating, but a decision about the inclusion of air conditioning may depend partly upon its particular importance to the geography program. Cartographic work can be easily damaged by perspiration, the supply of wall maps may be wrinkled, air-photos may curl with high humidity, and electrical equipment in an AVT room and a calculating room may overheat.

Lighting

An adequate amount of lighting for classrooms, cartographic work, and reading air-photos is essential, but the brightness of lighting should not be overdone. Recent editions of the American Standard for School Lighting stress the quality of lighting, e.g., brightness balance and glare reduction, more than just amount of light falling on an object.\(^1\) Proper lighting of educational facilities is achieved through varied levels of lighting in a room, which provide the desired balance in brightness and diminish total energy consumption. Glare can be reduced by eliminating sunlight and diffusing indoor lighting.

Control of light, especially the ability to change levels of lighting, is essential to many activities in geography. The heavy dependence upon display items, principally wall maps, in classrooms requires good quality light. During a single class period a teacher may want to refer to wall maps, project information from an overhead projector with intermediate lighting conditions, and show colored slides in a darkened room. Likewise, cartographic drafting and detailed map reading demand well-lit but glare-free areas, while utilization of several cartographic machines necessitates darkened areas.

One aspect of light control concerns outside light. Auditoriums, large classrooms, work rooms with cartographic equipment, and darkrooms ordinarily should have no windows. In other areas windows are optional. Although the control of light, as well as temperature and sound, is easier when windows are omitted, aesthetic and psychological factors support their inclusion. Where windows do exist, therefore, light-control devices must be included. Sunscreens, tinted glass, roll-down blinds, draperies, and Venetian blinds are some ways of restricting outside light. Either dark drapes or Venetian blinds placed in channels are recommended as durable, easily operated, and effective light-control devices. If a large room with many windows needs darkening, these hand-operated devices are too slow for several changes per class period: thus, either a permanent covering of the windows or motorized darkening device should be installed.

Light control also involves the regulation of illumination from inside the room. Varying amounts of footcandles can be achieved by using a rheostat or by combining different sets of lights. For most purposes, the use of light combinations is less costly and easier to operate. The locations of the control switches in a large room should be convenient to the instructor during various classroom activities. Switches to some, or all, lights should be at the room entrances, main lectern, and the control area for projecting equipment.

Sound Control

A good acoustical environment controls the noise generated within a room and restricts the intrusion of unwanted sounds from outside the room. Methods for sonic control have improved, but the problem persists because more machines generate greater noise, additional conduits open more sound tracks, and some new light-weight construction materials permit easier movement of sounds. The planning geographer may contribute to at least three design decisions that improve acoustics.

One group of decisions deals with the temporary division of spaces. Although operable partitions have merits, they tend to leak more sound than permanent walls. Also, changing the size and shape of an enclosed space alters the acoustics. Therefore, the planning geographer must weigh the advantages of flexibility gained from operable partitions against their disadvantages in sound transmission.

Another decision affecting sound control pertains to floor covering. Except for special areas, it is recommended that carpeting be used because of its known acoustical advantages. A study at the Rensselaer Polytechnic Institute reports that a carpet can cut noise in a room by 50 percent and that the noise level in carpeted corridors can be reduced 16 to 22 decibels.\(^1\) In fact, only since carpeting has become a common and practical floor cover have operable partitions become a reasonable way of creating truly malleable space.\(^1\) The primary reason for carpeting is its importance in controlling sounds that disrupt learning activities, but financial advantages also accrue because maintenance costs are 50 percent less in carpeted areas than in those with traditional floor finishes.\(^1\)

A third item that improves acoustical conditions and is also vital for geographic instruction is the wall tackboard. Seldom do college classrooms have adequate wall space for posting the maps needed in geography. Therefore, new facilities should be designed with large wall surfaces consisting of tackboard to satisfy this requirement. Fortunately,
cork boards soften room sounds, so this classroom item serves double purposes.\textsuperscript{16}

Rooms seating more than 150 students usually require sound amplification equipment, but this varies with speakers and acoustics. A lecturer with a resonant speaking voice in a room with good acoustical properties can be heard well by a class of 300 or more.\textsuperscript{17}

Services

Every new or renovated building should be supplied with water, electricity, and telephone services. In addition to the basic water needs for drinking, cleaning, and sewage disposal, geographers require water for some instructional areas. Several cartographic activities, ranging from cleaning penpoints to mounting wall maps and processing photographic prints, need water connections and sinks. Laboratories utilized in demonstrating stream flow and sedimentation must include water connections and adequate drains.

The electrical system must be supplemented with antenna and cable color television reception. Although video cassettes may revolutionize some television instruction in the future, at the present time collegiate education is too dependent upon television to neglect TV connections. Other electrical networks may be necessary, depending upon the teaching techniques and departmental emphases. If a department utilizes the audiovisual tutorial scheme, then a room needs to be designed with adequate voltage, plenty of outlets, and an under-floor distribution system that can be rewired with changing technology. If computer terminals are used for individualized instruction or for data processing, the room must be connected with sufficient electricity and with a coaxial cable to the computer center.

Some geography departments utilize a few gas outlets for specialized physical laboratories, but this is a service most smaller departments normally place low on a priority list. Also, very few departments have wastes demanding special attention. In any case, it is important to include all teaching equipment in the educational specifications so adequate systems can be designed by the architect.

Other Conditions

Assessing the role of aesthetics and general well-being is difficult. Although studies indicate that the productivity of office workers changes with environmental conditions,\textsuperscript{18} not too much is known about the relationship between studying geographic space and the setting in which such study occurs. It is known that most faculty members prefer windows in their offices;\textsuperscript{19} but the effect of interior vistas upon student concepts of distance and scale has not been examined. Even though the precise effects of building environments on geographic studies are not known, the design should strive toward maximum aesthetic qualities.

General Areas Of A Building

Most decisions pertaining to nonassignable space do not affect a geography department because this space does not consume floor area directly contributing to the geography programs. This applies especially to areas housing the mechanical equipment and the custodial supplies. Similarly, the architect normally follows standard procedures when designing and arranging toilet facilities; however, when located near classrooms they do provide a convenient place for washing hands by geographers who frequently use chalkboards.

Although stairs and elevators may not interest the planning geographer, the corridors do provide an opportunity for gaining extra benefits. In addition to the standard services such as fire alarms, drinking fountains, clocks, and public telephone, selected special services may be located in hallways. Students, especially geography majors, appreciate locker space. If study carrels or other commons areas are provided for students, hallway lockers may be superfluous; but in smaller departments with limited commons area, lockers encourage students to identify with the geography program. Hallway seating is also popular and helps keep circulation paths clear (Figure 4). Anyone who has climbed past students tiered on stairs and stepped over legs extended into the middle of hallways understands the need for between-class seating facilities.

Corridors and building entrances offer excellent opportunities for creating an atmosphere beneficial to geography. A directory at the entrance, public bulletin boards near the departmental office, the entrances, and at other frequently observed locations, and restricted notice boards near office and classroom doors aid in communicating basic information. Distinctively geographical exhibits, however, probably should be displayed in wall cases (Figure 5). Large maps, weather reports, and physical models are only three of many representations of spatial data that may aid informal education and publicize geographic activities by appearing in exhibit cases.\textsuperscript{20}

\textsuperscript{16} This dual utilization is illustrated by the facilities in the Department of Geography at the University of Georgia (Figure 9).
\textsuperscript{17} J. Sutherland Frame, \textit{Buildings and Facilities for the Mathematical Sciences} (Washington: Conference Board of the Mathematical Sciences, 1963), p. 15.
\textsuperscript{18} Gores, "The Crucial Years are Now," p. 3.
Figure 4: Corridor in a geography building. An exhibit case for maps and other displays, bulletin boards, and seating for students improve the utilization of corridor space.

Figure 5: Entrance to a geography department. (Department of Geography, University of Georgia)
Equipment Common To Many Areas

In addition to the building facilities and areas described above, certain equipment, customarily in several different rooms, is mentioned here (i.e., prior to describing specific spaces and equipment in Chapter IV). Some of the items of interest to the geographer are classroom display surfaces, facilities for projecting visual materials, and facilities for the handicapped.

Classroom Display Surfaces

The geographer’s concentration on spatial phenomena and their relationships requires frequent use of areal representations, primarily in the form of maps. Thus, one essential feature for any geography classroom is a rail with hooks for hanging wall maps. Although provision for a map rail is a simple equipment requirement, it is emphasized here because, in spite of its importance to geography, it is missing from many all-purpose college classrooms.

The simplest wall map rail is a single rail with sliding hooks affixed to the top of chalkboards, the top of tackboards, or to other positions along classroom walls (Figure 6). A continuous rail with many sliding hooks makes it possible to hang several wall maps of varying sizes around a room for use during a class period. These rails are available from most companies that sell wall maps (the Appendix lists suppliers).

Another method of providing for wall maps in a classroom utilizes a rack of rolled maps. A set of maps on spring rollers can be mounted at the front of the room with the top tilted away from the wall (Figure 7). This method guarantees that the maps in greatest demand are always in a classroom. Akin to the availability of basic maps in racks are the large relief maps that may be hung permanently on classroom walls.

