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FOREST TECHNOLOGY, A SUGGESTED TWO-YEAR POST HIGH SCHOOL CURRICULUM.

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ADMINISTRATORS, SUPERVISORS, TEACHERS, AND ADVISORY COMMITTEES MAY USE THIS GUIDE IN PLANNING AND DEVELOPING FULL-TIME, 2-YEAR, POST-HIGH SCHOOL EDUCATIONAL PROGRAMS TO PREPARE FOREST TECHNICIANS. IT WAS DEVELOPED BY EDUCATORS, PROFESSIONAL FORESTERS, EMPLOYERS, AND U.S. OFFICE OF EDUCATION PERSONNEL. PROGRAM CONSIDERATIONS DISCUSSED INCLUDE (1) OCCUPATIONAL INFORMATION REGARDING TECHNICIANS, ABILITIES REQUIRED, AND ACTIVITIES PERFORMED, (2) FACULTY, (3) STUDENT SERVICES, (4) RESOURCES, (5) FACILITIES, (6) ADVISORY COMMITTEES, AND (7) CONTINUING EDUCATION. A GENERAL DISCUSSION OF THE CURRICULUM COVERS A DESCRIPTION OF THE COURSES, THEIR CONTENT, AND THEIR RELATIONSHIP TO OCCUPATIONAL AND ORGANIZATIONAL REQUIREMENTS. THE HOURS REQUIRED, COURSE DESCRIPTIONS, COURSE OUTLINES, AND BIBLIOGRAPHIES ARE PROVIDED FOR (1) 13 TECHNICAL COURSES SUCH AS ELEMENTARY FORESTRY SURVEYING, DENDROLOGY, FOREST ORIENTATION SEMINAR, AND ELEMENTARY FOREST MEASUREMENTS, (2) ONE MATHEMATICS AND SCIENCE COURSE, (3) SIX AUXILIARY OR SUPPORTING TECHNICAL COURSES SUCH AS BOTANY AND TECHNICAL REPORTING, AND (4) FOUR GENERAL COURSES SUCH AS COMMUNICATIONS SKILLS AND ELEMENTARY BUSINESS MANAGEMENT. DETAILED INFORMATION IS GIVEN ON LIBRARY FACILITIES AND CONTENT, LABORATORY AND PHYSICAL FACILITIES, AND EQUIPPING LABORATORIES AND THEIR COSTS. THE APPENDIX INCLUDES A LIST OF SOCIETIES PERTINENT TO FOREST TECHNICIAN EDUCATION AND A PROCEDURE FOR LABORATORY REPORT WRITING. AN EXTENSIVE BIBLIOGRAPHY IS INCLUDED. (JM)

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FOREST TECHNOLOGY

A suggested curriculum for a two-year full-time program to educate highly-skilled forest technicians is necessary due to the rapid technological development in forestry and the crush of major field endeavors to the professional. The need for highly-skilled forest technicians continues to be critical in light of the increasing degree of sophistication in the field of advanced technologies in forest management.

This publication is intended as a guide for program planning and development, primarily in post-high school institutions. It is expected that adaptations will need to be made to suit various situations in several kinds of schools. The curriculum is a product of the efforts of a number of people - educators, professional foresters, employers and the staff of the Office of Education, Technical Education branch, concerned with the improvement of public education services.

This guide offers suggested course outlines, sequence of technical education procedures, laboratory layouts, equipment and land requirements, texts and references, discussions of library, lists of laboratory equipment and costs, and a selected list of scientific and technical societies concerned with the field of forestry. It is designed to assist school administrators, supervisors, department heads, instructors and advisory committees, who will be planning and developing new programs or evaluating existing programs in Forest Technology.

THE FOREST TECHNOLOGY PROGRAM

General Considerations

In recent years the conservation movement in America has surged forward with the rapid awareness by the public for the need for the protection and conservation of the natural resources. There has also been concern about present and future manpower needs for the management and efficient use of forest lands and other natural resources.

Various reports (too numerous to mention here) have demonstrated the need and the demand for greater depth in formal training and informal on-the-job training.

It is widely recognized that the practice of forestry always has required and always will require a large amount of technical work between the vocational and the professional levels.[1] It has been the general practice to get this technical work done by a combination of bachelor degree holders, student candidates for bachelor degrees, or persons without formal collegiate training, but with practical woods experience and informal training. Indeed, many early attempts to formally train one- and two-year forest technicians have been failures.[2]

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[1] H. W. Blenis, The Indispensable Forest Technician, Washington, D.C.: 1962, pp. 651-653.

[2] S. T. Dana and E. W. Johnson, Forestry Education in America Today and Tomorrow, Washington, D.C.: Society of American Foresters, 1963.

A technician is broadly defined as a person who occupies a position of intermediate responsibility between that of the professional practitioner or scientist on the one hand and the skilled vocational assistant on the other. Such a "middle man" in forestry has been extremely difficult to define. It is evident that "technician" is a generic term encompassing many and varied levels and types of technicians.[1]

As a middle man, the forest technician works under the general supervision of the professional forest manager, scientist, ecologist or biologist--supporting him, supplementing him, and freeing him for more duties requiring truly professional or scientific judgments.

The following rather lengthy definition of a forest technician may be helpful in defining a forest technician. "The forest technician is a person competent to occupy a responsible position in the line of authority between the skilled forest worker and the professional forester. He directs the activities of the former under the supervision of the latter and must apply in a responsible manner proven techniques which are recognized as being professionally sound. The techniques employed demand acquired experience and knowledge of forestry combined with the ability to work out the details of a task in the light of well established practices.

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[1]Editors 1966, Technician Education Yearbook, Ann Arbor, Michigan: Prakken Publications, Inc.

"The forest technician differs from the semi-skilled (vocational) worker in his knowledge of forestry theory and methods. The senior forest technician occupies the area between the skilled forest worker and the forester at the end of the spectrum closest to the professional forester. Technical training suggests the practical aspects of a training program--the application of methods and techniques associated with an applied science and a profession. The forest technician requires an education in training sufficient to enable him to understand the reasons for and the purposes of the operations for which he is responsible. He must be able to speak the same language as the professional and appreciate the professional point of view. The technician does not require either the depth or extent of scientific understanding required of the professional but he must have a practical working knowledge of the identical subject matter."[1]

Education

It should be possible for any student to go from a manual skilled operation such as a scaler or a skidder operator or any other type of manual skill into a technical training program provided that he shows the general aptitude and has the interest plus a basic understanding of scholastics. If he lacks the ability and other prerequisites, he should be

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[1]Minutes of the October 25, 1965, meeting of the Society of American Foresters Committee on Training of Forest Technicians, Detroit, Michigan.

encouraged to go into a trade or technical post-high school program in order to obtain the necessary mental aptitudes. It is also apparent that any person who cannot cope with a technical training program should never be considered an utter failure. He should have, if he is able to get into the technical training program in the first place, the ability to become highly skilled in his own specific field in a vocational skill.

The important point is this: employers who select candidates to send to vocational and technical programs will either have to select men with increasingly better basic education or select men with promise and encourage, help or otherwise assist them to improve their basic education before they can proceed to vocational or technical programs. The alternative, of course, must be to let the schools seek and select those with sufficient basic education to enable them to handle the vocational and technical courses; the employers will then recruit men with formal training and give them practice and experience on the job after they have left school instead of before. The best answer appears to be a combination of both operations whereby the educators, through a system of selective examinations, can choose those students with sufficient mental qualifications to enable them to do the technical scholastic work that is required. The one major problem appears to be that there is no test yet developed which will test the motivation of any student and this is where the employer who supplies or encourages a field man to go to a technical institute will have the advantage. This man, provided he has sufficient scholastic aptitude, has previously demonstrated his knowledge and interest in the field of forestry and is probably a far better risk with the ultimate objectives of graduating and moving back into the ranks of forest workers than is the man without previous forestry experience.

Although the principles of forestry have been known and have been practiced for over sixty years in the United States, it is just being understood that the field of forestry bears the same pressures as other fields, and with the increase in the federal activities in the forest resource management field with the passage of the Land and Water Conservation Fund Act in 1963, it is apparent that the population pressures and governmental activities have produced and will produce a need for more and better trained technicians. With the impact that the population has had and the increased technologies and the competition within companies for producing a better product faster, it is also apparent that these companies are in the process of great revision in their personnel policies. As a result, the forest technician is in greater demand now than ever before. Through the advent of the war in Viet Nam and the consequent reduction of the available labor force along with the awakening of the industry to the need for highly trained technicians to take over some of the "leg work" of the professional, it is considered that the field of forestry is wide open for potential prospects of a technician nature.

The objectives of the total curriculum recommended in this guide is to produce a competent forest technician. The technician must be capable of working and communicating directly with forest engineers, professional foresters and scientists as well as the production personnel in his area of work; he must satisfactorily perform work for his direct employer and also show the potential for growing into positions of increasing responsibility. In addition, the graduate forest technician should be an active, well informed member of his community and of society as a whole.

Any curriculum which, when mastered, will produce the type of graduate described above, must be carefully designed. Each course must be planned to develop the student's knowledge and skills in his particular area and be directly integrated into the curriculum. The sequence of courses is specially constructed to contribute uniquely toward the final objective of producing a competent forest technician. If close correlation of courses making up the curriculum is not maintained, the curriculum cannot provide the depth of understanding required of modern forest technicians.

The technical content of the curriculum is intended to supply a wide background in the diverse areas of applied forestry. A firm foundation in basic forestry techniques and basic forestry activities is supplied in the first year. The second year of work builds directly on this background. The method of analysis steadily becomes more sophisticated as the student progresses through the curriculum. There must be a strong emphasis on mathematics and the advanced techniques relative to inventory considerations.

Objectives of a Two-Year Program

Post-high school technical training in forestry is important not only to the employer, but to the many young persons, especially from rural areas, who are unable or unwilling to undertake four-year college instruction but who are interested in practical things and are capable of assuming formal study beyond high school. An educational gap exists between rural and urban youth. Only about one-third of rural youths go to college compared to about one-half of urban youths. This in itself is a sufficient criteria of the need for alternative educational outlets beyond the high school.[1]

Really high quality is a mandatory requirement to a successful technician education program. A competent trained teaching staff, adequate forest area, well equipped laboratories with apparatus representative of that used in the most modern forest industries, a good library, adequate classrooms, and an administrative direction sincerely dedicated to quality occupational education are eseential. It normally takes a minimum of five years and many thousands of dollars to establish a new program, assemble a staff, equip facilities and graduate the first class or two. When these graduates are successfully employed and competently advertising their

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[1] Editors 1966, Technician Education Yearbook, Ann Arbor, Michigan: Prakken Publications, Inc.

success to their peers and parents, the program is well started.

A poor program, on the other hand, is by far the most expensive of all. It costs almost as many dollars, wastes the time and the effort of the students and the staff, and most of all, disappoints future employers and disillusions students and their parents.

Planning the Technician Training Program

It is recommended that each state review its needs for forest technician training and the need of its youth for technician training. No state should be excepted from this concept. A state coordinating advisory committee should be set up in each state. It should include representatives of state departments of education, state, private institutions of higher education, including the community colleges, vocational-technical institutes, local education systems, and professional foresters and forest business entrepreneurs. A close liaison should be maintained with appropriate representatives of the state legislature and with federal agencies involved in education and training programs.

Cooperation within and between state agencies, educational institutions and local school districts, including reciprocal agreements on tuition and other matters, are highly essential. This is especially important in view of the needs of reducing program costs by eliminating or reducing duplications and inefficiencies. It is particularly important for training programs with relatively small enrollments.

While it is felt that every state should review its needs, it does not necessarily follow that all states should offer training programs for forest technicians. The possibility exists of regionalized efforts, perhaps through existing agencies such as the Western Interstate Commission for Higher Education, the Southern Regional Educational Board, the New England Board of Higher Education and the Committee for Institutional Cooperation in the Midwest. This should be explored, with a view toward assessing the needs and developing the means for such arrangements as establishing new training programs in certain specialties on an interstate basis, providing an interstate enrollment in existing curriculums, and establishing reciprocal agreements that will allow out-of-state students to participate in training programs without financial penalty.

Assessing the Capabilities of Establishing a Program

Educational programs may be needed, but the capability of providing them may be lacking. After a need survey has been completed, an institutional self-study to determine capability should be undertaken. Technical education programs must be of high quality or the student, his future employer and the college's reputation will all suffer.

Affirmative answers to the following questions should be assured before the decision is made to offer any new curriculum, even if the need for it has been definitely established.

1. Is adequate forest land available?

2. Can a well qualified faculty be obtained?

3. Will suitable space for classrooms, laboratories and shops be available?

4. Can tools, instruments and specialized equipment of high quality be provided in sufficient quantity?

5. Will the budget permit expenditures for replacement of worn out and obsolete equipment?

6. Can coordinating placement and guidance services be provided?

7. Are students with the necessary ability and interest available in sufficient numbers?

8. Will all these factors result in a program which will satisfy student and community needs at a reasonable unit cost?

OCCUPATIONAL INFORMATION REGARDING TECHNICIANS

The term "technician" in use here refers to highly skilled workers whose jobs require the knowledge and use of scientific and mathematical theory and specialized education or training in some aspect of technology or science and who, as a rule, work directly with scientists and professionals.

Technicians often do work which might otherwise have to be done by professionals. They may serve as technical sales or field representatives of manufacturers, advise on installation and maintenance problems or serve as field foremen on forest production units.

Forest technicians generally begin work as trainees or in the more routine positions under the direct and constant supervision of an experienced technician, scientist or professional. As they gain experience they are given more responsibility, often carrying on a particular assignment under only general supervision. Technicians may move into supervisory positions. Those with exceptional ability sometimes obtain additional formal training and are promoted to professional forestry positions.

Courses in post-high school technician programs are usually of college level. Instructional laboratory and field techniques are offered as well as courses in science, mathematics, and various technical studies, with emphasis on the practical problems students will need on the job.