Two limitations to a rack of rolled maps are the constraint of viewing only one map at a time and the lack of specialized maps. These handicaps can be overcome by using fixed rails for additional and specialized maps, which are carried to the classroom. Fixed map rails have limita-
Institutions, too, because instructors, particularly short persons, may have difficulty hanging maps high enough for viewing by all students. To overcome this handicap, a system of movable rails should be installed. A rail lowered from the ceiling by pulleys is satisfactory for one or two maps needing to be raised only a short distance. A single rail may bend with the weight of several maps, though, so it should be mounted on a sturdy frame (Figure 6). Where the maps need to be raised several feet (e.g., in auditoriums) or where the frame is too heavy for easy lifting, even when balanced with counterweights, the map frame should be powered like projection screens in auditoriums.

Except for the requirement that the maps are high enough so their bottom edges can be seen by all students, the location of maps within a room is not critical. They should not be hung where students must face the glare from outside windows, but otherwise, most areas of rooms have adequate lighting for viewing large wall maps. Also, at least one hanging location should be positioned so a single light can be directed on it periodically when showing slides in an otherwise darkened room.

Chalkboards are nearly as essential as maps for showing spatial information. This means that every learning area should be equipped with sufficient chalkboards for a variety of purposes, including areal sketching. A continuous chalkboard across the front of a classroom with a fixed map rail along its upper edge is fairly common in many geography classrooms, but it is preferable to have supplementary map hanging areas so the chalkboard is not obscured when several maps are being displayed.

If an entire wall cannot be devoted to chalkboard, then a system of panels should be installed so several exchangeable writing surfaces utilize the same space. Panels mounted in horizontal tracks free the area above the chalkboards for maps, but sometimes chalk causes trouble by getting crushed in the tracks. Panels mounted for vertical replacement make it easy to adjust the height for drawing and student viewing, but they do need counterweights for lifting small boards and motors for raising heavy chalkboards.

Chalkboards are made from a variety of materials that vary greatly in initial costs, ease of writing and cleaning, and durability. They can be obtained in a variety of colors, so one must be mindful of the general reflectance of the boards; they should be light enough to blend well with their background but dark enough to contrast with the chalk writing. Sometimes it is difficult to achieve adequate visibility under normal room lighting, so that chalkboards in large college classrooms should receive supplemental lighting. Geographers are reminded that chalkboard panels can be purchased with a permanently painted rectangular grid, which can be used for locational coordinates.

In addition to wall maps and chalkboards, geographers need plenty of vertical surfaces where flat maps and enlarged air photos can be displayed. The lack of adequate surfaces in many classrooms is evidenced by smudges and peeled paint where maps have been taped to walls. In large lecture rooms where the scale and areal generality of most flat maps are not suitable for viewing from a distance, chalkboards may have limited use; otherwise, there is little danger of providing too much chalkboard space in geography rooms. An entire wall can easily be reserved for maps used in lectures, student reports, and long-term study projects (e.g., notice the walls in Figure 9).

Commercial tackboard may be corkboard on a mounting sheet or a vinyl-covered composition board, but plyboard with a fabric covering of any material that holds and recovers from tacks is suitable. If it can serve also as part of a demountable partition with beneficial acoustical properties, it will provide multiple functions.

As a general rule, a chalkboard, a tackboard, and adjustable hooks for wall maps should be placed in all learning areas, ranging from classrooms to seminar areas to individual study spaces. Even though a portable chalkboard-tackboard combination can be rolled into a room, it is less satisfactory than a permanent set of display surfaces; therefore, these fixed display surfaces are considered general equipment for geography facilities.

21 For more detailed information see 'What Went Wrong?', pp. 109-110; and Frame, Buildings and Facilities for the Mathematical Sciences, pp. 137-141.
Facilities for Projecting Visual Materials

Projecting images on a screen offers another choice for displaying geographic information. Some projection equipment may supplement the display surfaces described above, while other projectors introduce a new dimension by showing motion. From a wide variety of projecting equipment a department must choose the appropriate combination of machines for different learning situations. The equipment described here deals with overhead, slide, and movie projectors, television receivers, and the facilities relating to these machines.

The overhead projector possesses so many teaching advantages it should be part of the permanent equipment in lecture rooms and be available for other learning areas. In auditoriums and large classrooms a projector screen and a stand for the projector are the primary accessory items. The screen needs to be large enough and positioned properly for easy viewing from all seating areas of the room. If the screen is placed in the corner of the room so it does not hide map rails, then wall maps can be seen at the same time. Because the overhead projector is located close to the screen, the top of a 6-foot screen should be tilted 12 to 18 inches farther from the wall than the bottom to avoid a distorted image. The composition of the screen surface should be selected primarily on the basis of the seating arrangement. Matte screens composed of fabric or painted fiberboard appear almost equally bright to all persons sitting within the primary viewing area, so they are generally most satisfactory. If most students are sitting close to the line of projection and the light is dim, then a beaded screen is better.

In rooms where an overhead projector is needed infrequently, fewer permanent facilities are needed. A pull-down mounted screen, a place to stand a portable screen, or an empty wall may suffice for the projection surface. In contrast to an auditorium where a base on which to place the projector may be built within the lectern complex, a small room needs only a set of electrical outlets. This is because a portable stand (cart) that holds supplies for the overhead projector (e.g., an extra projector bulb, extension cord, wax pencils, cleaning rags, extra transparency sheets) and has a place to lay transparencies can provide a useful foundation for the projector.

Slide and movie projectors require somewhat different facilities. The screen, or screens, for front projection can be the same as used for an overhead projector, but the vertical screen for these projections should not be tilted. Most manufacturers of screens provide charts for estimating the appropriate screen size, which relates to the optimum viewing area. In large rooms the size is usually big enough to require a motor for lifting and lowering the screen.

The location of the projector depends upon the focal length of the lens and the desired image size, but these requirements normally place the projector away from the lectern area in a large room. Consequently, facilities should be designed for the operation of the projector, either by another person or by remote control. The most satisfactory arrangement is a projection booth in the rear of the auditorium; this permits operation of the equipment without distraction as well as providing safe storage for the projector. An electronic system with dual controls (i.e., at the lectern and inside the projection booth) that operate the lights and projection equipment facilitates effective presentations.

An alternate method of projecting images in large-group areas utilizes rear projection, which means the projector and viewers are on opposite sides of the screen. Rear projection segregates the noise and confusion of a projection booth from the learning area and eliminates the need for darkening the room, but it requires space "behind" the display area (e.g., similar to the partially encircled areas shown in Figures 3-A and 3-E). The equipment necessitates a translucent screen and projectors with short focal lengths or plenty of projection distance, which can be gained from a set of mirrors. Much discussion surrounds the merits and design of rear projection facilities, so the planning geographer is advised to consult some of the sources listed in this report.

The design for small classrooms in which an instructor uses projection equipment directly may resemble the facilities for an overhead projector. Front projection, a pull screen, and mobile projection stand are adequate for slide and movie projectors. However, it is still helpful to plan light switches from both the lectern and areas near the projection position. Also, in contrast to auditoriums with no windows, small classrooms may have external light that needs to be barred with drapes or blinds.

Television monitors can be used to present information...

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23 See Geography and Educational Media, No. 3 in Topics in Geography series (Normal, Ill.: National Council for Geographic Education, 1967); John V. Battrum and Charles B. Varney, Geography via Projected Media, No. 3 in Do It This Way series (Normal, Ill.: National Council for Geographic Education, 1968); and Thomas D. Best, Geography via the Overhead Projector, No. 7 in Do It This Way series (Normal, Ill.: National Council for Geographic Education, 1968).

24 For suggestions about other audiovisual equipment, see comments about specific rooms in Chapter IV and the latest edition of The Audio-Visual Equipment Directory by the National Audio-Visual Association, Inc.


26 See especially Hauf, New Spaces for Learning.
from public channels, closed circuit networks, video tapes, and video cassettes. This medium is extremely useful for presenting information because it can store all audiovisual stimuli, including the projected images from other equipment. The limited amount of good materials available for several topics taught in college geography and the cost of production are currently major deterrents to more general use, but video production is increasing rapidly, so departments should plan facilities accordingly.

Television images appearing on the TV screen require closer viewing than projectors that use large screens. Only an estimated 25 to 55 students can view the television screen of most monitors, so multiple TV sets must be available for a large group of viewers. Adjustable and pivoting mounts from the wall, ceiling, floor, or on mobile cabinets allow the placement of multiple television receivers in a variety of positions in a large classroom. In small rooms one receiver is usually adequate, but its placement becomes critical. If students are seated at the same level (rather than at tiered levels like in an auditorium) with the average height of viewers' eyes four feet above the floor, the bottom of a 23-inch screen should be almost 7 feet from the floor when seating rows are 3 feet apart and 5 3/4 feet when seat row spacing is 5 feet.

Facilities for the Handicapped

Equipment and general facilities should aid the educational activities of all students and faculty; therefore, the planning geographer must make certain that facilities are designed to benefit persons who are physically disabled. A few general suggestions are made here, but the planner must adhere to the detailed state and federal specifications.