Students are taught the use of instruments and are also given instruction in the use of machinery and tools more to give them a familiarity with the equipment than to develop new skills.

Employment Outlook

Employment opportunities for forest technicians are expected to be extremely good through the mid 1970's. In recent years, technicians have been one of the fastest growing occupational groups and it is expected that this rapid growth will continue. In general, the demand will be strongest for graduates of a post-secondary school technician training program to fill high level forest technician jobs.

Among the factors underlying the increase in demand for technicians is the anticipated expansion of industry and the increasing complexity of modern technology. As products and the methods by which they are manufactured become more complex, increasing numbers of technicians will probably be required to assist professionals in such activities as production planning, maintaining liaison between production and engineering departments and technical sales work. Furthermore, as the employment of scientists and professional foresters continues to grow, increasing numbers of technicians will be required to assist them. It is estimated that in addition to the technicians required to fill new positions, more than 15,000 will be needed each year to replace those who retire, die or transfer to other occupations.[1]

Another factor behind the expected increase in demand for forest technicians is the growth of research and development expenditures. Such expenditures have increased rapidly in recent years and are expected to continue to rise through the mid 1970's, although somewhat more slowly than in the past.

Well-qualified women technicians should find favorable opportunities chiefly in drafting jobs, research and other laboratory work, and in computation and other work requiring the adaptation of mathematics. Over the long run, it is likely that more women will be trained to find employment in these and other technician occupations.

Estimated Need for Forest Technicians

Dana and Johnson asked the question: "How many men are going to be needed for what kinds of work, and with what training, both formal and informal, in order to provide the sort of management that is indispensable in meeting prospective requirements for forest goods and services."[2]

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[1] Editors 1966, Technician Education Yearbook, Ann Arbor, Michigan: Prakken Publications, Inc.

[2] S. T. Dana and E. W. Johnson, Forestry Education in America Today and Tomorrow, Washington, D.C.: Society of American Foresters, 1963.

It is presently believed that the larger public agencies and private forest resource organizations now require on the average of approximately 25 vocational aides to 15 technicians to 10 managers (professionals) to one scientist.[1] The above ratio may vary somewhat from region to region.

There is general agreement on the need for more and better men for all four of these work areas. On the other hand, as in engineering and certain other fields, there is now a widespread belief that there are far too many forestry schools turning out too many graduates who are neither the top quality technician nor the top quality professional that employers need and will be willing to pay for.

Assuming a ratio of two technicians to one professional and an intensity of forest resource management calling for one professional forester for every 20,000 acres of commercial forest lands and one professional forester for every 40,000 acres of non-commercial forest lands (Dean Henry J. Vaux's assumptions),[2] the estimated number of forest professionals and non-professionals employed in 1961 and needed by 1980 are as follows: present numbers--scientists, about 3,000; managers, about 10,000; specialists,

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[1] Peter W. Fletcher, J. L. George and R. E. McDermott, Training Technicians and Professionals for Natural Resources Management, U. S. Department of Interior: Resource Publication No. 30, pages 21-49.

[2] Dana & Johnson op. cit.

about 4,500; non-professional personnel--technicians--about 12,000; and forestry aides are presently running about 18,000. The potential (1980) for scientists is about 4,100, managers will run about 17,000 and specialists about 13,000. In the non-professional ranks the technicians will increase to about 24,000 and aides will jump to about 34,000. Over a twenty year period, based upon these assumptions, there is an indicated annual need for 620 technicians, about 390 of whom might be expected annually from one-year certificate or two-year associate degree programs, and about 230 annual full-time equivalents from Bachelor of Science degree students and locally experienced men. It has been computed, based upon these assumptions, that production of forest technicians between 1961 and 1980 will increase by 557%. Scientists with Doctoral degrees will increase by 100%; Masters, 150%; Bachelors, 67%; student trainees, 100%; and aides, 81%.[1]

Twenty-one forest technician training programs are now underway in the United States and have sufficient student enrollment to graduate 435 men a year. This compares with about 1,700 persons who now graduate annually with

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[1]Peter W. Fletcher, J. L. George and R. E. McDermott, Training Technicians and Professionals for Natural Resources Management, U. S. Department of Interior: Resource Publication No. 30, pages 21-49.

Bachelor of Science degrees in Forestry and related fields, from 48 collegiate institutions.[1]

Therefore, our country is now formally preparing about 3.9 professional foresters to one technician whereas Canada, on the other hand, is formally preparing about 3.3 technicians to one professional.[2]

Industrial and federal personnel in forest management in the United States have expressed a desire to see these figures reversed to one professional to three or four formally trained forest technicians for future years.[3]

Earnings

In general, a technician's earnings depend on his education, his technical specialty and his work experience. Other important factors which influence his earnings are the type of firm for which he works, what kind of work he does and the geographic location of his job.

Annual starting salaries for graduates of post-high school technical schools averaged about $5,000 in private industry in 1964.

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[1] Gordon Markworth, Statistics from Schools of Forestry for 1965 (Journal of Forestry 64:178-184), 1966.

[2] H. W. Blenis, "The Maritime Forest Ranger School and its Place in Canadian Forestry Education." Paper presented at the Annual Meeting of the New England Section, Society of American Foresters, Boston, Massachusetts, 1965.

[3] Personal interviews throughout the United States by the authors in 1966.

In federal governmental agencies in early 1965, beginning forest, engineering and science technicians were offered $4,005, $4,480 or $5,000 depending upon the type of job vacancy and the applicant's schooling and other qualifications. Some federal governmental agencies hire high school graduates and train them for technician jobs. Beginning salaries for these types range from $3,600 to $4,005 a year, depending upon the individual's high school courses and experience.

In 1964, the annual salaries of workers in high-level technician positions in private industry averaged $8,500 and approximately one-fourth earned over $9,200 a year, according to a recent survey conducted by the Bureau of Labor Statistics in Washington, D. C. The Bureau of Labor Statistics of the United States Department of Labor made a similar study in February and March of 1964. Data was gathered on approximately 66,000 engineering technicians. (The definition used for a technician was limited to employees providing semi-professional technical support to engineers engaged in such areas as research, design, development, testing and manufacturing process improvement and whose work pertained to electronic, electrical or mechanical components or equipment.) Technicians engaged primarily in production or maintenance work were excluded.[1] This, of course, leaves the forestry personnel out of the study.

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[1]Editors 1966, Technician Education Yearbook, Ann Arbor, Michigan: Prakken Publications, Inc.

SPECIAL ABILITIES REQUIRED OF FOREST TECHNICIANS

The highly skilled forest technician must be capable of working closely with scientists, engineers and professionals and must also have the ability to supervise and coordinate the efforts of skilled craftsmen and field maintenance men. These capabilities will allow technicians to be effective members of a scientific and management team whose work is to plan, assemble and operate various forest enterprises.

Job Possibilities

Graduates of this curriculum may expect to find employment in many areas in the forestry field. Each of these areas may require somewhat different abilities and different specialized knowledge and skills for a successful career. Most of these different abilities will be acquired by continued study on the job or in part-time study to master the specifics of a specialized field. The following listing indicates some of the major areas or clusters of job opportunities for forest technicians as they were described by employers.

1. Research Technicians: A technician working directly with scientists and professionals in developing new methods and operations, and in doing basic research.
2. Sales and Service Technicians: A technician representing a company and its product to a customer. He

advises the customer and is capable of installing, operating, trouble-shooting and training a customer's personnel to service and maintain equipment located at the customer's installation.

3. Operations Technician: The technician working in the field in either a public or private capacity. Working directly as a supervising foreman of field crews in many or all of the various operations assumed in an active natural resource manager.

In addition to these three major areas for graduates, there are numerous other areas in which the technician may work. To list all of these areas would be impossible. A few specific examples may indicate the wide diversity of employment opportunity available to forestry technician graduates.

The following occupational categories are listed as those positions for which a graduate forest technician would be adequately trained. These positions may be found with federal, private and state forestry concerns. Graduates are working for all three types of employers in various jobs in many regions.

Timber Stand Improvement (field supervisor and manager)

Nursery Culture Work in Forest Nurseries

Assisting on Lumber Grading Chain (trainees as professional graders)

Forest Surveying - boundary problems, deed research, campground and pond layout, road location and reconnaissance, elevation and drainage systems

Logging Engineer on small woodlots, Trainees for large logging sales company as Engineers

Log and Pulp Scaling

Timber Cruising and Volume Estimations

Timber Sale Layout and Marking

Sawmill Helper in any of various positions in sawmills

Kiln Operator and Schedule Man

Fire Control and assisting in pre-suppression and suppression activities

Forest Insects and Disease Observations and Control

Sales and Service Representative for wood products sales organizations

Park and Recreation Management of private and public campgrounds and parks

Company Clerks for wood operations

Lineman and Climber for tree companies working in the shade tree industries

General administration of a designated area within a state, state forest, or state park.

ACTIVITIES PERFORMED BY TECHNICIANS

The technical training program of which we speak is defined as consisting of organized, formal instruction beyond the twelfth grade at a level which is less than baccalaureate education. Such programs include at least a minimum of instruction in science, mathematics and the humanities in addition to the scientific and applied aspects of forestry. Emphasis is on practical application of theoretical knowledge and on occupational competence. The programs are terminal and ordinarily full-time. Some forest technicians perform manipulative skills while others supervise the application of such skills. Most do both. Their work is distinguished from that of the skilled worker primarily in that it is less repetitive, involves more mental activity and is more likely to require at least a minimum familiarity with the principles of science, engineering, mathematics and statistics, not to mention their own particular technical skills.

Because forest technicians are employed in numerous and often specialized situations, the adequately trained forest technician must have attained certain abilities, scientific knowledge and technical skills. These have been broadly outlined as follows:

1. Facility with mathematics: The ability to use algebra and basic trigonometry as tools in the development

of ideas that make use of scientific and engineering principles.

2. Proficiency in the application of physical science principles, including the basic concepts and laws of physics which are pertinent to the individual's field of technology.

3. An understanding of the materials and processes commonly used in the specific technologies.

4. An extensive knowledge of a field of specialization with an understanding of the engineering and scientific activities that distinguish the technology of the field.

5. Communications skills that include the ability to interpret, analyze and transmit facts and ideas graphically, orally and in writing.[1]

The forest technician will use the foregoing abilities, knowledges, and skills as he performs several skills (but usually not all) of the following general activities:

1. Applies knowledge of science and mathematics extensively in rendering direct technical assistance to scientists and professionals engaged in scientific research and experimentation.

2. Designs, develops or plans modifications of new

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[1] Occupational Criteria and Preparatory Curriculum Patterns in Technical Education Programs, Washington, D. C.: 1962, p. 5.

products and processes under the supervision of professional personnel in applied research design and development.

3. Plans production as a member of the management unit responsible for the efficient use of manpower, materials and machines in production.

4. Advises, plans and assists in estimating costs as a field representative of a manufacturer or distributor of a technical equipment and/or product.

5. Prepares or interprets basic engineering drawings and sketches as they pertain to his specific technology.

6. Selects, compiles and uses technical information from references such as engineering standards, forestry handbooks and technical digests of research findings.

7. Analyzes and interprets information obtained from precision measuring and recording instruments and makes evaluations upon which technical decisions will be based.

8. Analyzes and diagnoses technical problems that involve independent decisions.

9. Performs day-to-day supervision of forest production.

10. Performs routine administrative duties such as cooperating with people in the administration of public and private forest lands.

11. Deals with a variety of technical problems involving many factors and variables that require an understanding of several technical fields.[1]

A two-year curriculum must concentrate on primary or fundamental needs if it is to prepare individuals for responsible technical positions in modern forest industry. It must be honestly pragmatic in its approach and must involve a high order of specialization.

The Curriculum suggested in this bulletin has been designed to provide the maximum technical instruction in the time that is scheduled. To those who are not familiar with this type of educational service (or the goals and interests of the students who elect it), a technical program often appears to be inordinately rigid and restricted. While modifications may be necessary in certain individual institutions, the basic structure and content of this curriculum should be maintained.

The technical curriculum has the usually recognizable five subject matter divisions, namely: (1) specialized technical courses in the technology (forestry); (2) auxiliary or supporting technical courses (technical report writing and forest technology seminars); (3) mathematics courses;

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[1] Occupational Criteria and Preparatory Curriculum Patterns in Technical Education Programs, Washington, D. C.: 1962, p. 5.

(4) science (soils and botany courses); and (5) general education courses. The technical subjects provide application of scientific and engineering principles. For this reason, mathematics and science courses must be coordinated carefully with technical courses at all stages of the program. This coordination is accomplished by scheduling mathematics, science and technical courses concurrently during the first two terms - a curriculum principle that will be illustrated at several points. General education courses constitute a relatively small part of the total curriculum. It has been found that students who enter a technical program do so because of the depth in the field of specialization that the program provides. In fact, many students who elect this type of education program will bring to it a good background of general study.

Variety and quality of equipment and facilities such as land areas are more important than quantity in equipping laboratories for teaching forest technicians. Such equipment and facilities are indispensable if the training objectives are to be met. A separate section in this curriculum guide is devoted to the facilities for teaching forestry because of the special need for attention to the details of such facilities.

(Page 27 was omitted due to pagination. Due to the time element and cost it was unfeasible to retype and repage this manuscript.)

Safety is a constant preoccupation of all forestry and/or allied industries and its practice must be taught continually from the beginning of each course concerned with safety. A separate course in safety itself might prove desirable, however sufficient safety can be incorporated in the regular course material.

Communication is an important element of technical work. The educational program should include specific instruction in graphic, written and oral communication. In addition to these specifics, there should be a continual emphasis on written reports with rising standards of attainment as the student progresses in the program. Elements of industrial sociology, psychology and economics while necessarily limited by the time factor, must be considered important units of the curriculum.