In general, persons with walking disabilities have difficulties in gaining access to rooms, so the planner must remember their needs especially when designing circulation spaces. For persons in wheelchairs, rest rooms should have wide doors, arm supports, and special toilet and washing facilities; doors must operate with handles rather than knobs; telephone and drinking fountains should be available at low heights; and, elevators to upper floors and ramps to entrances must be accessible. The controls for the self-operated elevators must be low enough to reach from a wheelchair and have numbers that can be felt by blind persons.

The needs of deaf and blind persons involve learning facilities as well as circulatory ones. The importance of visualizing spatial relationships in geography generally means that students with hearing handicaps will fare better than those with sight problems. For those with auditory limitations, adequate facilities for displaying and projecting visual materials is extremely important. The planner must provide a variety of display methods so instructors can transmit information through as many senses as possible. Examples are well-labeled maps plus movie and television documentaries that include sign language or subtitles.

Persons with blindness may encounter considerable difficulty in many geography classes. Equipment items aiding blind geographers include a library of audio tape cassettes for the main textbooks, a thermoform machine for making maps and duplicating other materials, and an atlas of Braille maps. To reduce the less severe problems encountered by color-blind persons, color combinations for display facilities (e.g., chalk and chalkboard) must be selected carefully.

Although being left-handed is not regarded as a handicap, such persons may find a classroom with writing surfaces positioned only for right-handed persons an irritation. Approximately nine percent of facilities should be oriented for left-handed persons.

Summary

Many design problems facing a planning geographer are not peculiar to the educational needs of geography. The shape and arrangement of classrooms, the construction and finishing materials, the engineering of the building's environmental systems, and the provisions for handicapped persons are all questions relating to the design of most educational facilities. These more general design problems still require specific decisions from the planning geographer, as well as from other members of the planning committee.

Other design problems are more distinctive to the facilities planned for a geography department. Among the most fundamental requirements for nearly all aspects of geographic work are surfaces where maps can be displayed and analyzed. The geographer logically provides initial guidance...
in solving planning problems relating to displaying maps. The need for display facilities occurs in most geography areas, so a successful design can be generalized and adapted for many rooms.

In addition to those design decisions with wide applications, either throughout educational facilities or throughout geography spaces, others apply to the distinctive facilities needed for specified geographic activities. Some of these space and equipment decisions are considered in Chapter IV.
IV. SPECIFIC GEOGRAPHY SPACES (ROOMS) AND EQUIPMENT

Educational specifications are statements about learning activities and the facilities required to achieve explicit educational goals. The geographer preparing a document of educational specifications must therefore deal with specific spaces and equipment that aid geographic education. General considerations about total area needed, locational relationships of identified spaces, and building facilities provide an essential framework, but they have meaning only when manifested in detailed specifications. These specifications should include comments about objectives for each identified space, activities and persons to be accommodated, and adjuvant equipment.

Educational facilities are described here under seven categories of space corresponding to the groupings used in Chapter II for estimating total floor area. These are subdivided into specific rooms for purposes of discussion; they are not presented as the ideal for every geography department to emulate. As stated previously, no design is ideal for all departments, so the facilities described in this chapter only survey potential geography spaces. These “rooms” represent one possible division of space, so alternate combinations are discussed for most identified areas.

Classrooms

This category includes all areas called classrooms, lecture halls or auditoriums, seminar rooms, and their supporting storage areas. Most persons regard classrooms as the most vital component of educational facilities because these areas are where teacher and student come together most frequently for a direct exchange of ideas.

Basic Classroom

A fundamental facility needed for group learning is the “basic” classroom. The room suggested is octagonal because that shape accomplishes space efficiency and superior acoustical properties (Figures 8 and 9). This room easily seats 94 students and contains a spacious dais in less than 1400 square feet, which averages less than 15 square feet per student station. Combined with efficient floor area are excellent acoustical properties achieved by the non-rectangular shape and the fact that no seat is more than 30 feet from the speaker.

The proximity of students to the front of the room is beneficial in other ways. It diminishes the excessive distance between instructor and students that most college teachers deplore. In addition, it insures that more information on wall maps and similar materials can be seen than is true in many classrooms seating 94 students. Only six rows of armchairs, tiered and in fixed positions, insure that the display areas can be seen easily by all students. By placing the chalkboard with sliding panels, the projector screen, map racks and two television receivers plus the ubiquitous map rails along the three front walls, several display media can be used simultaneously or sequentially. A remote control panel placed on a movable lectern for use when showing slides can be helpful; but the short distance from the dais to the projector cabinet-booth reduces the necessity for such a control panel.

The size of the dais allows space for a small table without hampering the movements of the instructor to and from the maps and other display surfaces. The table can hold an overhead projector, display physical models, serve as a study desk, or function as a speaker’s table. Sometimes it is necessary to adjust the position of the table when it is used as a stand for some projectors; but other projections originate from the cabinet-booth at the rear of the room. The enclosed cabinet-booth provides safe storage for projectors and a cubicle that reduces noise from movie projectors during operation. Sets of recessed lights are arranged and controlled so varying amounts of light can be switched on or off from the projection cabinet, either door, and the lectern. Also, a single directed light focuses on one map rail for instantaneous use when the room is darkened for a slide or movie presentation.

The classroom is not restricted to any particular location in the building provided it is accessible to student traffic yet isolated from disrupting noise. The interior position of this classroom makes designing the areas adjoining the oc-
Figure 8: Basic geography classroom. This octagonal room with a maximum dimension of 42 feet and facilities for multi-media displays is appropriate for classes of varying sizes up to 94 students.
tagonal shape easier; and it eliminates windows, which simplifies darkening the room, aids in regulating ventilation, and reduces outside noises. The absence of windows does not require that the classroom be in an interior position, of course, because buildings can be constructed without windows in exterior walls.

This basic classroom presupposes other rooms designed for lecturing to large groups, conducting laboratory activities, and teaching map skills. In a small department it may be necessary to combine in one room the facilities that support several kinds of activities. If this is the case, the planning geographer may wish to incorporate features suggested for several different rooms into a single room. Ideas for combining an instructional laboratory with a classroom into one multi-purpose geography room have been suggested elsewhere. ²


Another possible alternative is to eliminate the basic classroom. In the past, a college without classrooms implied correspondence courses, but recently several colleges have commenced programs modeled after the Open University of England. These programs, which originate from colleges-without-walls, present information through radio, television, and/or cassettes so students can receive lessons at home or in other non-classroom places. Periodic discussions or testing are sometimes included in these programs, but such group meetings do not depend upon a classroom. The omission of one type of classroom does not necessarily mean concurrently eliminating other campus facilities. In fact, a department that teaches introductory materials through electronic media outside a basic classroom probably will depend more upon other spaces for working with maps, laboratory instruments, and related equipment.

Large Lecture Area

In contrast to the versatile basic classroom is the auditorium, which is used primarily as a lecture hall for large groups. A planning geographer can obtain a variety of sug-
gestions about these areas because they are frequently planned for many users, ranging from public lectures to instructors of diverse subjects. These many interests in large lecture rooms have led to the development of methods for analyzing seat dimensions, row spacings, floor slope, room volume, and associated variables.

The multitude of interests and the various guidelines for auditoriums may reduce the geographer's general responsibility but necessitate more emphasis on the special display surfaces (discussed in Chapter III) required for geographic instruction. The facilities should make it easy for an instructor to use visual and auditory aids that can be seen and heard clearly by all students. A successful presentation of multiple media depends partly upon a good system for controlling facilities during the lecture period. Two or more of the chalkboards, map rails, and projection screens should be motorized so they can be moved quietly and quickly by operating a control panel at the lectern. Similarly, control of lights, including the darkening of windows if any exist, and operating the television and projecting equipment can originate from the same panel.

The large lecture room is normally designed for presenting information but with limited facilities for two-way communication between the lecturer and the class. However, installation of an electronic response system allows an instructor to obtain immediate answers from students. This equipment permits each student to operate an individual responder unit for selecting multiple-choice answers, which are then instantaneously displayed and recorded at the control console. By posing a few key questions throughout a lecture, an instructor can gain information about the successfulness of his/her presentation and can make adjustments accordingly.

Some departments prefer to substitute additional medium-sized classrooms for a large lecture room. These allow smaller classes than usually scheduled in auditoriums and, consequently, permit more direct exchanges between instructors and students than is possible through an electronic response system. If the departmental teaching strategy concentrates upon interaction learning, then areas should always be designed for small classes rather than large groups. If, however, only expository methods are employed, then large-group areas are more efficient in person and space utilization than numerous smaller rooms.

Another alternative to the large lecture room is an area equipped to present information repeatedly through electronic media because reaction learning can also be achieved effectively by viewing presentations recorded on tapes. Once the maps, films, and lecture comments are organized by an instructor, they can be programmed for repeated showings to small groups or individuals. Viewing may occur in a theatre room where a student or staff operator shows selected slides with sound and movie films periodically. Audiovisual tutorial carrels and television viewing areas offer alternatives for seeing programmed materials. Provided the materials are updated periodically, electronic presentations may serve as an adequate substitute for a large lecture area. Obviously, if a geography department decides to eliminate large-group space, it will want the assurance that a campus auditorium will be available on special occasions.

Seminar Room

A room that seats only 10 to 25 persons may be called a seminar room. This space is planned to provide a scholarly setting for instructor and students to study and discuss topics together; consequently, the size of the group should be small enough to allow all members to participate. For geographers, the seminar room needs facilities that aid in presenting and examining maps and similar distributional representations.

In contrast to the basic classroom and the auditorium with their fixed internal arrangements that focus upon the lectern area, the seminar room needs movable furniture. Tables should be small enough for moving and assembling into various shapes, yet large enough to hold flat maps. By furnishing some trapezoidal tables, several variations in composite size and shape can be arranged (Figure 10). Accompanying chairs that can be stacked also aid in easy adjustments for varying class size.

A geography seminar room should be equipped with the same set of display surfaces provided other classrooms: a chalkboard, a rail for hanging wall maps, and a vertical surface (tackboard) for posting flat maps. The size and positions of display surfaces are less critical in a seminar room than in large classrooms because of proximate and movable seating. A projector screen, multiple electrical outlets, and connections for cable television permit bringing projection and television equipment to the seminar room for temporary use.

As an alternative to a separate seminar room, any classroom with movable chairs and a few tables can serve multiple purposes. Some colleges use operable partitions to convert a medium-sized classroom into two or three seminar rooms. The difficulties sometimes associated with operable partitions are usually not severe when separating seminar

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5 Comments on the design of control panels are available in Duncan, *Modern Lecture Theatres*, pp. 292-293.
groups because (1) seminar activities normally do not produce noise problems, and (2) the lack of one permanent wall does not hamper planning adequate display surfaces and electrical connections for small rooms.

Designing a room for both seminar and conference activities makes sense for a small department because both serve small groups engaged in discussions. Potential conflicts can be reduced by carefully scheduling seminars and conference meetings and by establishing a few rules that maintain room appearance.

Storage for Classroom Visuals

Space should be reserved for the storage of departmental materials such as wall maps, transparencies, and other display items used in general classrooms. A separate room may be unnecessary in a very small department with one or two instructors if materials can be stored securely in a classroom. In departments with several faculty members teaching in different rooms throughout a building, the most economical system is a central storage area.

The kind of materials stored will vary, but four kinds are described here: wall maps, transparencies, slides, and extra projectors. The types of storage facilities constructed for rolled wall maps might be grouped as those in which the maps hang, stand vertically, or lie horizontally. The hanging type (Figure 11) is achieved by inserting a hook in the end of map’s encircled wooden rod (i.e., the bottom rod when the map is unrolled, then suspending it from metal rods or a series of pegs. This method has the advantage of easy access to many maps stored in a compact area, so normally it is the best storage type. The second type of storage is accomplished by standing maps individually in tubular swinging frames (Figure 12) and by placing sets of maps in “umbrella stands” or frames (Figure 13). A third general group of map storage facilities are ones that hold maps horizontally on racks (Figure 14), bars, or shelves. Rolled maps placed horizontally will not sag (which may occur when loosely tied maps are stored vertically), but this method usually consumes more area than the vertical methods.

Planning the storage of transparencies, slides, and extra projectors is simplified because they do not depend upon specially constructed storage facilities. A single filing cabinet (standard office style) is satisfactory for keeping mounted transparencies for overhead projectors. The easiest storage for 35 mm. slides are commercial cabinets designed to store several hundred slides. 7 Extra projectors can be kept on portable stands so the units are ready to be moved when needed. If extra projector bulbs, extension cords, and related supplies are not kept with the portable cart, a separate storage cabinet for these items should be planned for the room.

The key to successful storage and retrieval of visual materials is the classification scheme and index to the location of each item. This involves the planning geographer if the length of wall maps affects their categorization and, hence, the proper proportion of long and short racks. If the location of each individual map is indexed, map positions

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Figure 11: Wall maps stored by hanging. A hook in the wooden rod of all maps and a series of hanging bars provide a compact and convenient method of storing rolled wall maps.

Figure 12: Wall maps stored by standing individually. Rolled wall maps placed in tubular swinging frames are easy to classify.

Figure 13: Wall maps stored by standing in groups. A small collection of rolled wall maps can be stored as a group in "umbrella stands."
must be marked, map dividers installed, and provisions for expansion included. Auxiliary retrieval equipment helps in examining specific items prior to class use. For wall maps, this requires only some hooks on which unrolled maps can be hung while the potential user examines them. Many slide cabinets have an opalescent screen that displays an entire rack of slides; if such cabinets are not purchased, then a small lighted surface (or even a nearby window) can serve the same purpose. Two electrical outlets are adequate for testing projectors prior to using them in classrooms. A table or desk for keeping indexes and check-out records supplements the other retrieval facilities.

The shape of a storage room is unimportant, but its location relative to other identified areas should be considered carefully. Because valuable projectors and awkward maps need to be transported to classrooms, the distance between the storage room and the classroom should be minimal. It is especially advantageous to have the storage room located on the same floor as the classrooms it supports in order to facilitate movement of equipment on rolling carts (for projectors and, if desired, for portable wall map carriers). The room environment should be cool, dark, and dry to protect the quality of maps and slides.

Instructional Laboratories

An instructional laboratory serves the same educational objective as a classroom, but it is categorized differently because its equipment restricts its use to fewer kinds of activities. For example, the basic classroom suggested here for geography can serve classes in many other college departments, but a cartography laboratory is more difficult for most other disciplines to use effectively.

Physical Geography Laboratory

The physical geography laboratory is used to study the geography of natural phenomena by directly investigating selected relationships. Demonstration and inquiry methods, rather than reaction learning, are emphasized: consequently, the space should be designed for an instructor with 15 to 25 (with a maximum of 30) students working individually, in small groups, or as a class. Activities may include observing and demonstrating physical models of the earth, physical phenomena (e.g., landforms, weather, soils), measuring phenomena recorded on topographic and other maps, summarizing these data, and formulating principles about the relationships among these and other natural phenomena.

An introductory course in physical geography is offered in most geography departments, but the laboratory facilities supporting this course differ. Some departments combine laboratory equipment with a lecture classroom; others retain distinct laboratory rooms. The latter situation is described here because it illustrates preferred facilities. The proposed physical geography laboratory (Figure 15) is designed primarily for working with maps and earth models on the assumption that students will spend blocks of time in other specialized labs for units on climate, soils, and geomorphology. These specialized laboratories, described under Research Areas, contain the more complex facilities associated with research work but which also provide excellent teaching opportunities.

The proposed physical geography lab contains 15 movable tables, large enough (e.g., 30" x 60") to provide an area for one or two students to work with topographic maps, weather maps, computer print-outs, and similar materials. In addition to the display facilities recommended...

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*It is the most common class in junior colleges, according to Anderson, Geography in the Two-Year Colleges, p. 22.

9See footnote 2 of this chapter.

Also, it should be easy for a user of this publication to select items from a comprehensive list; the alternative situation, i.e., to expand a restrictive list of facilities, would limit the adaptability of this section. For example, water connections are assigned to specialized laboratories in this proposal, but a planning geographer who modifies this plan into a single physical geography room should definitely make it a "wet" lab.
Figure 15: Laboratory for physical geography. Student activities may include observing physical models of earth phenomena and measuring from topographic and other maps; observations and measurements involving more complex facilities are designated for specialized laboratories.
for the basic classroom (i.e., map rails, chalkboard, tackboard, projector screen, and television monitor), long-wall cabinets are furnished with working surfaces at a 3- to 3½-foot height for displaying and using models, maps, and laboratory instruments. The cabinets can be used for storing flat maps (e.g., multiple sets of ones used in lab exercises), globes, relief models, atlases, rock specimens, and similar supplies. Valuable and fragile items (e.g., planimeters, table-top tracing boxes, stereoscopes), may be kept in an adjacent storage and preparation room. In addition to storage, an adjoining room provides space for preparing lab demonstrations, for repairing materials, and as a projection booth.

The recommended 1080 square feet (30' x 36') in this room plus 120 square feet, representing half of the shared storage and preparation room, totals 1200 square feet. Adhering to the guidelines of 68 square feet per student station (noted in Chapter II), this leaves 840 square feet allocated per 30 students. These 840 square feet contribute to the space allocated for teaching activities in the nearby specialized laboratories.11

Cartography Laboratory

The cartography laboratory is designed for teaching and learning the skills of map making. For teaching mapping...
techniques, audiovisual and display facilities recommended for a basic classroom are adequate, especially with the inclusion of large tackboards and chalkboards.

Drafting tables and chairs (i.e., adjustable stools) consume the largest floor area in this room. Approximately 36 square feet are needed for each 3 x 5-foot table with adequate seating area and associated circulation space (e.g., tables in Figure 16 are separated by one foot in rows three feet apart). Other major consumers of space are a light table, a sink, map cases, lockers, and storage area; but floor area can be saved by using alternative kinds of equipment. For example, a general light table for tracing can be replaced by portable tracing boxes placed on the drafting tables, and the number of map cases and lockers can be reduced if the tables include map and instrument drawers. Also, usable space is enhanced if the tables are connected to electrical outlets in the ceiling rather than across aisles to wall outlets or into irksome electrical boxes on the floor.