The course outlines in this guide are short and descriptive. The individual instructor will have to prepare complete courses of study and arrange the curriculum material in a logical teaching order prior to starting instruction. Suggested forest technology laboratory layouts and equipment found under "Facilities" may be helpful to instructors preparing to teach the courses.

This material is not intended to be applied to any given situation exactly as outlined; it is presented to illustrate the form and content of the complete forest technology program. In keeping with the form of previously published guides, it is planned as a full-time post-high school program. It is expected however, that these materials will also be of use in planning extension courses and vocational programs in secondary schools.

FACULTY

The effectiveness of the curriculum depends largely upon the competence and the enthusiasm of the teaching staff. The specialized nature of the curriculum requires that the instructors of forestry subjects have special competencies based upon proficiency in technical subject matter and professional forestry experience.

Beyond this an instructor of forest technology must understand the educational philosophy, the objectives and the unique organizational requirements that characterize technical education programs.[1] Instruction in the technical education program is not a matter of conducting independent classes in separate subjects; all courses are closely interrelated.

A two-year curriculum must concentrate on primary needs if it is to prepare individuals for responsible technical positions in modern industry. It must be essentially pragmatic in its approach and must involve a high degree of specialization.

To be most effective, members of the faculty responsible for this program must have interests and capabilities which transcend their area of specialization. All of the faculty members should be reasonably well oriented in the requirements for study in the forest sciences and their application so that they may use forestry field examples or subject

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[1] Occupational Criteria, pp. 10-17.

matter as supporting materials in teaching their respective courses. For example, if the communications courses are to be of maximum value, the teacher should be familiar with the communications problems and demands placed upon forest technology personnel. Without such a background, the communications course work may not offer the support that is needed in the total program of education for the technician. Similarly, various scientific principles may be taught in courses in mathematics and measurements with the respective course instructors emphasizing and illustrating how the principles are utilized in forestry design and application.

Teachers of specialized technical subjects require advanced professional training. In the past many of these teachers have been recruited from the ranks of the biology profession. Experience has shown that professional forestry graduates who have acquired suitable professional experience and who have continued their practical education often become excellent teachers in this type of program. People with this background are more likely to understand the objectives and unique instructional requirements of technical education. Furthermore, individuals with this particular background often bring to the program enthusiasm and an appreciation of the values of technical education; characteristics which are essential to the success of any educational program.

Since the teaching of programs for highly skilled technicians must be a series of well integrated courses if the scope and depth of training given is to be adequate, careful consideration must be given to when and at what level a new concept is to be introduced. This may be accomplished through "team teaching." In this sense, team teaching is the organization of a technical staff into a coordinated teaching unit. The teaching assignments are made on the basis of the individual member's special training and talent. Concurrent courses are closely coordinated by team members to best utilize the student's time while he is moved smoothly on to progressively higher levels of understanding. Team teaching can only be developed and nourished by the teaching faculty. A weekly departmental staff meeting to encourage the development of team teaching is recommended. At these meetings each instructor should check with instructors of concurrent courses to insure that close coordination is being maintained. This is especially important with new courses and new techniques. If less than optimum coordination is evident, the important factors can be analyzed by those involved and a solution to the problems could be found.

In addition to keeping concurrent courses well coordinated, staff meetings provide for free exchange of ideas on teaching techniques discovered to be useful and on recently developed laboratory projects which seem to be particularly successful. Any project which seems especially interesting and beneficial to the student should be analyzed to see if the same principles of presentation can be employed in developing other projects. Special attention should be given to any scientific or technical journal articles that may improve the teaching of a subject area which presents new information which should be taught.

To help keep a staff effective, its members should be encouraged to participate as active members in professional and technical societies. Through these media they can keep up with the newest literature in the field and maintain close liaison with employers of technicians and other leaders in the field by meeting or attending meetings addressed by the leading specialists in the field. Encouragement of instructional staff self-development is increasingly being provided by technical school administrators in the form of released time and financial assistance to attend society meetings and special technical teacher-training institutes. Periodical sabbatical leaves should be offered to allow staff members the opportunity to increase and update their professional experience or for further study.

When determining teacher loads for faculty members teaching technical specialty courses, consideration must be given to the number of student contact hours required by their schedules. Fully effective instructors in a special area of education require considerably more time to develop courses and laboratory materials than do shop instructors or teachers of general education courses. A contact or work load of 15 to 20 hours per week usually constitutes a full teaching load for any technical specialty teacher. The rest of their time should be spent in assisting students, course development and developing effective laboratory experiments.

Class size must be considered in developing effective teaching since individual attention is recognized as a vital teaching element in the technical programs. The maximum size of a lecture class may vary somewhat depending on the material to be covered, the lecture room size, and the teaching technique used; but for most blackboard lecturing, classes of between 20 and 30 students usually should be considered the optimum. If little or no class discussion is attendant to the lecture, the size of the class may be significantly increased by use of overhead projection of carefully prepared portions of the lecture normally written on blackboards.

Careful planning of laboratory teaching schedules is important. Laboratory sections should not be overloaded with students. Effective teaching can never be accomplished if there are too many students per work group. If too many students try to work on the same project, most of them will not benefit because they are unable to participate sufficiently in doing the work themselves. In the forestry field optimum group size is generally two or three at the maximum. A desirable student-faculty ratio is 10-15:1 under field conditions, depending upon the nature of the course.

Technical curriculums are designed to produce support personnel which increase the effectiveness of operating teams. This principle of support personnel may be employed to increase the effectiveness of the teaching staff. Staff assistants may be used in stock control to set out the proper equipment for laboratory classes, to keep equipment operating properly, to fabricate training aids and to do a limited amount of routine paper grading. This allows the teaching staff to devote considerably more time to curriculum development activities, preparation of handouts to supplement lecture material, and to insure that the necessary components are properly functioning and equipment available when needed. Resourceful use of support personnel makes possible the use of a smaller but versatile staff which may be maintained as enrollment varies. By adjusting the size of support personnel staff to the demands of enrollment, a school may, to a degree, adjust the problem of having too few instructors when the enrollment is high and too many instructors if enrollment is reduced. Most of the support personnel may be recruited from the student body or through graduate student assistance from other universities.

Experience has indicated that the number of staff members required to present an effective program in a post-high school forest technology curriculum would be a minimum of four men, depending upon the enrollment. One man would be required as administrative head of the program. His responsibilities would include among other duties, budget requirements, placement responsibilities, and public relations.

Additional supporting staff must include a custodian for the buildings, and a secretary-typist. Experience has shown that an efficient secretary-typist would be well able to provide secretarial assistance to four men. An increase in teaching personnel would require a commensurate increase in secretarial assistance.

STUDENT SELECTION AND SERVICES

While the effectiveness of a technical education program depends greatly upon the quality of the faculty, he program's ultimate objective is to produce high quality graduates. It is essential therefore, that the students accepted into the program have certain capabilities. If the incoming student's background is inadequate, the instructors will tend to compromise the course work to allow for his inadequacies, with the probable result that the program will be inadequate in depth and scope.

Students chosen for the forest technician program should have similar backgrounds and capabilities and should exhibit some evidence of maturity and seriousness of purpose; otherwise, the program may never reach its objectives. Applicants who have demonstrated their competence and ability through previous field experience, and have the other required prerequisites, should perhaps receive priority consideration in enrollment. Wide ranges of ability among students can create an inefficient teaching situation, thereby preventing progress of the program at the necessary rate. The amount of material to be presented and the principles to be mastered require students who are not only well prepared in course material but also have the ambition, desire and will to master a difficult program and to develop their capabilities to the utmost.

This curriculum is designed for high school students who have particular abilities and interests. In general, students entering this program should have completed two years of high school mathematics including algebra and geometry, and preferably a year of the physical sciences, either chemistry or physics (preferably physics). The ability levels of those who do and those who do not meet these general requirements will vary greatly. If a student enters the program without adequate preparation, he will usually find that the program cannot accomplish the desired preparation of a highly capable technician. To that extent the program will fail. If applicants for admission do not have the necessary mathematics, science or language skills, they should expect to take remedial work before entering the program.

Effective guidance and counseling is essential. Students should be aided in selecting educational and occupational objectives consistent with their interests and aptitudes. Whenever possible, institutions offering technical education programs should consider the use of standardized or special tests to assist in student selection, placement and guidance. A student should be advised to alter his educational objectives if it becomes apparent that he is more suited to other programs, either by reason of lack of interest in the technical program or lack of ability to satisfactorily complete the curriculum or interest and capacity greater than the scope of the technical program.

The new student should be quickly familiarized with the facilities on the campus and particularly should be given a tour of the library facilities and be made familiar with the procedures and rules governing the use of the library. If possible, organized field trips to nearby forestry operations should be arranged early in the program to give new students an opportunity to see forest technicians on the job. These tours might possibly provide the motivation and perhaps point out why certain required subjects are important.

Departmental student organizations may be formed to help bring together people with similar interests. The meetings of these organizations should provide exercise for the students in arranging their own programs. Speakers from industry or selected films may be used to stimulate interest at meetings. Student organizations may assist with and participate in departmental activities such as career days and open house visitation events.

Students should be given information concerning student membership in technical societies and be encouraged to join such societies if eligible. Student chapters of professional societies offer an opportunity for the student to receive material of an excellent quality on a regular basis at nominal costs. After graduation and suitable field operations, the forest technician may find society membership and the regular reading of journal articles an important method of keeping his knowledge current in the field.

Academic achievements of students should be recognized in some manner. Many institutions grant an associate degree as tangible recognition of achievement upon graduation. One function of a departmental club may be to make an annual presentation of an outstanding graduate award. Industrial organizations may contribute to offer an annual scholarship award.

Girls whose interests and scholastic preparation cause them to be attracted to this type of program may be encouraged by the employment opportunities for women in forestry research and related work. The aptitudes and abilities for women with scientific interest and training particularly suit them for much of the analysis and related laboratory work in many forest research and manufacturing or allied institutions employing scientists.

Admission Policies

Many junior colleges admit any high school graduate or any adult who can "profit from the instruction." Others have developed admissions criteria similar to those in use by universities and liberal arts colleges. Between these extremes are many institutions whose admissions policies are not exactly "open door" nor are they highly restrictive. Typical of this group are those colleges which require a "C" average from high school. In recent years, some "open door" colleges have adopted a "probation-at-entrance" admission plan for all students whose high school grades average below "C". Probationary students who earn a 2.0 grade point average on a 4.0 scale in the first semester of a general or opportunity program, are taken off probation and may move into one of the regular curricula. Failure to make a "C" average in the general program will possibly result in dismissal from the college.

Rank in high school graduating class has been and still is one of the most reliable predictive devices. Standardized achievement, aptitude and interest tests should be used to supplement information from the high school record. Two of the more widely used standardized tests are the C.E.E.B. - S.A.T. batteries and the S.C.A.T. Battery. Both produce raw scores which can be converted to percentile ranks on national norms for college freshmen and both yield a "Q" (quantitative or mathematical) score and a "V" (verbal skills) score.

No single selection criterion should be used alone. At least two, and preferably three, should be considered:

high school rank in class; the S.A.T. - S.C.A.T. battery; the I.T.E.D. IV, "ability to do quantitative thinking"; and the I.T.E.D. II, "general background in the natural sciences" (these are the Iowa tests of educational development). A tentative selection criterion could be applied to the following:

1. Students who are generally above the 70th percentile on freshman norms, and who have a "B" or better average in high school math -- science majors should probably be encouraged to enter a pre-engineering or pre-science transfer program.

2. Students whose test records place them at or above the 50th percentile and who have a "C" or better grade in a college preparatory program (with significant mathematics and science work) through high school are ordinarily good prospects for forest technology curriculums. A good standard test for mechanical aptitude might well be given as a check on the other predictors.

3. Students who rank as low as the 20th percentile in the college freshman norms and who have completed elementary algebra and/or plane geometry with grades of "C" or better might be accepted for enrollment in vocational curricula of the highly skilled and industrial type. A mechanical aptitude test is again advised.

Guidance of the Technical Student

All junior college students should have counseling services available to them both before and after registration and enrollment in classes. Guidance services are especially important for employment-bound students. A personnel folder should be made up for each student as he begins registration and enrollment and should be kept up-to-date during the period of his college attendance. The folder should contain as a minimum:

1. The student's high school transcript, his rank in his graduating class and letters of reference from high school sources.

2. Results of all standardized intelligence, aptitudes and achievement tests with raw scores converted to percentiles and college freshman norm.

3. Results of vocational interest tests with a profile interpretation.

4. Anecdotal reports of conferences with the student and his parents.

5. His assignment to a curriculum and the proper notation as to his status.

6. His class schedule of courses and the hours of class attendance for each semester.

7. Grade reports and other periodic casual reports from his instructors.

8. A record of part-time or full-time job experience with an evaluation sheet filled out by employers.

9. A record of extra-curricular activities.

10. A cumulative record of courses completed, grades attained and progress made toward meeting the requirements for the associate degree in the occupational field selected.

A weak spot in the guidance program of many junior colleges is the "first point of contact" interview. Too often this interview is a hurried conversation at the registration counter, followed by a flurry of filling out forms and an assignment to a counselor on the basis of the student's declaration of educational and occupational goals. This procedure may be satisfactory for a few well-motivated and self-directed students, but for most the first point of contact should be a searching, probing session with a professionally trained guidance counselor. The outcome of this interview could then influence the nature of the testing program and the assignment to a proper counselor for curriculum and course selection.[1]

McDaniel points out that junior colleges enroll unusually large proportions of undecided and vaguely

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[1] J. W. McDaniel, Essential Student Personnel Practices for Junior Colleges, Washington, D.C.: 1962.

decided students. Career decisions must be made soon or time will be wasted. "Frustration, failure and dropout often result from lack of choice or wrong choice. Good choice is made difficult by inadequate information, faulty self-appraisal, peer influence, status values, family pressure, conflict with immediate needs."[1] Proper counseling can minimize the "frustration, failure and dropout" to which McDaniel refers. Giving the students a good start will materially reduce the counseling load later in the semester, and will enable the college to maintain its program of quality within diversity as it serves the needs of the student.