The cartographic instruments required depend upon the course content and departmental policy regarding student purchases or rental of some materials. Items frequently included in a cartography teaching laboratory are the following:

- Lettering sets (e.g., Doric or Leroy) with inking pens and pencil
- Drafting machines with plastic scales (or, fixed-head T-squares, flat scales, protractors, and triangles)
- Curves, sine and French
- Variable-taper lead pointers
- Bow compasses (4½” and 6½”) with lengthening bar and attachments for pens
- Drop-bow compasses
- Scribing and graving instruments

The relative location of the cartography area may depend upon the degree of specialization designed for various activity-spaces. In a department with very limited facilities, elementary cartography can be taught in any room where portable drafting surfaces can be placed upon standard classroom tables. In another department, the cartography teaching lab may also function as a cartographic workroom, which requires a location with light control. In a department with distinctive areas of specialized usage (as described here), the cartography laboratory should be located near the work and teaching areas for photographic processing, map and photo interpretation, cartographic services, and data calculations.

Map and Airphoto Interpretation

A course that teaches skills in interpreting maps and aerial photographs is useful for college students studying geology, botany, forestry, military science, architecture, regional planning, real estate, etc., as well as geography. Space for explaining and demonstrating these skills should be located near the cartographic complex and the area with specialized equipment used in viewing remote imagery. One requirement for the room itself is a good light control system, including a method for darkening the room.

The audiovisual and display facilities suggested for this room are almost identical to those recommended for the cartography teaching laboratory. One possible variation is a steel chalkboard for holding magnets against aerial photographs. The primary working areas for students are tables whose tops hold wide maps, react to magnetic holders for photographs, and are hard and smooth for precise measuring and drawing (Figure 17). Storage facilities must include map cases for topographic sheets, filing cabinets or library boxes for aerial photos, and locked cabinets for instruments.

Equipment used for teaching an introductory course in airphoto interpretation is suggested elsewhere. A more complete list of items suitable for an advanced course in map and airphoto interpretation may include the following:

- Scanning stereoscope
- Mirror stereoscope
- Zoom stereoscope
- Stereo micrometer
- Stereotape
- Slope estimator
- Stereo-slope meter
- Stereo-comparator
- Height finder
- Polar planimeter
- Air photo slide rule
- Parallax converter
- Radial line plotter
- Portable film viewer
- Vertical Sketchmaster
- Densitometer, reflection
- Densitometer, transmission

Audiovisual Tutorial Laboratory

The audiovisual tutorial laboratory is planned for students to learn by hearing and seeing materials presented on audiovisual equipment. It is an area where students study individually in carrels at their own timing and rates of pre-

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sentations. By listening to taped instructions, each student is directed to view slides, films, maps, and models available in the carrel or at the general display areas. Programmed narration and questions provide auditory explanations and guidance for understanding the visual presentation.\(^1\)

The planning geographer should consider four types of space when designing AVT facilities: the control area, a general display area, the carrel, and a storage area. The control area is for the room supervisor and the master switches for the carrel equipment. In addition to a desk, chair, and filing cabinet for the supervisor, there should be an information board near the entrance of the room for general announcements and for information about the availability of carrels at each moment. If the availability of carrels is reported electronically by lights, a duplicate information board at the entrance of the building (or elsewhere on campus) can be operated remotely.

General display areas may be centrally located tables, on which selected materials are placed (see those pictured in Figure 18), tackboards and map rails, and an adjoining alcove where video tapes, film loops, or other materials requiring specialized equipment are used.

The carrel itself can range in complexity from a study desk with a single slide projector and tape recorder to a soundproof enclosure with a combination of two slide projectors and an audio cassette player with earphones operated from its own control panel. An enclosed carrel should have a window in the door to prevent a feeling of claustrophobia, but other walls must be reserved for a projection surface, tackboard or pegboard, and bookshelves. A control panel that operates the equipment insures better success than if the student has to switch each machine separately.\(^2\)

Storage space is required for slides, extra slide trays, tape cassettes, maps, reserve machines, and extra equipment items (e.g., projector bulbs). The space should adjoin the main AVT room for ease in replacing damaged items quickly and in stocking the machines at the end of each teaching unit.

An AVT room does not have many locational requirements. If the entire building is not air-conditioned, it should be located where the temperature can be regulated

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\(^2\) If this control panel is installed in the writing surface, approximately nine percent of the carrels should have it positioned for left-handed students.
Figure 18. Room for audiovisual tutorials. Open carrels located around a central display table give easy access to learning materials. (Department of Geography, Wisconsin State University, Eau Claire)

easily. The room will probably be open for a longer time each day than other classrooms, so it should be in a secure but convenient situation near the building entrance. The AVT with its accompanying storage space does not necessarily need to be located close to other classroom or teaching areas.

The audiovisual tutorial laboratory is not easily combined with other types of learning areas, so alternatives are limited; however, numerous other kinds of facilities may provide feasible substitutions for the AVT lab in toto. One option, of course, is the rejection of these electronic teaching devices concurrent with greater reliance upon lectures delivered to large groups. Another possibility utilizes a viewing theater where programmed audiovisual materials are shown repeatedly on projection screens or television sets to groups of students. A third alternative, though not equivalent, is the portable carrel kit that permits a student to borrow audiovisual materials and equipment for utilization at off-campus locations. In this situation, few simple carrels should be available for students who want to study near other departmental facilities rather than elsewhere on campus or at home. A fourth choice in those colleges maintaining an all-campus media center equipped with audiovisual tapes and cassettes is to program courses for use at that center. In fact, as video cassettes become more common, these may simplify equipping departmental AVT labs because several media can be integrated on video tapes. A fifth alternative involves computer assisted instruction, which is described in the next section.

Computer Instruction Laboratory

The goal of every educational endeavor is the encouragement of self-generated and self-directed learning. One avenue toward this goal is through the use of computer facilities, specifically field plotters and remote terminals. The field plotter, which is an easily operated analog computer, simulates a wide range of geographic phenomena and illustrates many spatial principles.18 If used by beginning students for solving assigned problems, several plotters on study desks need to be available in a working laboratory. Similarly, remote terminals, either cathode ray tubes or teletypewriters, can be used by a large number of beginning students in computer-assisted instruction (CAI).19 A room containing several computer terminals provides the essential equipment for utilizing this learning method; however, if terminals scattered throughout the campus are available for geography students, the machines need not be concentrated in a single laboratory.

A room equipped with either field plotters or remote terminals used for CAI encourages self-directed learning because both employ individualized, interacting teaching techniques. Even greater possibilities for self-generated learning challenge students in a room where a few field plotters and computer terminals are reserved for student creations of simulation models and related computer analogs.

Special Projects Laboratory

A similar kind of self-directed activity, but not involving computer equipment, depends upon a laboratory designated for constructing special student projects. Common projects in departments with a major emphasis on educational geography may involve producing physical models and visual materials by student teachers for use in primary and secondary schools. The construction of physical models for demonstrations and learning games (e.g., similar to the Portsville model developed by the High School Geography Project)20 necessitates a supply of carpentry and craft tools. Larger equipment items might include a work bench, jig saws, a buffer, a hooded spray booth, and a drying oven.

For students who learn techniques of making classroom audiovisuals for teaching geography,21 equipment that aids in the production of slides, transparencies, and video tapes is required. Basic equipment may include:

- A 35 mm. camera
- Macro lens
- Photocopy stand
- Light box with electronic strobe
- Transparency copy machine
- Vidicon television camera with tripod
- Video tape recorder
- Portable television camera and recorder
- Light package or set of four photoflood lights
- Microphone
- Slide projector
- Overhead projector
- Television monitor/receiver

These facilities can also assist faculty members in preparing visual media for their lectures and AVT programs.

Sound control is the dominant locational factor for this room. Noise, especially that caused by woodworking, should not disturb other areas. Conversely, if the room is used for recording on audiotapes, outside noises must be excluded. Other special considerations in planning the room are ventilation for spray paints, power or fuel for the oven, power for the flood lights, and air conditioning.

Research Areas

This section deals with the space allocated to the “research” category defined in Chapter II. This title will not present problems to departments with both graduate and undergraduate programs and emphasizing activities that lead to publications. Other departments may not qualify for “research” space under a restrictive institutional definition, so this section might initially appear irrelevant for their planning problems. However, many of the facilities described here are extensions of instructional laboratories and can logically be considered part of the “instructional” areas.

Special Laboratories for Physical Geography

Facilities are needed for demonstrating to students, as well as for conducting research into, the processes and in-

terrelationships that produce the areal arrangements of natural phenomena. Instructional and research laboratories are proposed for weather and climate, geomorphology, and soils, but other natural phenomena (e.g., vegetation and ground water) can be studied in a similar manner, so these suggestions are more illustrative than exhaustive. A department wishing to establish a laboratory for advanced research in a specific field should obtain advice from experts in that field, so only the basic equipment is mentioned here.

In learning about the geography of weather and climate, facilities are needed for measuring, recording, storing, and analyzing atmospheric conditions at given earth locations. Although the location of equipment for measuring local atmospheric conditions must be outside the building, cable connections will allow placing recording graphs and dials in a corridor display case or in the weather lab.

Some instruments for measuring and collecting basic weather data are these:

- Thermometer
- Minimum-maximum thermometer
- Sling psychrometers
- Instrument shelter
- Precision microbarograph
- Hygrothermograph
- Standard 8" rain gauge with windshield
- Recording (tipping bucket) rain gauge with remote recorder
- Aerovane-anemometer recorder and transmitter
- A clock with a set of weather dials for continuous reading of temperature, barometric pressure, relative humidity, precipitation, wind direction, and wind velocity

Additional items might include a precision (mercurial) barometer, a mechanical pyronograph (solar radiation recorder), and a high-volume air sampler with accessories and shelter. The space and equipment designed for storing and analyzing atmospheric data will vary with the way this specialized laboratory functions with the general physical geography labs. If, for example, small groups of students spend time in the laboratory while studying a particular unit on weather and climate, appropriate teaching facilities must be provided.

Laboratory facilities for geomorphology invariably include a stream table because of the dominant influence of running water in shaping the earth’s surface. The same wet lab can be used for soil analysis by including gas connections and a fume hood. In addition to the stream table, some equipment for this geomorphology and soils laboratory are:

- Tables with acid-resistant tops
- Wall-mounted cabinets
- Oven
- Refrigerator
- Soil moisture tension apparatus
- Controlled-environment growth chamber
- Soil depth probe
- Soil auger
- Soil test kit
- Set of sieves
- Sediment core assembly
- Sediment separation unit
- Velocity meters

Cartography Work Area

An area designed for all drafting projects, except those assigned in the cartography teaching laboratory, will be used for advanced cartography, cartographic services, and other specialized cartographic work by students, technical staff, and teaching faculty. This area should be located close to the cartography teaching laboratory; in fact, in a small department, the two might be combined in one room. And, like the cartography teaching laboratory, it should be

![Figure 19: Relationship of cartographic complex. Spatial and functional relationships among rooms involving maps and earth imagery are symbolized by their common edges.](image-url)
located near the areas for photographic processing, map and photo interpretation, analyzing remote imagery, and data calculations (Figure 19). In cases where the geography department provides cartographic services for the rest of the college community, this work area and an adjoining office should be accessible for persons who utilize the service.

Equipment for this area should include all items suggested for the cartography teaching laboratory plus the following:

- Stick-up-type machines (Varityper and Headliner)
- Adjustable light-intensity tracing table
- Reflecting projector
- Digitizer and plotter, or automatic digitizer with optical scanning capability
- Diazo printer
- Vacuum frame and pump
- Copy camera

Photo Processing

An important phase of map production converts original drawings to reproducible plates, which involves photo processing. Because photographic reproduction is essentially a functional extension of the cartography complex, an area for this activity should be located near the cartography teaching and work rooms. However, the location of the darkroom may be influenced by the need for water connections, waterproof floors, and adequate ventilation.

The design of a standard darkroom with a light-protected entrance and safelights is usually achieved without difficulty, but supplementary arrangements may be needed if planning a second darkroom for a process camera. Equipment for a basic darkroom includes stainless steel sinks, thermostatic mixing valve with dial thermometer, film storage cabinet with cutter, enlarger, pinpoint light source, printer, film timer, printing timer, washer-viewer, masking easel, film dryer, print dryer, and a large wall clock. If process camera facilities are included, additional items needed are vacuum frames, arc lights, and more work benches.

Remote Imagery Interpretation

Societal demands for more information about environmental relationships have promoted studies that extend the traditional skills and instruments involved with interpreting maps and air photos. With the advent of remote sensors orbiting the earth, voluminous data are now available for analysis; geography, which is one of several disciplines utilizing the imagery from remote sensors, is concerned especially with pattern recognition and environmental relationships.23

A room designed for analyzing imagery should be near areas with the related activities of interpreting air photos and using cartographic equipment. More critically, though, the room should be positioned where vibrations are minimized and where light is easily controlled.

Rapidly developing technology is affecting the equipment related to imagery interpretation faster than items recommended for many other areas. With this reservation in mind, a suggested list of instruments includes:

- Tube magnified, 7x, with .001 and .1 mm. reticles
- Folding stereoscopes
- Height finders
- Rules of various types
- Aerial photo slide rule
- Mirror stereoscope
- Zoom stereoscope
- Photo interpreter light table with overhead carriage

Calculating Room

Calculating equipment is valuable for many aspects of geographic work, so space for it might logically be provided in classrooms, laboratories, offices, and research areas. Rather than supplying many areas with calculating equipment, an effective way of meeting most of these needs is by equipping a single room where students and faculty can engage in quantitative analysis. It must be conveniently located because of the common need for calculating equipment by persons from several different areas; however, the room should be situated where noisy machines do not create a problem.

Installed features in a calculating room include heavy-duty electrical outlets, a stable wall-mounted table for desk calculators, chalkboard, and a tackboard. Suggested furniture items for the room are chairs, storage cabinet, filing

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23 An excellent guide is the inexpensive booklet, Photolab Design (Rochester, N.Y.: Eastman Kodak Company, 1967).
drawers for computer cards, bookcase, and waste basket. Calculating equipment may include: (1) basic calculators, either a variety of standard electronic desk calculators or a calculating system with keyboard units, data storage unit, and electronic package; (2) facilities for interacting with the campus computer, either remote terminal or teletypewriter; (3) facilities for computer graphics, either a hardbed plotter or graphics screen; and, (4) basic auxiliary hardware for computer work, e.g., a key punch.

Alternative designs for an area devoted to calculating equipment depend upon having a few desk calculators within the department plus being near a convenient interdisciplinary calculating area. This alternative is more feasible if a department has a computer instruction laboratory (as described above) where computers might be available during slack hours. However, these computer terminals by themselves are not an adequate substitute because (1) they will be occupied by students engaged in CAI much of the time and (2) many students who need to make simple calculations may not have the necessary skills for using computers.

Faculty Research Area

A geographer requires sufficient office space for working with maps (as explained in Chapter II). This office space may be adequate for certain research activities but very inadequate when analyzing several maps simultaneously, which requires additional research space. The time efficiency resulting when faculty members are able to leave maps spread out for several days also justifies a separate research area. Furthermore, for team projects, a separate place is needed to spread maps, computer sheets, and related materials. Facilities for these activities can be provided in a room equipped with large tables, abundant display surfaces, and ample area for special project equipment.

Offices

Office space is where teaching and administrative personnel work. Most office equipment planned for a geography department may resemble that provided most college departments, but the areal size of geography offices should be greater than the college norm.

Faculty Office

The faculty office is where a professor studies, prepares for classes, confers with students, and engages in some kinds of research. The facilities should provide an environment for accomplishing these goals efficiently. In addition to the “standard” office equipment, a geographer requires a work table (which may be a drafting table) and a map case (Figure 20). Also, some geographers may need an electronic calculator and filing drawers for computer cards, but these two items need not occupy additional floor space if they are placed on the work table and under the stand holding map cases, respectively.

Faculty offices should be isolated from noisy and congested areas, yet accessible to students. Because most professors prefer a window, offices should be positioned along an exterior wall.

Chairperson’s Office

The departmental administrator (i.e., chairperson, head, director) needs an office where both faculty and administrative duties can be performed. Compared to other faculty activities, the administrative obligations require extra equipment (e.g., filing cabinets and chairs) and additional space for meeting with small groups and working on administrative projects and reports. The administrator’s office should be close to the main departmental reception area (Figure 21) and where a second exit is available.

Conference Room

A room where faculty, students, and visitors can hold special meetings is important for many small group activities. The conference room should contain a large boat-shaped table with seating for a dozen persons plus the same kind of display surfaces and audiovisual facilities as those recommended for a seminar room.

Departmental Office Area

Space and equipment are required for the myriad of secretarial and clerical activities that support the educational program. The arrangement and sizes of spaces may vary (Figure 21), but they should include a reception area, secretarial and clerical sections, and storage space. The reception area is where visitors and communications are received and re-directed, so it should contain controls for a telephone and intercom system, mail boxes, and chairs for visitors. Space is needed for typists who handle general departmental, administrative, and faculty typing needs. Associated with these secretarial stations should be a workroom containing equipment for copying, cutting, collating, and stapling materials. If a department uses a safe for temporary storage of tests after they have been duplicated.

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24 This isolation includes the need for privacy, which is a fundamental condition for effective college work; see, e.g., “Now, A Systems Approach to Furniture for Faculty Offices,” EFL College Newsletter, No. 86 (1970), p. 9.
Figure 20: Offices for geography faculty members. Each arrangement of furniture is suggested for a geographer with 170 square feet of office space.

Figure 21: Geography departmental offices. The diagrams show two possible clusters of rooms around the departmental reception area. Details about the placement of doors and furniture must depend upon the specific positioning of corridors and exterior walls.
and assembled, the workroom is a logical location for it. For larger departments, an office for a second administrator (i.e., an assistant chairperson or executive secretary) should be incorporated into the departmental office complex.

Study Carrels for Student Instructors

Advanced students who assist in the instructional program need space where they can study, keep their teaching materials, and confer with the students under their supervision. The space can be shared in an extra faculty office or delimited by using demountable partitions in a large room. Within this space each student instructor needs a desk, chair, filing drawer, bookshelves, and tackboard plus access to an extra chair, extra filing drawers, telephone, and a map drawer.