Placement

Graduates of technical programs should be aided in every way possible in finding suitable employment. Placement personnel should be aware of the needs of the forest industry for forest technicians and should acquaint prospective employers with the qualifications of graduates. The placement function is an extremely valuable service to the student, the institution and the employer. In the final analysis, placement of graduates is an important responsibility which is directly or indirectly that of the department head. An excellent placement record is very important in getting other students to enroll. In addition, the school should make periodic follow-up studies of the

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[1] J. W. McDaniel, op. cit.

graduates to determine their progress and how their training aided them or was deficient in certain areas. Many times this information can indicate how the curriculum or teaching techniques may be improved.

Placement is the keystone in the occupational education structure. It should not be left to chance nor should it be entrusted entirely to some agency outside of the college. The assistance of other placement agencies, public and private, may be welcome but the major directive effort should be centralized in one person or office at the college. Industrialists and businessmen seeking employees should be able to deal with one office. Placement records should be centralized in the department head's office where they may be kept up to date.

It is especially important that the junior college which operates technical education programs have an effective placement bureau. Graduates of these programs move into relatively new occupational streams, where channels for job placement are not yet well established. The professional occupations on the one hand and the trade and craft occupations on the other are served by public and private agencies accustomed to dealing with well established job categories. In general, these agencies are not accustomed to serving the technician and by the same token, employers with middle-level job openings do not normally seek these employees through existing agencies. Junior college graduates and local employers too will be best served if the college operates its own placement bureau.[1]

Student Activities

Extra-curricular activities form a very valuable part of campus life. Students should be urged to participate in any activities supported by the institution. Outing clubs, chorus, bands, science clubs, and other organizations are highly desirable for the total development of the student. Athletic departments sponsor basketball, baseball and football, and schedules can be arranged with preparatory or other technical schools.

One of the primary clubs or organizations in any technical forestry program should be the Forestry and Wildlife Club, which should strive to establish an intimacy between forestry students and their faculty, and to enlighten other students in various forestry activities. The objective of the clubs could be a diversified program which might offer recreational and educational benefits. Typical activities might include the showing of films on the various fields of forestry, lectures by speakers from forest industries, outings consisting of woodsmen's

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[1]Milton C. Mohs, Service Through Placement in the Junior College, Washington, D. C.: 1962.

competitive field events, dances, parties and various weekend trips such as hiking, canoeing and snowshoeing in season. Here a student could also gain proficiency in speech or other oral presentations on material learned from past experience or through library research. This would enable a student to gain more poise and ability before a group.

TEXTBOOKS, REFERENCES AND VISUAL AIDS

Textbooks, references and visual aids for teaching any technology must constantly be reviewed and supplemented in light of (1) the rapid developments of new knowledge in the field, and (2) the results of research and methods of teaching and developing basic concepts in the physical and biological sciences, and mathematics. This is especially true in the forestry area. The impact of the development of whole new areas of theoretical and applied scientific knowledge is demanding new textbooks, new references, new material in scientific and technical journals and new visual aid materials.

New textbooks will reflect new methods of teaching scientific principles and applications as fast as current educational research becomes applicable. Extensive research and methods of teaching mathematics, management, mensuration, silvics, silviculture, statistics and other diciplines in recent years almost certainly will produce changes in teaching materials and methods. It is therefore mandatory that instructors constantly review new texts, references and visual aid materials as they become available, and adopt them when they are an improvement over those suggested here or presently being used.

The suggested texts and references listed in each course have been carefully selected; from the list presented it should be possible to select suitable texts. It should not be interpreted that unlisted books are not suitable. There are, no doubt, excellent ones which have not been included only because of lack of complete familiarity with them.

Before a department head or instructor undertakes a program in forest technology or any course contained in the curriculum, it is urged that he familiarize himself with the texts and references listed here and any new ones available. The instructor should also familiarize himself with the availability of "non-text" material such as publications available from experiment stations, pulp and paper companies, and state forestry organizations. He will then be in a position to select the text which best serves his particular needs in providing a lucid, high level, technical presentation to his students.

Visual aids can be of great help in teaching programs. The aids which are listed in this guide have been selected from an extensive list and represent those considered most suitable at the time the curriculum was prepared. Again, there are many which are not listed because the variety and extent of the materials make an all-inclusive listing prohibitive. From those listed and others available and pertinent, an instructor may select those visual aids which meet his teaching objectives.

A recent increase in slide tape programs has proven most gratifying and useful for use in technical education programs. Instructors are urged to utilize these programs insofar as their programs permit.[1]

In addition to the visual aids available for teaching the physical sciences and forestry principles, there are and probably will continue to be, valuable films and other pertinent materials showing forestry research or production which should be used selectively in teaching forest technology.[2] Visual aids should always be previewed and analyzed for timeliness and pertinency before being utilized in a teaching situation.

The well equipped, modern library should have some type of duplicating service available so that copies of library materials may be easily obtained by students and staff. This service allows both students and staff to build up-to-date files of current articles appropriate to the courses in a curriculum. This service should be available to the students at minimum cost and free of personal cost to the staff. A satisfactory arrangement based on experience utilizes a large dry copy machine and allows duplication of library materials for students at the rate of five cents per page.

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[1] Slide tape program listing available from Chief, Timber-Tips U. S. Forest Service, Washington, D.C.

[2] N. T. Sampson, Films and Filmstrips on Forestry, Nacogdoches, Texas, 1965.

The teaching staff is allowed duplication of up to 20 pages per day without personal charge to the instructor. Any excess is either charged to the department having material duplicated or to the staff member at the rate of five cents per page. The current rate in some universities and junior colleges is a maximum charge to the department or the student of ten cents per page.

LABORATORY EQUIPMENT AND FACILITIES

Laboratories, land area, and equipment for teaching forest technology programs must meet high standards of quality since the objectives and strengths of the program lie in providing valid laboratory and field experience, basic in nature, broad in variety, and intensive in practical experience. Well equipped laboratories with sufficient facilities for all students to perform the laboratory work are required for these courses. The training program should emphasize field experiences which illustrate the function and application of a wide variety of forestry equipment, and their use in representative applications.

Variety and quality of equipment and facilities are generally more important than quantity in equipping laboratories. Laboratory and field equipment and facilities are a major element of the cost of such a program; they are indispensable if the training objectives are to be met.

Equipment must be of good quality if laboratory and field work is to supply valid experience for the student. Inferior equipment may not show the principles being studied or may not be sensitive enough to provide reliable, precise data and may require unreasonable amounts of time and expense to keep them repaired and adjusted to useable condition. It is recognized that the initial cost of high quality equipment is usually greater than that of low quality, but the difference in cost is justifiable because it makes possible laboratory experiments that give more precise results and longer life to the equipment.

In the staff selection of laboratory equipment, the need for each item should be well established. Expensive apparatus may not always be required. Relatively inexpensive units can sometimes make the principles more evident because they present only the barest essentials. The number of units purchased, the particular areas of interest, the particular industry emphasis, and the ingenuity of the instructor(s) in adapting equipment to teaching needs will play a major part in governing the laboratory equipment which is selected and its cost. Throughout the program, emphasis should be on the basic principles which serve as the basis for so many forest management decisions.

SCIENTIFIC AND TECHNICAL SOCIETIES

Scientific and technical societies are an important source of instructional materials and other potential opportunities for benefit to both staff and students. Such societies provide in their publications and in their regularly programmed meetings a continuing disclosure and discussion of new concepts, processes, techniques, and equipment in the sciences and related technologies. Outside of personal, practical experience, they are probably the greatest single device by which persons engaged in applying a particular body of science keep abreast of new developments. Their data are presented in such a manner as to provide a "popularizing" and an informative bridge between the creative, theoretical scientists and the applied science practitioners including the technicians, and are usually the first medium to announce and describe significant discoveries and applications of research in the field.

Instructors in technical programs should be encouraged to become active members of scientific and technical societies to help keep abreast of new developments in the technology and to foster acquaintance with persons in the community who are actively interested in the field. Some educational institutions pay part or all of the costs of attendance at local or national society meetings as a means of encouraging activity in such societies.

Students of forest technology should be made aware of the literature and services of these societies early in their study program. Student affiliate memberships are offered by some of these societies and students should be encouraged to become such members.

The Society of American Foresters
Suite 300
1010 16th Street, N. W.
Washington, D. C. 20036

This is the largest and longest established professional society for foresters, which numbers about 15,000 at the present time. Its chief organs are the Journal of Forestry and Forest Science publications. It offers a student affiliate membership and an affiliate class B membership for technicians upon graduation and a suitable term of forestry employment.

The American Forestry Association
919 17th Street, N. W.
Washington, D. C. 20006

This is an organization of conservation-minded citizens, foresters and laymen, numbering 40,000 members. They publish American Forests monthly.

A listing of other technical forestry societies compiled in mid-1966, appears in Appendix A.

ADVISORY COMMITTEES AND SERVICES

Experience has shown that almost all successful technical education programs are supported by and demonstrate the benefits of advisory committees and special consultants. Most institutions have an advisory committee or committees to assist the administration in planning and implementing over all programs which meet the objectives of the institution and the needs of those whom it serves. In addition, for each specific technology program or other specialized occupational objective there is a special advisory committee made up of representative employers, knowledgable civic leaders, public employment services, scientific or technical societies and associations in the field and specialists from the staff of the school as well as a strong representation of professional men from the particular technology.

The curriculum advisory committee usually is appointed by the chief administrator or the dean of the institution when it becomes evident that a particular technology should be considered as a program to be offered by the institution. The advisory committee then assists in making the necessary surveys of the need for technicians: what they should be able to bring to an employer to meet the needs of the employment opportunities; available student population; curriculum; faculty; laboratory facilities and equipment; and cost of financing of the program. Often they provide substantial support to school administrators in appropriation requests, raising public funds and in obtaining state or federal support for the program.

Sometimes the studies of the committee show that the proposed program should not be undertaken and the committee's work is done, having rendered a valuable service to the community and the institution. When the studies indicate that a program should be initiated, the support and assistance of the committee is invaluable, especially in planning and initiating the program. When the first few classes of students graduate and seek employment, the committee can assist in placing them on jobs and help to evaluate their performances. Minor modifications are often made in the program as a result of these evaluations.

Committee members' effective appointment should be a minimum of two years, so that the duties will not be burdensome yet long enough for constructive service, and so others who are qualified and interested may serve. A committee usually numbers from six to twenty men, averaging about twelve. Those selected to serve are always busy people and meetings should be called only when there are problems to be solved or tasks that committee action can best accomplish. The head of the institution or the department head of the technology generally serves as chairman. Such committees serve without pay as interested citizens; they enjoy no legal status but provide invaluable assistance whether serving formally or informally. The continuous support of an advisory committee has been found to be a constant source of strength for the program and the most reliable means of keeping up-to-date, high quality and successful.

This publication is intended as a guide for program planning and development, primarily in post-high school institutions. It is expected that adaptations will need to be made to suit various situations and schools of any kind in a locality. The assistance of an advisory committee and of special consultants using such a guide as the starting point and modifying it to meet local needs has been found to be an effective means of initiating programs found to be needed, and developing them quickly to a high level of excellence. Courses in guides such as this have often been modified by schools and their advisors to serve the needs of employed adults who need to update or upgrade their skills and technical capabilities.

Advisory committees can be very helpful in technical education planning for a specific community. Such committees usually are made up of knowledgable and technically informed representatives of industry, state employment services, education, and professional or trade associations who have special knowledge of employment needs of the community. One of the important functions of any advisory committee is to provide a medium for communication. The committee can interpret the needs of the community to the school and at the same time make the contributions of the school known to the community.

Land grant and four-year colleges and universities which offer degree programs in agriculture have an important responsibility in providing support and assistance in the development of forest technician training programs. Whether or not they actually conduct technician training programs on their own campuses, the colleges, schools, and departments of agriculture should be represented in the state-wide coordinating committee that is recommended. Faculty members should be members of boards and committees and assist in the guidance of individual technician training programs.

There are several important major reasons for this recommendation. The men on these faculties generate the basic knowledge and theory which guide forest technician training programs. They are responsible for preparing the forest scientists and forest engineers whom the forest technicians are to support. They are able to assist personnel in industry, governmental agencies, their own colleges and agricultural experiment stations. They appreciate a role in potential contributions of any forest technician.

Arrangements might possibly be made for the use of four-year college laboratories and other facilities (when they are not in use) for technician training programs not conducted by the college.

It is essential that forest technician training programs be clearly distinguished from vocational training programs on the one hand, and baccalaureate degree programs on the other. In most instances and insofar as possible, a separate staff and separate courses should be maintained for the student in degree level programs in both two-year and four-year forestry programs. Ordinarily, placing degree and terminal students in the same class is highly unsuitable for both.

Technician programs should be truly terminal rather than providing pre-professional courses for four-year students and should strongly support policies of four-year institutions to refuse to award transfer credits for courses that careful appraisal has shown tend to modify the objectives and the standings of a baccalaureate degree.

Occasionally an able forest technician will "find" himself during his technician training and wish to transfer to a degree program. This man is a so-called "late bloomer." He should be allowed to transfer but not without meeting all the requirements for the baccalaureate program. He should be inconvenienced rather than his classmates in the degree program, or his education might well be devalued. If not, a transfer student may find upon graduation that he has the aspirations for the salary and prestige commanded by a bachelors degree but essentially the preparation for a technical position.

The responsibility for avoiding the problems thus described lies not only in the hands of those who plan, administer and teach in the two-year or four-year institutions, but also with counselors in secondary schools and schools offering technician training programs. In this way, the student's abilities and aspirations are properly assessed, so that both the student and the counselor have a realistic view of the student's possibilities but with the added safeguard that movement is facilitated when ability is demonstrated.