Such space and equipment are suggested for a situation where the student instructor is responsible for a portion of some course (e.g., supervising laboratory sessions). However, if graduate students are assigned full responsibility for regular classes, their facilities should resemble those of other faculty members. Conversely, if students only assist faculty instructors and thus have no exclusive teaching responsibilities, their facilities can be reduced accordingly.

Library Areas

The storage and retrieval of library materials is important to all academic disciplines. For the geographer, the concern with proper facilities is accentuated because maps create special problems of classification, storage, and circulation.

Map Library

College map libraries are frequently housed within geography departments for staffing reasons and because the majority of users are usually geographers. The importance of the personnel factor is illustrated by the fact that "geographers seem uniquely qualified to participate in selection, classification, and interpretation of maps in libraries."25 Obviously, if the college maintains the all-campus map collection in the main library, the planning geographer will not need to design a map library for geography quarters. When these circumstances apply, the department may only need space for some supplementary cases holding flat maps used in teaching. If, however, the college delegates the responsibility for the campus map library to the geography department, the following comments are pertinent.

The map library should be located on the ground floor because of the weight of stored maps.26 This location usually makes the library more accessible to campus users than elsewhere in the building; it simplifies keeping the library open when other parts of the building are locked; and, it makes deliveries easier. Within the map library area, space must be designed for the map collection, a study area, supplementary storage, displays, acquisitions and cataloging area, and the curator’s office. Whether all of these areas are clearly identified or not depends partly upon the size of the map collection. A collection of 100,000 maps, which is illustrated here (Figure 22), is a size for which these divisions in a map library are discernible.27

Most maps are kept in 5-drawer metal cases with inside dimensions of 30” x 42” x 2”, but other dimensions are suggested for some situations. Drawers of size 36” x 48” hold two stacks of U.S.G.S. topographic sheets; and 42” x 72” drawers are needed for navigation charts and other oversize materials.28 Maximum depth of drawers is normally 2-2½” because, if maps are stacked higher than two inches, it is difficult to withdraw those at the bottom. Some librarians prefer to keep maps that are removed frequently in drawers no deeper than 1¼”. If the cases in the main part of the library are stacked three high with plexiglass sheets on the top, they can serve as a temporary writing and working surface. Cases in the supplementary storage area may be stacked higher as the collection grows.

Maps belonging to a set requested frequently can be assembled in large spring-back covers, which are placed on wide but closely spaced shelves (Figure 23, left center). Atlas cases with roller shelves (Figure 23, center back) are valuable for holding many atlases of varying sizes. Other standard library items include vertical files for small maps and air photos, shelves for current periodicals, a filing cabinet for card catalog, study tables, and chairs. A copying machine, a light table, and an enclosed area for a tracing instrument that changes map scale (e.g., a Map-o-Graph) are needed where scholars copy maps. A roll of tracing paper from which users can purchase individual amounts is a welcome service. If plastic relief maps are kept with this collection, map rails for hanging the large ones around the room are a

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26 For example, four full map cases weigh more than 200 pounds per square foot. For additional weight estimates see Bahn, "Map Libraries—Space and Equipment," Figure 1.
Figure 22: Floor plan of map library. A collection of 100,000 flat maps can be stored, retrieved, and studied comfortably in an area of approximately 2,000 square feet.
should be installed high above the map cases. Small maps with raised relief may be stored in cabinets with shelves 28" x 40" x 4". Standard equipment for the curator’s office, tables and a sink for the acquisitions area, and display cases for the exhibit area are other items suggested for the map library.

Departmental Storage Library

Even though the campus library contains the main collection of materials relating to geography, selected items such as reference materials, census and similar documents, theses and other departmental publications, and basic geography books should remain where students and faculty have ready access to them. Fulfilling this objective usually requires designating a room within the geography quarters as a "departmental library." When this room is primarily a storage area for documents, decisions about the internal design may be secondary to locational factors. Access to the documents, and their removal, can be controlled without a librarian when the room is located close to the main departmental office. Also, short-term use of materials is aided by locating the room adjacent to a general reading room.

The principal equipment for the storage of departmental library materials is adjustable shelving. A simple check-out procedure might use a filing cabinet, desk, and chair. Reading facilities are not suggested for this room, but rather for a separate reading room (see below).

Commons Area

Academic ideas and inspiration are not confined only to classrooms and laboratories; scholars often find intellectual stimulation in informal discussion. To design areas where faculty and students can relax and discuss common interests is another way of promoting educational objectives.
Commons Room

Faculty, students, and others associated with a college department frequently cluster around a coffee pot near someone's desk, a vending machine, a spot in the student union, or an off-campus cafe. This is not to deny that scholarly discussions, as well as relaxation, may occur at any of these places, but an area designed to encourage an exchange of ideas in an informal setting within the geography quarters is a wise use of space. To maximize the benefits derived from a commons area, it should be space common to all persons associated with the department, that is, one commons room rather than separate lounges for faculty and various categories of students. The area is most effective when located in the vicinity of the main departmental office.

Equipment in a commons room needs only to serve the functions of the area. A carpeted room with sofas, easy chairs, and magazine racks aids in relaxing; a kitchenette with heating unit, sink, refrigerator, and cabinet assists in snacking and serving "teas" on special occasions; a tackboard helps in posting messages; and a small chalkboard may prove handy during informal discussions.

Reading Room

A room within the geography quarters where students can read and study between classes achieves several educational goals. It can serve as part of a campus system of scattered study areas, as reading space for users of the departmental storage library, and as a place for geography periodicals and "reserve" reading materials.

Furniture items may include the following: tables with chairs, bookshelves, filing cabinets, magazine racks, and easy chairs. A tackboard and hooks for maps equip the room especially for geography students. For departments that provide lockers for geography majors, a portion of this room is a logical location for them.

An alternative design for departments with a small total floor area combines the reading room and general commons room, even though the multiple uses might sometimes disturb the study environment. Other designs with limited floor space might assign the commons activities to the special projects laboratory or a seminar room during specified hours.

Equipment Storage

The efficient use of space is partly dependent upon removing from working areas those materials not currently in use. This necessitates designing places to temporarily store such items. The majority of storage space should be associated with the areas it serves (e.g., a room for rolled maps and other visuals near classrooms, shelves for laboratory materials adjoining the instructional laboratories, and storage cabinets for the AVT supplies near the tutorial carrels). Nevertheless, a department usually possesses other equipment requiring additional storage space.

Field Equipment

Field equipment requires storage space, but it is not easily associated with a specific room because of its utilization outdoors. The storage of field items is preferably on the ground floor for easy loading into vehicles; otherwise there are few restrictions on the size, shape, or position of the storage area. Adjustable shelves and storage cabinets should be provided for keeping items in order.

Instruments used in field geography often include:

- Plane table with tripod
- Alidade
- Stadia rods
- Hand level
- Pocket transit
- Topographic chain
- Engineering tape
- Marking stakes
- Theodolite

Miscellaneous Materials

Storage space may be required also for extra special faculty collections, supplementary wall maps, plus other materials peculiar to each department.

Some geography departments convert flat maps into wall maps for hanging in classrooms. If no woodworking room is designed (see Special Projects Laboratory), space in a "storage room" can be used for map mounting. A common type of map mounting requires a wooden panel 9' x 12' on which muslin can be tacked, a sink for mixing the wallpaper paste, and shelves for storing the supplies (e.g., the muslin backing, paste, half-rounds, tacks, nails, and a few tools).

Summary

Geographers need classrooms, instructional labs, offices, research areas, library areas, commons areas, and space for equipment storage to support the varied educational activities of a college program. The manner in which space and equipment are allocated to these various activities by each department results in widely different solutions. Space requirements vary with the type of geography program, the size of the department, and the type of facilities available. The efficient use of space is partly dependent upon removing from working areas those materials not currently in use. This necessitates designing places to temporarily store such items. The majority of storage space should be associated with the areas it serves (e.g., a room for rolled maps and other visuals near classrooms, shelves for laboratory materials adjoining the instructional laboratories, and storage cabinets for the AVT supplies near the tutorial carrels). Nevertheless, a department usually possesses other equipment requiring additional storage space.

Mounting equipment can be simplified by purchasing iron-on backing material (e.g., Chartex from Seal Industrial Products, Inc); in which case only facilities for attaching half-rounds and hangers are needed.
department depends upon several factors. Consequently, the merits and limitations of design alternatives must be examined within the context of these factors. This chapter presented definite suggestions for most kinds of learning activities occurring in geography departments, hence it may serve as a base for developing other designs. It is hoped that each planning geographer can combine these suggestions with the recommendations originating from other sources into a unique design that promotes the educational program of a specific college.
APPENDIX: SOURCES OF INFORMATION

Organizations

A very valuable source of information for the planning geographer may be an organization whose primary function is to provide help in planning educational facilities. Listed are the major national organizations dedicated to improving the design of college facilities.

Council of Educational Facilities Planners, 29 West Woodruff Avenue, Columbus, Ohio 43210, is a nonprofit association of individuals, institutions, and firms whose activities include planning, equipping, and maintaining educational facilities. Information can be obtained from the Guide for Planning Educational Facilities and other publications listed in the Bibliography plus periodical issues of CEFP Journal.