It is recommended that all persons with high school diplomas and a favorable recommendation and who meet reasonable standards of personality and character be admitted into technical training programs. With the admission standards for baccalaureate programs rising rapidly, it would probably be unwise for technician programs to exclude students ranking in the lower portion of their high school graduating classes and it is urged that experimentation be conducted with other young persons who, because of apathy, personal situations or for other reasons, did not complete high school but have the ability and potential for being challenged by a forest technician training program.

The following suggestions may be worth consideration:

1. Develop the technical program one careful step at a time, or the first program may be the last.

2. Make good use of advisory committees. Their work is only advisory, but listen to ideas.

3. Consider regional cooperation in offering forest technician training. In this way, additional funds and resources could be allocated and hence create a more effective program.

4. Develop cooperative work-study programs in forestry. Realistic training and effective placement are inherent in cooperative technology programs.

SUGGESTED CONTINUING STUDY

A two-year curriculum must concentrate on the primary needs of science, mathematics and the related knowledge and skills of the technology necessary to the preparation of the student for employment upon graduation.

Obviously, such a course of study cannot in two years cover in-depth all of the subjects which are pertinent to the technology. Some important related subjects may only be touched upon in that time.

Some form or continuation of study for graduates of technology programs is therefore mandatory. By reading the pertinent current literature related to the technology, the student may keep abreast of the technical developments in a special field, but this tends only to build on the organized technological base provided by the curriculum studied.

Formal continuation or supplementary courses provide the most efficient and practical means for the graduate technician to add important related areas of knowledge and skill to his initial education. They have the advantages of systematic organization of subject matter, disciplined and competent teaching, class discussion, and may be scheduled for evening or Saturday hours outside the graduate's working day. Naturally, an intelligent man has the ability to learn through experience and association with skilled men and professional in the field; however, he is also subject to picking up poor work habits and methods from the same sources.

Some suggested continuation or extension courses for graduates of this forest technology curriculum follow: (1) Elementary Statistics; (2) Applied Forest Photo-Interpretation; (3) Advanced Mensuration; (4) Psychology and Human Relations; (5) Basic Physics; (6) Advanced Logging Techniques; (7) Road Location and Boundary Line Surveying; (8) Road Engineering; (9) Bridge Construction and Forest Improvements; and (10) Industrial Management and Supervision.

The program is not intended to make the individual proficient in all of the duties he might be asked to perform. Proficiency in work of a highly specialized nature will come only with practice and experience. It is impossible to forecast the exact requirements of any individual and it is almost impossible to predict accurately the course or rate of change of various technologies. Employers generally recognize that recent engineering technician graduates may require a year or more to obtain the specific training needed to orient themselves to their responsibilities and roles in any organization. Similarly, employers of newly graduated forest technicians must generally provide a three- to six-month period to orient the technician to the special situations, processes and problems encountered on the job.

Furthermore, the productive graduate technician will continue to study throughout his career in order to develop to his fullest capabilities.

FOREST TECHNOLOGY CURRICULUM

FIRST YEAR

	Class	Laboratory	Outside Study	Total
SEMESTER I				
Elementary Forest Surveying............	2	6	4	12
Communication Skills.....	3	0	6	9
Technical Mathematics....	4	0	8	12
Dendrology..............	1	6	2	9
Botany..................	2	3	4	9
Forestry Orientation Seminar.............	1	0	2	3
	13	15	26	54
SEMESTER II				
Technical Reporting......	3	0	6	9
Elementary Forest Measurements.........	1	6	2	9
Applied Silviculture.....	2	6	4	12
Forest Soils.............	2	3	4	9
Technical Drawing........	0	6	0	6
Elementary Business Management...........	2	3	4	9
	10	24	20	54

On-the-Job Work Experience in the Forestry Field
(Summer Program - 15 weeks duration at 40 hours per week)

FOREST TECHNOLOGY CURRICULUM

SECOND YEAR

	Class	Laboratory	Outside Study	Total
SEMESTER III				
Personnel Management.....	3	0	6	9
Forest Business Methods..............	2	3	4	9
Timber Harvesting........	2	6	4	12
Advanced Forest Surveying............	1	6	2	9
Outdoor Recreation.......	1	6	2	9
Wildlife Ecology.........	1	4	2	7
	10	25	20	55
SEMESTER IV				
Elements of Social Science..............	3	0	6	9
Forest Products Utilization..........	2	6	4	12
Forest Protection........	2	3	4	9
Advanced Forest Measurements.........	2	8	4	14
Forest Photo-Interpretation.......	1	6	2	9
	10	23	20	53

Regional Forest Practices and Utilization (Three weeks of concentrated field observation at the close of the second year, at 40 hours per week)---3 credit hours

BRIEF DESCRIPTION OF COURSES

The course outlines in this guide are short and descriptive. The individual instructor will have to prepare complete courses of study and arrange the curriculum material in a logical teaching order prior to starting instruction. Suggested laboratory layout and equipment found in the Facilities, Equipment and Cost section may help in organizing the program. The subjects of specialization are introduced in the first semester in close correlation with other subject matter.

It will be necessary for an instructor or department head considering the establishment of a program such as this to adapt, reorganize and modify this material to local and regional requirements.

The responsibilities of management in the form of safety practices and special aspects of forest safety are considered in all courses. No effort is made to present a separate and complete study of safety in itself.

SEMESTER I

Elementary Forest Surveying

The theories and basic principles of plane surveying with practical field applications. An elementary course in land surveying including the theory of measurements, solution of triangles, angles, bearings, azimuths, linear and angular measurements. This course includes traverse computations, areas, topographic surveys, meridian determination, and public land surveys. Students become familiar with mapping and map making and proficient in the use of the compass, the Abney level and tapes. Experience is gained in the procedure of searching out property ownership in public records.

Communication Skills

A program designed to promote greater confidence and ability in reading, writing, speaking and listening.

Technical Mathematics

A course providing the basic algebraic topics, radicals and exponents. Introduction of functions and graphs. The functions of graphs from simple applications of algebra. Trigonometric functions of angles and the applications of right triangles, identities and equations to survey problems. Experience from industry has indicated that facility with the slide rule for forestry students is not necessary, therefore the use of desk calculators is stressed. The increments in mathematics are not evident here. Mathematics is also introduced into and utilized to a great extent in Elementary and Advanced Surveying, and Elementary and Advanced Mensuration.

Dendrology

A knowledge of trees, their habits and principal botanical features, form, site, associates, reproduction, growth and range of the major commercially important forest trees of the region.

Field studies are concerned with the taxonomy and identification of native and introduced forest trees and shrubs in both winter and summer. In season, herbacious forms of vegetation found in local forest associations are studied. Students are trained in the use of plant keys. Ecological work concerns itself with plants in their natural surroundings as well as with artificially created surroundings common in most areas.

The relationship of plants, and more specifically trees, to their total environment. The nature of plant communities, the climatic factors of air, light, temperature, radiant energy, soil, biological factors and plant succession are covered.

A practical field examination covering the total course in the identification of the local flora is given.

Botany

A study of the structure and life processes of seed plants influencing plant behavior. A survey of the plant kingdom is included here. Consideration is given to the structure of cells, the nature of protoplasm and the metabolic processes in plant cells. Emphasis is placed on the structure of roots, stems, leaves, flowers and seeds. Metabolic processes, plant responses and plant heredity are also covered.

Forestry Orientation Seminar

A course designed to orient the beginning student in a post-high school educational program. The student is given occupational and professional orientation by means of panel reports and resource personnel visitations. Consideration is given to the broad historical development of forestry in Europe and the United States, to forest terminology and to forest policy at various levels. Current events in forest management activities are discussed.

Forest organizations at the private and various governmental levels are examined. A survey of the various kinds of occupations is made and the demands and opportunities are stressed.

Forestry programs, education, research and future trends are analyzed. Representative guest lecturers from industry and government are invited to participate.

SEMESTER II

Technical Reporting

Technical report writing - a study of the effective means of presenting information. The student learns the utility of graphs, drawings, sketches and outlines for various types of oral and written reports. The student acquires knowledge concerning sources of report material, and instruction is given in the actúal setting up of a report, complete with footnotes, mechanical aids and bibliography. Oral reporting is stressed and emphasis is placed on such things as time limits, outlining, organizing and source materials. Numerous ways of developing an outline which will best fit the needs of the individual student are analyzed. Every effort is made to impress the student with the importance of speech in everyday life; the way in which it frequently makes for success or failure in his chosen field.

While time is not given to the phonetic alphabet, every effort is made to make the student familiar with the generally recognized basic principles of speech and to develop in the individual confidence, poise and power. Student recordings of speeches are analyzed and evaluated in class discussions.

Elementary Forest Measurements

The basic techniques of log and pulpwood scaling, tree measurement, form class and volume determination. The measurement of the volume of all forms of forest products, both after cutting and while still in the log, the tree or the stand, and the measurement of the growth of trees and stands of timber in terms of these products.

Methods of taking measurements by direct and indirect systems are covered as are volume computations, type mapping, and graphic presentations.

Applied Silviculture

An introduction to the artificial reforestation, natural forestation and silvicultural practices in the United States. Improvement of forest stands employing the basic silvicultural practices of weeding, thinning, pruning and various cutting techniques and the marketing of stands prior to logging operations.

The subject deals with the science and art of producing and tending the forest. The principles involve the nature of forest trees and stands, their growth, reproduction, environment, composition, nutrition and various responses. Practices related to the methods of handling forests as modified by economic factors.

A discussion of the significant biological, physical and economic qualities of the various forest regions of the United States and their effect on silvicultural practices are presented. Emphasis is placed on regional conditions, on the physiography, ecology and soils, climate and weather, and the silviculture of the major tree groups.

Field work provides an opportunity for the practical application of silvicultural methods to forest stands.

Work in chemical control, sampling and collection of field data is included.

Forest Soils

The student is introduced into the basic principles of soils, soil management and fertility. The physical and chemical properties of soil, and soil and water conservation techniques are discussed. Soil materials, formation and classification of soils and soil organisms are covered; also soil management systems for specific crops, including forest crops.

Technical Drawing

A beginning course for students who have had little or no previous experience in drafting. The principle objectives are to introduce a basic understanding of orthographic projection and freehand sketching; ability to understand detail and assemble working drawings and to produce clear legible and neat drafting work using current drafting tools and techniques. Topographic drawing and freehand lettering is stressed as a requirement for map drafting and forest management activities.

Elementary Business Management

This course introduces the student to the fundamental principles and techniques of organization, management and operations of a successful business enterprise. The students are given practical knowledge of the principles of selling, inventory, accounting and other phases of management. Discussions on forest enterprises are presented by guest speakers.

On-The-Job Work Experience in the Forestry Field

The student is given an on-the-job introduction to the various fields of forestry through employment with a forestry concern or organization in the summer months between his freshman and sophomore years. Experience gained will give the student a greater understanding of the more in-depth discussions presented in the second year.

SEMESTER III

Personnel Management

The basic principles of organization for effective personnel management. The organization of industrial and governmental personnel and the study of types of organizations at private and various governmental levels. Special consideration is given to the foreman and his responsibilities. The hiring and training of employees, planning and making assignments, special problems of forest technicians, records of reports, and human relations are subjects covered. The psychology of motivating and directing people, dealing with unions and other organized groups, training and maintaining morale.

Guest speakers, qualified in organization and administration are invited as lecturers from time to time. An opportunity to direct the work of fellow students in field exercises is given in all courses concerned with outdoor field exercises.

Forest Business Methods

An introduction to simple bookkeeping problems, taxation, capital gains, simple contracts, and techniques of timber valuation. State forest laws are considered in detail as are services required in the conduction of a forest business enterprise.

Timber Harvesting

Harvesting methods which include the physical layout and economic, silvicultural and protection considerations. The maintenance of logging tools and machinery, with emphasis on foremanship and woods safety currently being practiced in the region. Special consideration is given transportation media, logging costs and safety.

Trips are taken to local logging operations and field exercises of several week's duration involving various phases of logging are included. This practical exercise covers phases from the standing tree to log decking at the roadside and transportation.

Advanced Forest Surveying

Precision surveying techniques and applications with particular emphasis on the place of precision instruments in forest survey work. The theory and practice of plane surveying including taping, differential and profile leveling, cross sections, plane table, transit, stadia, and transit-tape surveys are included.

Outdoor Recreation

Survey of the recreational use of all forest resources including an understanding of the psychology of recreation. Planning and design of recreational areas is considered. An introduction into the wild land resources is considered.

The importance of forest recreation and its relationship to other forest uses is discussed. The economic importance of outdoor recreation, the organization and administration of forest land for recreational purposes are presented. The present status, objectives and policies of both private and public agencies are emphasized. The simple kinds of frame structures for picnic tables, fireplaces and other recreation structures are studied.

Field trips taken to local recreation areas and practical field exercises in the development, construction and maintenance of facilities at an area provide practical field experience.

Wildlife Ecology

The principles of wildlife ecology in the conservation of all wildlife resources with emphasis on terrestrial communities. General wildlife management techniques are considered in the laboratory segments. An understanding of the interactions of the wildlife population with conflicting forest use is heavily stressed.

SEMESTER IV

Elements of Social Science

A practical consideration of the interaction of man and his immediate society, and the organization of social groups and entire cultures. Emphasis is placed on individual and group behavior as they are influenced by the customs and institutions of the rural setting.

It is expected that the student will be best equipped for dealing in a practical way with specific social problems by being armed with some reliable information about how people in general are as they are, and how they function in the world, why and how societies are structured as they are, how people function in human groups, and some sense of the pervasiveness and antiquity of the culture which both directs and limits the growth characteristics of societies of today.

Forest Products Utilization

The objective of this course is to give the student an appreciation of how wood is utilized after being harvested. The process of converting logs to lumber and other marketable by-products is considered as well as air and kiln drying methods. Proper lumber stacking procedures and yard layout is discussed. An understanding of the marketing of various forest products is undertaken. Particular stress is placed on mill waste utilization.

Forest Protection

An introduction to the more important insects and tree disease-causing organisms in the region are considered. Control methods employed against forest insects and diseases are discussed. More emphasis is placed on the identification of the insect and disease organisms and their effect on the forest environment than on control methods.

The importance of forest fire protection and the basic principles of forest fire behavior are studied. Pre-suppression activities are covered, including fire detection, travel, public relations and organization. Fire danger instruments are demonstrated. The various methods, equipment and crew organization in fire suppression are given.

Advanced Forest Measurements

The latest techniques of timber inventory, the principles of stratification in the design of cruises and the construction of volume tables and their uses are stressed. Formal cruise reports are required in which the student indicates his grasp of the types and methods of presentation of technical data and their meaning. Practical experience in preparing cruise maps is gained as well as basic statistical knowledge.

Forest Photo-Interpretation

The principles and practices of interpreting aerial forest photographs with particular emphasis on forest typing, mapping, road reconnaissance and forest inventory techniques. The use of aerial photographs for the purpose of obtaining spatial measurements such as location, direction, length, size, area and volume. The geometry of aerial photographs, stereoscopic parallax, photo-mensurational techniques and the use of photographs in forest inventories are considered.

Laboratory exercises using aerial photographs of the local area are given. Problems in photo scale, relief displacement, height, bearings, distances and type mapping are solved with these photographs. This program is closely tied in to the work given in Advanced Forest Measurements.

Regional Forest Practices and Utilization

This course departs from the traditional classroom-laboratory approach to teaching. It consists of three weeks of concentrated field observation conducted upon completion of formal classes at the end of the second year. It is expected that the student will be able to bring together any loose ends he may have after viewing the on-going management practices current in his region. This course, coupled with his on-the-job training experience obtained the previous summer, as well as formal course work, should serve to give the student a well grounded approach to forestry and business management practices.

CURRICULUM CONTENT AND RELATIONSHIPS

Functional competence in a broad field such as forest technology has at least three components around which the curriculum must be structured: (1) the training should prepare the graduate to take an entry job in which he will be productive; (2) the broad technical training together with a reasonable amount of experience should enable the graduate to advance to positions of increasing responsibility; and (3) the foundation provided by the training should be broad enough so that the graduate can do further study within his field of technology. This curriculum has been designed to meet these three requirements.

A two-year technology program has certain unique requirements that influence the content and organization of the curriculum. Some of these requirements are imposed by the occupational functions that graduates must be prepared to perform; some result from the need for special courses that will maximize the effectiveness of teachers who have special competencies; and others arise because of the need to teach both technical principles and related practical application in the limited time available. The forest technology curriculum reflects three basic requirements: functional utility, units of instruction in specialized technical subjects, and provision for the teaching of principles by application.

The sequence of the courses in a two-year technical curriculum is as important as the content of the courses if the limited time available is to be used to full effectiveness. In general, the subject matter in the curriculum is carefully coordinated in groups of concurrent courses, which are arranged so as to blend smoothly from one group of courses into the next, thus carrying the student to a deeper understanding of basic principles while broadening his scope of understanding in the many diverse areas of forestry. This is in sharp contrast to the arrangement of the usual professional curriculum in which basic and somewhat unrelated courses make up the first part of the study program, and specialization is deferred to subsequent terms.

The relationship between laboratory time and class lecture or theoretical study time is of extreme importance in a technical education curriculum. All of the theory, skills, techniques, applied principles, materials, knowledge, processes and understandings needed by the technician could be taught in the laboratory without separate and organized theoretical classes. The converse is not true - since laboratory and field experience, skills, know-how and capability, which are the most characteristic attribute of the technician, cannot be learned in classrooms without laboratories. However, organized and related ideas, concepts and factual information can be taught in theory classes, judiciously illustrated by demonstration and other visual aids, employing selected texts and references; and requiring regular and systematic outside study on the part of the student. Group teaching usually makes more efficient use of the instructor's time in a theory class than in a laboratory and tends to emphasize and develop the student's skills in obtaining knowledge from printed sources. Thus, there must be a special relationship between the amount of time spent in the scientific and technical theory classes and that spent in the laboratory and in the field.

This curriculum provides an equal distribution of time to field and laboratory hours in the technical specialty during the second two semesters because introductory field and laboratory skills and knowledge of apparatus, tools, processes, materials, devices and good practices can and should be learned under actual conditions as early as possible. It can be started without much underlying theory. As soon as the underlying theory can be developed and understood it can be increasingly incorporated into laboratory and field work which then becomes a more significant experience for teaching the subject in depth.

Since many basic skills have been learned in the first year and since enough basic theory underlying the new material has been required, the laboratory and field time required to illustrate principles and to teach new material in second-year courses need not be as long as in the first two semesters. Since more technical specialty courses are studied in the third and fourth semesters than in the first and second, the total laboratory and field time may be greater than is spent in the first year. Experience has shown that the relative number of semester hours of science or technical specialty laboratory and field work compared to class theory hours should not be reduced materially in teaching forest technicians. Such a reduction usually causes loss of interest and failure or dropping out of the typical student or produces a graduate who is deficient in the absolutely essential laboratory and field capabilities and is therefore untrained for his occupational objectives and unemployable at the technician level.

The laboratory and field exercises suggested in this curriculum outline and in the course descriptions are not necessarily intended to be a single session, but rather as total hours of laboratory per week to be scheduled in reasonable and effective increments. For example, a four-hour laboratory total per week for a course might be scheduled as two, two-hour sessions or one four-hour session, depending on the subject material.

In technical curriculums it is mandatory that specialized technical course work be introduced in the first semester. This is subject, of course, to the whims of nature's seasons, since a majority of the laboratory work is done in the field. Deferring this introduction, even for one term, imposes serious limitations on the effectiveness of the total curriculum. Several important advantages occur from an early introduction of the technical specialty:

1. The student enrolled in school to study forestry starts his training immediately in this specialty providing motivation. If the first semester consists entirely of general subjects - mathematics, English, social studies -

students often lose interest.

2. By introducing the technical specialty in the first semester, it is possible to achieve greater depth of understanding in specialized subjects in the later stages of the two-year program.

3. The student sees immediate application for the principles he studies in mathematics and elementary forest surveying courses.

Discipline and intellectual honesty must be a part of the training of any technician. He must report accurately on what he observes. Any modification of the observed data should be fully explained in his record of the work. False reporting, if detected during the training of a technician, should be dealt with severely by any instructor. The original data reported by an employed technician may become evidence in a court of law and is therefore of great importance and should be thoroughly stressed.

Throughout the course of study the student is trained in the scientific method of observation and to record his observations in laboratory reports. A laboratory notebook should be required of all laboratory courses.

During the first semester, Elementary Forest Surveying provides the student with a basic understanding of one of the fundamental concepts behind forest management as it relates to the ownership pattern of forest lands. The concentration of this course is in the field aspects of forest land surveys and the student should be exposed to various topographic and site conditions.

Technical Mathematics is a sequence of selected topics in algebra and basic trigonometry and gives a student the ability to understand concepts which allow him to utilize the basic trigonometric tools in Elementary and Advanced Surveying course work. Dendrology and Botany compliment each other insofar as the understanding of tree physiology, growth, tree identification and tree ecology is concerned, and wherein these aspects are investigated heavily as growth characteristics in Elementary Forest Measurements and Applied Silviculture it naturally follows that the presentation of these courses be in sequence in order to give the student a sound background in the cell structure and ecology of the species. Forest Soils is concerned with giving the student a basic understanding of the movement of water, soil types and their effects upon forest growth; hence this, too, is given early in the student's curriculum so that the knowledge gained will be usable in later work.

Elementary Business Management precedes the material presented in Forest Business Methods since a basic understanding of business terminology is mandatory prior to the consideration of forest business procedures in a more in-depth study.

During the period between the first and second years the student is given the opportunity to gain employment with a forestry concern to enable him to apply his previously obtained skills and knowledges and to obtain new ones. It is highly important at this point for the student to obtain knowledge and be exposed to ideas from persons in the forestry profession other than his instructors. Experience has shown that this period should extend from a minimum of ten weeks to a maximum of sixteen weeks, depending upon the school calendar.

Timber Harvesting presents the actual harvesting operations wherein a student begins to understand the economics of forest production and planning including equipment purchase and maintenance.

Courses such as Outdoor Recreation, Elements of Social Science and Wildlife Ecology assist the student in understanding the social, psychological, economic and ecological factors influencing forest management policies associated with conflicting land-use programs. The student is exposed to the various demands for recreation of all forms and its compatability with timber production in terms of past, present, and future uses of forest land.

Personnel Management is presented in the third semester in order to prepare the student for leadership potential in his technical specialty during his third and fourth semesters.

The fourth term provides further depth of comprehension and practice in the application of principles, techniques, skills and concepts previously learned. Advanced work in Forest Measurements and Forest Photo-Interpretation are given here so that the total relationships of inventory techniques can be appreciated and consolidated in both programs. It is highly necessary for a student to relate the photo-visional relationships of his work in interpretation to the operations of cruising timber. Forest Products Utilization is a study of the basic utilization of forest products. Here, also, is the portion of the program wherein utilization and marketing of sawmill and industrial waste materials are presented.

Forest Protection is given at this time in order for the student to understand the insects, diseases, and fire problems of forest management. The basic identification and control of the insects and disease epidemics are illustrated in this course.

Close correlation of concurrent courses has not been stressed as strongly in the third-and fourth-semester courses as in the first-and second-semester courses due to the diverse areas of study in the second year. Necessarily, there are areas of overlap in course content throughout the second year, but by scheduling regular discussions between members of the staff teaching concurrent second-year courses, the most effective material may be prepared for each course, thus eliminating duplication of material and the loss of time.

Communication Skills emphasizes the mechanics of reading, writing, listening, speaking and reporting early in the curriculum (first semester). These skills are reinforced by Technical Reporting in the second semester. Instructors in the technical courses must set increasingly high standards of clarity, consciseness and neatness for student work in reporting. Freedom to report on technical subjects of their own choice may add reality and extra motivation for technology students.

In the final phases of the two-year program, the standards of reporting should approach those required by forestry organizations. At the same time, instructors should encourage individual style and initiative by allowing as much freedom as possible in reporting, consistent with established school standards. Not all reports should be of a type which require a disproportionately large number of hours for preparation. The judicious use of informal reporting as well as formal reporting allows training in both forms with the realism encountered in employment, and adjusts the time required of students in writing formal reports to a reasonable portion of their time.

At the end of the formal two-year program, experience has shown that a regional tour of the major forest industries is desirable. This tour should be a minimum of two weeks' (preferably three) duration and would assist the student in pulling together the concepts, ideas and practices learned in the previous two years plus the summer training period into a comprehensive understanding of forest management practices in the region.

The course outlines included in this guide are concise and comprehensive. They are intended as guides rather than as specific plans of instruction to be covered in an inflexible order or sequence. They represent a judgment on the relative importance of each instructional unit, especially where time estimates are shown for the divisions within each course. It is expected that the principles outlined in these courses will be supplemented with practical applications whenever possible. Field trips add greatly to the effectiveness of the instruction if they are carefully planned in advance so that the processes observed are understood and related to the subject material being studied at the time of the trip.

Outside study is a significant portion of the student's total program. In this curriculum, two hours of outside study time have been suggested for each hour of scheduled class time. A typical weekly work schedule for students in the first semester of this curriculum would be: class attendance, 13 hours; laboratory 15 hours; outside study 26 hours -- a total of 54 hours per week. This is a full schedule but not excessive for this type of program.

It should be noted that no examinations have been scheduled in the outlines. It is clearly intended that time be available for examinations. Therefore a 17-week semester is assumed, and the outlines are designed to cover a full 16 weeks. The primary objectives of examinations are to evaluate the student's knowledge and cause him to make a periodic comprehensive review of the material presented in the course. The results of examinations may also point out weaknesses in teaching techniques of subject matter covered.

It is expected that the experienced instructor will make liberal use of charts, slides, models, samples, and specimens, as well as particular forest areas which illustrate special technical aspects of the subject.

These usually are accumulated from experience of previous laboratory, field or lecture preparations by the instructor, and should be updated regularly when new developments require it. They are too specific for any attempt to be made to list them in this guide.

It is suggested that summer employment in the forestry field be required and arranged for the student between the second and third semester.

COURSE OUTLINES

The courses which follow are intended to suggest the content which might be taught in the curriculum. The material suggested provides a practical and attainable coverage of the field and has been reviewed by experienced instructors in successful forest technician educating programs, and by representative employers of skilled forest technicians.

It is expected that these materials will be modified in some measure to fill the needs as defined by local advisory committees to take advantage of the special interests and capabilities of the teaching staff in any particular institution; but the implied level, quality and completeness of the program should not be compromised.

At the end of each course is a list of text and reference materials. Each should be analyzed for its content and pertinency. New and more suitable ones should be substituted if they become available. The information needed to cover a particular course in technician educating curriculums, particularly the technical specialty courses, are almost never available in one textbook; hence, the multiple listing of references. Usually, they should be considerably augmented by current materials from manufacturers, trade journals, technical societies, and suppliers of apparatus and services in the field of applied science being studied.

Suggested visual aids are listed for many courses. Each should be used when pertinent and when its use will teach more efficiently than any other method. Excessive showing of films at the expense of well-prepared lectures and demonstrations is to be avoided. The suggested outside study periods may well be utilized instead of class lecture time for the showing of some films. All visual aids should be examined by the instructor before they are shown. Those listed after courses show the name and address of the supplier, size and mm., minutes required for showing, and whether they are sound or silent. This provides the necessary information for selection to fit projection equipment.