Educational Facilities Laboratories, Inc., 477 Madison Avenue, New York, N. Y. 10022, is a nonprofit corporation funded by the Ford Foundation to help schools and colleges by encouraging research and experimentation and the dissemination of knowledge about educational facilities. Information is available from several publications listed in the Bibliography and, prior to August 1972, the EFL College Newsletter.

Society for College and University Planning, 616 West 114th Street, New York, N. Y. 10027, is an association concerned primarily with facilities for higher education. Their newsletter, Planning for Higher Education, is now published by the Educational Facilities Laboratories.

Educational Resources Information Center, Clearinghouse on Educational Management, University of Oregon, Eugene, Ore. 97403, one of several ERIC units funded by the National Institute of Education, collects information about educational facilities. Research reports are announced in Research in Education, U.S. Government Printing Office, Washington, D.C. 20402, and journal articles are listed in Current Index to Journals in Education, CCM Information Corporation, 866 Third Avenue, Room 1126, New York, N. Y. 10022.

Publications

Information about new technology and current educational research is available from many magazines and other periodical publications. Several educational journals may be helpful, but those that frequently have news relating to equipment decisions are cited.

American School and University, 757 Third Avenue, New York, N.Y. 10017, a monthly journal concerned with the planning, furnishing, and maintenance of educational facilities.

Architectural Record, P.O. Box 430, Hightstown, N.J. 08520, a monthly journal with architectural information about facilities for colleges.

Audiovisual Instruction, devoted to educational methods of instruction; published ten times a year by the National Educational Association of the United States, Department of Audio-Visual Instruction, 1201 Sixteenth Street, N.W., Washington, D.C. 20036.

The Audio-Visual Equipment Directory, an annual publication by the National Audio-Visual Association, Inc., 3150 Spring Street, Fairfax, Va. 22030; describes and lists suppliers for many kinds of classroom equipment.

College and University Business, 1050 Merchandise Mart, Chicago, Ill. 60654, a monthly journal concerned with college problems including the planning of facilities.

Educational Technology, 140 Sylvan Avenue, Englewood Cliffs, N.J. 07632, a monthly magazine reporting especially on new educational equipment.

EPPE Educational Product Report, an annual set of nine issues published by the Educational Products Information Exchange Institute, 386 Park Avenue South, New York, N.Y. 10016; impartial and independent studies of the availability, use, and effectiveness of educational equipment.

Guides to Educational Media, a guide to catalogs, professional organizations, and periodicals on educational media published occasionally (3rd ed. in 1971) by the American Library Association, 51 East Huron, Chicago, Ill. 60611.

Learning Directory with an annual supplement published by Westinghouse Learning Corporation, 100 Park Avenue, New York, N.Y. 10017; provides information, including names of suppliers, on many kinds of classroom equipment.

Sweet’s Information Services, an annual set of catalogs on architectural materials and equipment; should be available in many college libraries.

Training in Business and Industry, 33 West 60th Street, New York, N.Y. 10023, a monthly journal about educational methods and equipment used by businesses in their training programs.

Equipment

Equipment catalogs from supply companies are valuable references for planning facilities. Variation in size and diversity of products makes it difficult to formulate a universal list of suppliers for any one type of educational equipment; nevertheless, catalogs from representative companies can
provide a basis for learning about many available items. Lists of suppliers for particular kinds of equipment are published (e.g., equipment guide for photogrammetry), but the most comprehensive list is the annual one issued by the American Association for the Advancement of Science in its journal, *Science*. Some of the companies whose catalogs may aid planners of geography facilities are listed below.

**Maps and Relief Models**
American Map Co., Inc., 3 West 61st St., New York, N.Y. 10023
Benefic Press, 10300 West Roosevelt Rd., Westchester, Ill. 60153
Cenco Scientific Co., 2600 South Kostner Ave., Chicago, Ill. 60623
George F. Cram Co., Inc., 730 East Washington St., Indianapolis, Ind. 46206
Denoyer-Geppert Co., 5235 Ravenswood Ave., Chicago, Ill. 60640
Hammond Inc., Maplewood, N.J. 07040
Hearne Brothers, 26th Floor–First National Bldg., Detroit, Mich. 48226
Hubbard Scientific Co., 2855 Shermer P.J., Northbrook, Ill. 60062
Jeppesen and Company, 8025 East 40th Ave., Denver, Colo. 80208
Kirtler Graphics, Inc., 4000 Dahlia St., Denver, Colo. 80216
A. J. Nystrom & Co., 3333 Elston Ave., Chicago, Ill. 60618
Rand McNally & Co., P.O. Box 7600, Chicago, Ill. 60680
Science Related Materials, Box 1422, Janesville, Wis. 53545
Seal Industrial Products, Inc., 251 Roosevelt Drive, Derby, Conn. 06418
Weber Costello Co., 1900 North Narragansett Ave., Chicago, Ill. 60639

**Cartographic and Photogrammetric Equipment**
Abrams Instrument Corp., 606 East Shawnees St., Lansing, Mich. 48901
Air Photo Supply, 158 South Station, Yonkers, N.Y. 10705
Art-O-Graph, Inc., 529 S. Seventh St., Minneapolis, Minn. 55415
Bausch & Lomb, 635 S. Paul St., Rochester, N.Y. 14602
Eugene Dietzgen Co., 22 W. Madison St., Chicago, Ill. 60602
Fairchild Space & Defense, 300 Robbins Lane, Syosset, N.Y. 11791
Hamilton Manufacturing, 1316 18th St., Two Rivers, Wis. 54241
Wild Heerbrugg Instruments, 465 Smith St., Farmington, N.Y. 13669
Instronics, Inc., Suite 204, Bridge Plaza, Ogdenburg, N.Y. 13669
Itek Corporation, 10 Maguire Rd., Lexington, Mass. 02173
Kelsch Instrument Co., 2411 W. Fayette St., Baltimore, Md. 21223
Krafft & Esser Co., 20 Whippney Rd., Morrisztown, N.J. 07960
Kreonite, Inc., 715 East Tenth St., Wichita, Kans. 67201
Polaroid, 549 Technology Square, Cambridge, Mass. 02139

The Richards Corp., 1545 Spring Hill Rd., McLean, Va. 22101
Sticor Corp., 285 Emmet St., Newark, N.J. 07114
Vactyper Corp., Div. of Addressograph-Multigraph Corp., Newark, N.Y. 14513
Visual Products Division, Minnesota Mining & Mfg. Co., 2501 Hudson Rd., St. Paul, Minn. 55119
Carl Zeiss, 444 5th Ave., New York, N.Y. 10018

**Calculating Equipment**
Burroughs Equipment & Systems Division, 6071 2nd Ave., Detroit, Mich. 48232
Friden Division, Singer Co., 2350 Washington Ave., San Leandro, Calif. 94577
Hewlett-Packard, 1501 Page Mill Rd., Palo Alto, Calif. 94304
Honeywell, 200 Smith St., Waltham, Mass. 02154
IBM, 1123 Westchester Ave., White Plains, N.Y. 10604
Interpretation Systems, Inc., P.O. Box 1007, Lawrence, Kans. 66044
Monroe Calculator Co., 550 Central Ave., Orange, N.J. 07051
Oliver Corp., 500 Park Ave., New York, N.Y. 10022
SCM Corporation, 299 Park Ave., New York, N.Y. 10017
Sharp Electronics, 10 Keystone Place, Paramus, N.J. 07652
Wang Laboratories, 836 North St., Tewksbury, Mass. 01876

**Equipment for Physical Geography**
Bendix, 1400 Taylor Ave., Baltimore, Md. 21204
Epic, 150 Nassau St., New York, N.Y. 10038
Fisher Scientific Instruments, 711 Forbes Ave., Pittsburgh, Pa. 15219
Geo Materials Technology, 435 E. 3 St., Mount Vernon, N.Y. 10553
Humboldt Mfg., 7300 W. Agatite Ave., Chicago, Ill. 60656
Kahl Scientific Instruments, Box 1166, El Cajon, Calif. 92022
Soilmoisture Equipment, Box 30025, Santa Barbara, Calif. 93105
Soiltest, 2205 Lee St., Evanston, Ill. 60201
Stratex Instruments Co., Box 27677, Los Angeles, Calif. 90027
Testing Machines, 400 Bayview Ave., Amityville, N.Y. 11701
Vap-Air, 6444 W. Howard St., Chicago, Ill. 60648
Robert E. White Instruments, 33 Commercial Wharf, Boston, Mass. 02110

**Materials for Teaching Physically Handicapped Students**
American Printing House, 1839 Frankfort Ave., Louisville, Ky. 40206
American Thermoform Corp., 8640 E. Sawson Ave., Pico Rivera, Calif. 90606
Alexander Graham Bell Association for the Deaf, Inc., Volta Bureau, 1537 Thirty-fifth St., N.W., Washington, D.C. 20007
Howe Press, Perkins School for the Blind, 175 Beacon St., Watertown, Mass. 02172
Recording for Blind, Inc., 215 East 58th St., New York, N.Y. 10022
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"What Went Wrong?": *Maintenance and Operation Errors to Avoid In Educational Facility Planning*. Columbus, Ohio: Council of Educational Facilities Planners, 1968.