TECHNICAL COURSES

ELEMENTARY FOREST SURVEYING

Hours Required

Class, 2; Laboratory, 6.

Course Description

An elementary course in surveying including the fundamentals of plane surveying and the use and care of equipment. Understanding of the theory of measurements, solution of triangles, angles, bearings and azimuths is emphasized; students become familiar with mapping and proficient with the use of the staff compass, the Abney level and topographic tape.

If at all possible, it is recommended that courses in technical mathematics and applied drafting for forestry be taken prior to or concurrently with elementary surveying.

It is not necessary to follow the sequence of the subject matter in the detailed outline. In cases where the geographical location of the school is such that extreme or inclement weather conditions occur early in the semester, indoor work such as computations and plotting may need to be given prior to field work. Since surveying is an outside activity, every effort should be expended to provide the maximum in field exercises.

Terrain selected for field problems should be rugged enough to introduce normal complexities but not to the point of requiring excessive time in execution. Areas used for surveys should be such that stakes for unfinished exercises can be left in place until the survey is completed, after which each survey party should remove the stakes and other markings. Laboratory-field survey periods will generally be three hours twice a week, with a two-hour period for class lectures and problem solving; however, this will also vary. Field work should approximate industrial practice, with proper stress on the degrees of precision required in good surveying practice. Field notes should be reduced to a convenient form for plotting or calculation of distances, areas, and volumes. Field notebooks should be kept according to good professional practice and errors of closure recorded. If a survey party on a field problem exceeds the permissible error, it should repeat the problem outside the regular class hours. Students should become proficient in the duties of each member of a survey party by rotating from position to position. They should be required to read and study the daily assignments as homework. It is also expected that the students will have some computations to finish outside of class time after having started them in the classroom.

Major Divisions

		Hours Class	Hours Laboratory
I.	Introduction and Field Notes	2	2
II.	Linear Measurements	5	8
III.	Direction--Angles and Bearings	6	12
IV.	Boundary Surveys	3	18
V.	Traversing	5	30
VI.	Mapping	3	12
VII.	Determination of Area	3	8
VIII.	Public Land Surveys	5	6
	TOTAL	16	96

I. Introduction and Field Notes

A. Units of Instruction

1. Definition of surveying
2. Kinds and classes of surveys
3. Precision and accuracy
4. Sources of surveying information
5. Field notes

B. Laboratory Projects

1. Errors and mistakes
   a. Distinction between errors and mistakes
   b. Distinction between precision and errors

c. Classes of errors

d. Reduction of errors

2. Relation between angles and distances

3. Student problems

II. Linear Measurements

A. Units of Instruction

1. Units of length

2. Instruments

a. Steel tapes, surveyor's and engineer's

b. Steel pins

c. Chains

d. Range poles

e. Plumb bobs

f. Care of equipment; splicing tapes

3. Pacing

4. Measuring with steel tape: level ground

5. Measuring with steel tape: sloping or uneven ground

6. Use of surveyor's topographic tape

a. Tape held level

b. Tape on the ground

c. Abney level and topographic tape

7. Stationing

8. Errors in taping

a. Incorrect length; corrections

b. Slope and alignment

c. Tension

d. Plumbing points and setting pins

9. Mistakes in taping

a. Omitted tape length

b. Misreading tapes

c. Calling and recording numbers

d. Mistakes on add and subtract tapes

10. Special problems in the use of tapes

a. Measuring around obstacles

b. Measuring inaccessible lines

11. Student problems on linear measurements

B. Laboratory Projects

1. Practice pacing and converting distances to feet around a level traverse of a known area. Compute precision.

2. Using an engineer's tape, tape around a level traverse of a known area. Compute precision.

3. Practice pacing a known traverse of a wooded area of rough topography. Compute precision.

4. Using a topographic tape and related equipment, tape a traverse in a wooded area of rough topography.

Accuracy must be within the allowable limits.

If not, field problems are to be repeated.

III. Direction--Angles and Bearings

A. Units of Instruction

1. General remarks

2. Bearings

a. Meridians--magnetic, true and assumed

b. Magnetic declination

c. Magnetic bearings--conversions

d. True bearings--conversions

3. Geodetic azimuths

a. Azimuth and back azimuth

b. Bearings to azimuths and azimuth to bearing

4. Closed and open traverses

a. Interior angles

b. Exterior and deflection angles

5. The compass and its use

a. Reading a bearing

b. Calculating bearings from angles and angles from bearings

c. Sources of errors

1. Parallax

2. Needle bent or sluggish

3. Local attraction

4. Variations of declination

d. Mistakes

1. Misreading quadrant letters

2. Transposing the quadrant letters

3. Misreading the circle

e. Accuracy

6. Student problems on the measurement of direction

B. Laboratory Projects

1. Set a series of points and determine the bearings of known objects; compute the angles between points.

2. Set up a closed traverse and determine the bearings of a series of lines. Compute the interior and deflection angles of the traverse.

3. Compute the corrected bearings of lines originating at a point containing magnetic attraction.

4. Drive four or five stakes at random, forming an irregular polygon no side of which is less than 150 feet. Beginning at any stake survey this polygon, measuring the forward and back bearings of each line and its length.

IV. Boundary Surveys

A. Units of Instruction

1. General
2. Basis of land titles
3. Property description by metes and bounds
4. Property description by block and lot
5. Property description by coordinates
6. Registration of title
7. Registry of Deed procedure
8. Registry of Probate procedures
9. Establishing past declination from known monuments
10. Establishing bearings by trial line
11. Determining bearings by offsets

B. Laboratory Projects

1. From present declination and a line between two known points, set up a compass and determine the past declination. From this compute present bearings of a past survey.
2. Set up a line between two points, one of which cannot be seen from the other. Determine the actual bearing by trial line. On the same line, determine the bearing by right angle offsets with a staff compass and tape.
3. Make a thorough title search from the Registry of Deeds and the Registry of Probate of a

parcel of land near the campus. From the data gathered, search the area for landmarks or monuments called for in the deed.

4. Retrace the original surveyor's tracks to determine errors and problems encountered.

V. Traversing

A. Units of Instruction

1. Definition and uses

a. Open traverse

b. Closed traverse

2. Methods of running a traverse

a. Traverse by compass bearings

b. Traverse by direct and deflection angles

c. Traverse by azimuths

3. Measurement of length

4. Selection of traverse hubs

5. Angle closure

6. Organization of field party--traverse notes

7. Use of traverse computation forms and tables

8. Traverse by latitudes and departures

9. Transit rule

10. Compass rule

11. Statewide coordinate systems

12. Computations of missing bearings and distances from latitudes and departures or coordinates

13. Sources of error

B. Laboratory Projects

1. Assign a boundary survey of a wooded area of at least 30 acres in size of varying topography to a survey party of three men. Assign survey parties to specific tasks so that each student will have an opportunity to participate and become acquainted with all the field procedures.

2. Conduct a surveying exercise of the area emphasizing the use of compass, tape, Abney level, and notekeeping. Walk the area with the students to acquaint them with the landmarks. Locate all topographic features on line and witness all corners. The data obtained from this survey should be utilized in later laboratory sessions on mapping and area computations.

VI. Mapping

A. Units of Instruction

1. General information

2. Drafting and lettering

3. Plotting

a. coordinate method

b. Tangent method

c. Chord method

d. Protractor method

e. Latitudes and departures

4. Plotting detail

5. Plotting contours

6. Topographic symbols

7. Title and balance

8. Sources of error

9. Student homework problems

B. Laboratory Projects

1. Students will map an area with data obtained from the survey completed in the previous assignment by latitudes and departures.

2. Map the same exercise by protractor and scale and compare the error of closure obtained from both methods.

3. Using contour data obtained with the previous exercise, plot contours on the plat.

VII. Determination of Area

A. Units of Instruction

1. General information

2. Field measurement

a. Triangulation

b. Offsets

c. Double meridian distances

d. Coordinates

3. Map measurements

a. Division of area into triangles

b. Coordinate squares

c. Polar planimeter

d. U. S. Forest Service dot grid

B. Laboratory Project

1. Calculate the area of survey completed in V by double meridian distances, triangulation, polar planimeter and U. S. Forest Service dot grid.

2. Conduct other exercises using area determination methods.

VIII. Public Land Surveys

A. Units of Instruction

1. General information

a. Boundaries

b. Division

2. Initial point of survey

3. Principal meridian

4. Base line determination

a. Solar method

b. Tangent method

5. Parallels

6. Guide meridians
7. Township lines and corners
8. Subdivision to sections
9. Subdivision of sections
10. Fractional sections
11. Meander lots and corners
12. Lost and obliterated corners
13. Description by township, section and smaller subdivision
14. Sources of error
15. Selected student problems for homework assignment

B. Laboratory Projects

Make a field trip, if feasible, to an area land out by public land survey system and retrace survey showing lines of convergence and section corners. Have the representative of the agency discuss the utility of the public land survey system and explain some of the problems associated with the establishment and use of public land surveys.

Texts and References

Boucher and Moffit. Surveying.

Breed and Bone. Surveying.

Breed and Hosmer. Elementary Surveying.

Brinker and Taylor. Elementary Surveying.

Brown. Boundary Control and Legal Principles.

Brown and Eldridge. Evidence and Procedure for Boundary Location.

Davis. Elementary Plane Surveying Forestry Handbook.

Forbes. Forestry Handbook.

Kissam. Surveying.

Low. Plane Table Mapping.

Meyer. Route Surveying.

Pofford. Handbook of Survey Notekeeping.

Rubey, Lommel and Todd. Engineering Surveys.

Tracey. Plane Surveying.

------ Surveyor 1 & C. Navy Training Manual NAVPERS 106 33-A.

------ Surveyor 3 & 2. Navy Training Manual NAVPERS 106 32-B.

------ Elements of Surveying. Army Technical Manual TM 5-232.

DENDROLOGY

Hours Required

Class, 1; Laboratory, 6

Course Description

Dendrology is a basic course in the ecology and identification of the various species of woody plants typical of the major timbered regions of the United States.

The objectives of this course are to create an interest in, a practical understanding of, and a working knowledge of the woody plants used in the geographical area where the course is taught. This This will insure that the students can effectively utilize this knowledge and information in the field of forestry. A further objective is to have students identify each plant by its outstanding characteristics in as many seasons of the year as is possible, considering the location of the institution offering the forest technician program. Further, to understand how to effectively grow these species by having a knowledge of the form, habit, height, soil requirements, root system, flowering and fruiting characteristics, ecological relationships, susceptability to insect and disease attack, and the peculiarities of each. This information will tie-in directly with the Applied Silviculture course. An effort should be made to insure that species are observed and identified under typical and atypical forest conditions. A further effort should be made to present to the students typical tree characteristics throughout the range of seasons. The use of dichotomous plant keys should be stressed.

The order of material presentation may be changed to suit the instructor and the seasons without any detrimental effects.

Major Divisions		Hours Class	Hours Laboratory
I.	Classification of Plants	1	6
II.	Plant Characteristics Used in Classification	3	12
III.	Span of Life	1	20
IV.	Angiosperms	2	20
V.	Gymnosperms	2	20
VI.	Biotic Community	5	10
VII.	Environmental Principles	2	8
	TOTAL	16	96

I. Classification of Plants

A. Units of Instruction

Botanical Classification (Binomial System)

1. Division
2. Subdivision
3. Class
4. Order
5. Family
6. Genus
7. Species
8. Scientific names

B. Laboratory Projects

1. Visit a local herbarium or park and observe the classification of plants and their identifying characteristics
2. Introduce and explain the meaning of various terms in identifying characteristics of trees

II. Plant Characteristics Used In Classification

A. Units of Instruction

1. Leaves
    a. General features
    b. Leaf arrangement
    c. Leaf composition
    d. Leaf shape
    e. Leaf margin
    f. Leaf apices and bases
    g. Leaf venation

h. Surface features

2. Twigs

a. Buds

b. Leaf scars

c. Stipule scars

d. Lenticels

e. Pith

f. Spurs

g. Spines and thorns

3. Bark

4. Flowering characteristics

5. Fruiting characteristics

6. Habit of growth

B. Laboratory Projects

1. Using a dichotomous twig key, demonstrate to the students the methodology of "keying out" a simple specie which has large, well defined identifying characteristics

2. Allow the students to "key out" a selected group of species

III. Span of Life

A. Units of Instruction

1. Annuals

2. Biennials

3. Perennials

a. Herbaceous perennials

b. Woody perennials

(1) Tree

(2) Shrub

(3) Vine

B. Laboratory Projects

1. Identify ten to fifteen species by ecological association, taxonomy and observation of plant characteristics under field conditions

2. Identify five to ten species by scientific and common name in a field quiz. These species can be softwoods, hardwoods or a mixture depending on the instructor's preference.

IV. Angiosperms

General discussion of monocots and dicots--practical field identification by leaf, bark, twig, habit, site, fruit, form

A. Units of Instruction

1. Salicaceae

a. <u>Salix</u>

b. <u>Populus</u>

2. Juglandaceae

a. <u>Juglans</u>

b. <u>Carya</u>

3. Betulaceae

    a. _Betula_

    b. _Alnus_

    c. _Carpinus_

    d. _Ostrya_

    e. _Corylus_

4. Fagaceae

    a. _Fagus_

    b. _Quercus_

5. Ulmaceae

    a. _Ulmus_

    b. _Celtis_

6. Moraceae

    a. _Morus_

7. Magnoliaceae

    a. _Magnolia_

    b. _Liriodendron_

8. Saxifragaceae

    a. Gooseberry and currants

9. Hamamelidaceae

    a. _Liquidambar_

    b. _Hamamelis_

10. Platanaceae

    a. _Platanus_

11. Rosaceae

    a. <u>Prunus</u>

    b. <u>Malus</u>

    c. <u>Pyrus</u>

    d. <u>Sorbus</u>

    e. <u>Amelanchier</u>

    f. <u>Crataegus</u>

12. Leguminosae

    a. <u>Gleditsia</u>

    b. <u>Cladrastis</u> <u>lutea</u>

    c. <u>Robinia</u>

B. Laboratory Projects

1. Identify ten to fifteen species by ecological association, taxonomy and observation of plant characteristics under field conditions

2. Identify five to ten species by scientific and common name in a field quiz. These species can be softwoods, hardwoods or a mixture depending on the instructor's preference.

V. Gymnosperms

General discussion--identification by needles, bark, range, form, habit

A. Units of Instruction

1. Pinaceae

a. Abies

b. Pinus

c. Larix

d. Picea

e. Pseudotsuga

f. Tsuga

2. Taxodiaceae

a. Sequoia

b. Toxodium

3. Cuppressaceae

a. Libocedrus

b. Thuja

c. Cupressus

d. Chamaecyparis

e. Juniperus

4. Taxaceae

a. Torreya

b. Taxus

B. Laboratory Projects

1. Identify ten to fifteen species by ecological association, taxonomy and observation of plant characteristics under field conditions

2. Identify five to ten species by scientific and common name in a field quiz. These species

can be softwoods, hardwoods or a mixture depending on the instructor's preference.

VI. The Biotic Community (Ecosystem)

A. Units of Instruction

Environmental factors controlling the community

1. Climatic factors
    a. Radiant energy
    b. Light--affecting the following:
        (1) Photosynthesis
        (2) Transpiration
        (3) Direction of growth
        (4) Flower production
        (5) Enzyme action
    c. Temperature
    d. Air
        (1) Carbon dioxide concentration
        (2) Atmosphere
        (3) Water content of atmosphere
        (4) Wind
2. Physiographic factors
    a. Pedogenisis
    b. Edaphology
        (1) Mineral components and physical characteristics
        (2) Organic content

(3) Soil water

(a) Hydrophytes

(b) Xerophytes

(c) Mesophytes

(d) Halophytes

(4) Soil atmosphere

(5) Chemical factors

(a) Soil acidity

(b) Exchangable bases

(c) Inhibition of growth by plant products

(d) Alkalinity

(e) Salinity

(6) Topography

3. Biological factors

a. Plants as factors

(1) Competition

(2) Parasites

(3) Epiphytes

(4) Symbiosis

(a) Mycorrhiza

(b) Nodules

(5) Other soil flora

b. Animals as factors

(1) Pollination

(2) Dissemination

(3) Soil animals

(4) Insects

(5) Large animals

(6) Man

B. Laboratory Projects

1. Observe, under field conditions, the effects of competition on timber stand composition. Discuss and demonstrate the relationships of edaphic and climatic factors on plant growth.

2. Observe specie composition in different ecological niches

VII. Environmental Principles

A. Units of Instruction

1. Energy flow

2. Cycling of minerals and gasses

3. Principle of limiting factors

4. Plant succession

B. Laboratory Projects

1. Field final examination in the identification of hardwood species under field conditions

2. Field final examination in the identification of softwood species under field conditions

Texts and References

Bailey. The Cultivated Conifers of North America.

Britton. North American Trees.

Billings. Plants and the Ecosystem.

Cheyney. What Tree is That?

Dame. Trees of New England.

Hardin. Workbook for Woody Plants.

Harlow. Fruit Key and Twig Key to Trees and Shrubs.

__________. Trees of Eastern United States and Canada.

__________ and Harrar. Textbook of Dendrology.

Makin. Identification of Trees and Shrubs.

Oosting. Study of Plant Communities.

Odum. Ecology.

Petrides. A Field Guide to Trees and Shrubs.

Preston. North American Trees.

Visual Aids

Cornell University, New York State College of Agriculture, Film Library, Ithaca, New York

Spruce Bog/An Essay in Ecology. 23 minutes, color, sound. A description of the conditions under which a spruce bog is formed with details of the plant types found at successive stages of development from open water to mature spruce forests. Time lapse photography illustrates the growth and decay of vegetation preceding the appearance of sphagnum moss which chokes off water to make the floor of the forest. The film discusses the commercial uses of peat extracted from such bogs and the value of black spruce to Canada's pulp industry.

Coronet Instructional Films, Coronet Building, Chicago, Illinois

Trees: How We Identify Them. 11 minutes, color or black and white, sound. Citing many varieties as examples, the film points out ways to identify--by shape, bark, leaves and fruit--and to explain the differences between deciduous trees and evergreens. Individual characteristics of many trees are shown, and activities are suggested which will motivate students to take a greater interest in the trees in their community.

Indiana University, Audio-Visual Center, Bloomington, Indiana 47405

How Trees Live. $16\frac{1}{2}$ minutes, color, silent. The subject of this film is the raw materials and energy required for growth from a seed to a mature tree; where these components come from and how they function. The effects of the presence or absence of water, carbon dioxide, the sunlight on rate of growth are demonstrated, as well as the presence or absence of chlorophyll in the synthesis of starch.

Succession--From Sand Dune to Forest. 16 minutes, color.

Temperate Deciduous Forests. 16 minutes, color, sound. Shows a typical deciduous forest, plants and animals and their adaptations to seasonal change. The full yearly cycle of spring, summer, autumn, and winter is shown through the use of time lapse photomicrography and live photography.

McGraw-Hill Book Company, Text-Film Division, 330 West 42nd Street, New York, New York 10036

Applied Ecology. 28 minutes, color, sound. Shows misuse of soil and resources by man. Describes measures to reduce wastes and restore land now unusable. Illustrates classification of land according to its best use.

Cymnosperms. 28 minutes, color, sound. Describes alternation of generations of the pine. Discusses the coniferous forests, the ginkgo and the cycads.

Life of the Angiosperm. 28 minutes, color, sound. Describes alternation of generations of angiosperms. Describes development of pollen grain, egg, pollination, fertilization, and maturation of embryo into mature plant. Discusses senescence in plants. Differentiates between monocotyledons and dicotyledons.

Likenesses and Differences in Angiosperms. 28 minutes, color, sound. Discusses the uses of angiosperms. Describes the classification of the angiosperms into orders, families, genera, and species. Explains a race, a cultivar, and a hybrid.

Plant and Animal Distribution. 28 minutes, color, sound. Describes ecologist role, position; defines population, community, ecosystem. Emphasizes plant and animal distribution in regions with favorable survival conditions. Illustrates North American biomes, mountain zonation, disjunctive distribution.

Plant Succession. $14\frac{1}{2}$ minutes, color, sound. This film shows the sequence of stages of theoretical primary succession from bare rock to hardwood forest climax. It is clearly pointed out that not all regions go to this final theoretical stage, but that where soil, precipitation and temperature are limiting factors, the evergreen forest, prairie, tundra and desert may be the climax stage for that particular region.

Systematics and Plant Evolution. 28 minutes, color, sound. Out in the countryside the scientist attempts to classify plants. Oaks and sunflowers lead the student into a clearer understanding of the world of plants and of the principles of classification and evolution.

The Deciduous Forest. 28 minutes, color, sound. Shows physical factors limiting deciduous forest distribution in eastern U. S. Explains adaptations of vegetation inhabiting the deciduous forest. Describes important subdivisions of the deciduous forest in eastern U. S.

The Spruce Bog. 28 minutes, color. A description of the conditions under which a spruce bog is formed, with details of the plant types found at successive stages of development from open water to mature forest. Time lapse photography is used to illustrate the growth and decay of vegetation.

National Film Board of Canada, 680 Fifth Avenue, Suite 819, New York, New York 10019

Native Trees of Canada. 42 frames, black and white. An aid in identification and study of coniferous and deciduous trees native to British Columbia, with description of their characteristics and commercial uses.

Society for Visual Education, Inc., 1345 Diversey Parkway, Chicago, Illinois 60614

Telling Trees Apart. 48 frames, color. Conifers and broadleaved trees. Identifies leaves, bark buds, flowers, fruit.

State University of New York, College of Forestry, Department of Forest Extension, Syracuse, New York Identifying Common Trees. 44 frames, color. Shows how to identify trees by characteristic outstanding features, examination of the bark, leaves, flowers, seeds, etc.

FORESTRY ORIENTATION SEMINAR

Hours Required

Class, 1; Laboratory, 0

Course Description

An introduction is given on the educational institution, the new type of learning situation facing the student and the objectives of the Forest Technician program.

The multiple-use concept and historical development of forestry are presented. Major and allied forestry fields are discussed to give the students an understanding of what forestry entails. Current forestry programs of federal, state and private organizations are introduced.

The remainder of the course is devoted to giving the student occupational and technical orientation by means of lectures, visual aids and the use of representative guest speakers.

Major Divisions

		Class Hours
I.	The Student and The School	2
II.	Multiple-Use Concept of Forestry	1
III.	Development of Forestry in the United States	2
IV.	Forestry and Its Allied Fields	3

V.	Current Programs in Forestry	3
VI.	On-The-Job Training Programs	1
VII.	Career Employment Opportunities	4
	TOTAL	16

I. The Student and The School

Units of Instruction

1. The Forest Technician Curriculum
   a. Objectives
   b. Curriculum design
   c. Options
   d. Other types of non-professional training programs
2. Applied vs. theoretical approaches in instruction and training
3. Organization of field work
   a. Percentages of time in the field
   b. Care of equipment and machinery
   c. Crew organization--team work
   d. Class field trips
4. Four-year schools' transfer policies
   a. Accreditation of forestry schools
   b. Admission policies of eastern and western schools
5. Special student equipment required
6. Sources of forestry reference material

II. Multiple-Use Concept of Forestry

Units of Instruction

1. Wood
2. Water
3. Wildlife
4. Forage
5. Recreation

III. Development of Forestry in the United States

Units of Instruction

1. Forestry in colonial times
2. Federal
3. State
4. Farm
5. Private

IV. Forestry and Its Allied Fields

Units of Instruction

1. Protection
2. Management
3. Harvesting
4. Lumber manufacturing and sales
5. Woods: its nature and uses
6. Secondary forest products

V. Current Programs in Forestry

Units of Instruction

1. Federal

    a. National forests

    b. Bureau of Land Management

    c. Bureau of Indian Affairs

    d. National Park Service

    e. U. S. Fish and Wildlife Service

    f. Tennessee Valley Authority

    g. Federal Cooperation Programs

    h. Others

2. State

3. Colleges of forestry

4. County and community forests

5. Industry and other private forest programs

VI. On-The-Job Training Programs

Units of Instruction

1. Necessity

2. Requirements

    a. School

    b. Employer

    c. Student

3. Summer employment opportunities

4. Past employers sympathetic to training forest technicians

VII. Career Employment Opportunities

Units of Instruction

1. Demand for trained forest technicians

2. Private industries

   a. Salary comparisons with other agencies

   b. Opportunities for advancement

   c. Organization structure

      (1) Large

      (2) Small

3. Agencies other than industrial

   a. Federal government

      (1) U. S. Forest Service

      (2) Bureau of Indian Affairs

      (3) Bureau of Land Management

      (4) Bureau of Outdoor Recreation

      (5) National Park Service

   b. State

   c. Local

      (1) County

      (2) City

      (3) Institutions

      (4) Associations

      (5) Estates

      (6) Cooperatives

Texts and References

Randall. "So You Want to be a Forester?"

Shirley. _Forestry and Its Career Opportunities_.

Visual Aids

U. S. Forest Service, Washington, D. C. 20250

Timber Management on the White Mountain National Forest.

ELEMENTARY FOREST MEASUREMENTS

Hours Required

Class, 1; Laboratory, 6

Course Description

A forest enterprise is concerned with growing tree crops. As a consequence, a technician must be capable of assessing the volume of growing timber, its quality and its rate of growth as well as measuring the volume of various products removed from the land.

This course is designed to give the student the basic skills and principles of timber measurement. Mathematics and the geometric principles related to tree growth and measurement are stressed as a continuation of material presented in Technical Mathematics. Elementary Forest Measurements stresses the techniques and principles of log grading, long and short log scaling and the factors relating to growth in the forest stand. The effect of log defects on volume and grade of lumber are demonstrated by "opening up" selected logs in the sawmill and giving students the opportunity to analyze the results.

Major Divisions

		Hours Class	Laboratory
I.	Introduction to Forest Measurements	1	0
II.	Principles of Measurement	1	6
III.	Volume Measurement	4	24
IV.	Log Rules and Log Scaling	4	30
V.	Measurement of Diameter and Heights of Standing Trees	2	6
VI.	Log and Tree Grading	2	18
VII.	Factors Affecting the Growth of Trees	2	12
	TOTAL	16	96

I. Introduction to Forest Measurements

A. Units of Instruction

1. Standard units of measurement as used in forestry
    a. Measurement of products and logs
    b. Measurement in the tree
    c. Measurement of growth
2. Scope of forest measurements
    a. Reason for inventories
    b. Reason for volume calculations

B. Laboratory Projects

None

II. Principles of Measurement

A. Units of Instruction

1. Introduction to measurements

2. Accuracy of measurements

    a. Errors

    b. Rounding-off

    c. Significant figures

3. Review of basic mathematics

    a. Ratio

    b. Percentages

    c. Proportion

    d. Area

    e. Volume (geometric principles)

4. Data gathering and methods of presentation

    a. Graphs

    b. Curves

B. Laboratory Projects

1. Mathematical problems using conversion factors

    a. Lengths--inches to links, feet to chains, feet to rods, feet to meters

    b. Area--square inches to square feet, square feet to acres, square feet to square meters, square feet to square chains, square chains to acres

c. Volume and capacity--cubic inches to cubic feet, cubic feet to cubic yards, cubic feet to bushels, fluid ounces to cubic inches, pints to cubic inches, gallons to cubic inches

d. Weight--pounds per square feet to pounds per square inch, gallons of water to pounds, cubic feet to pounds of water

e. Quantity of forest products--fence posts to board feet, poles to board feet

f. Equivalent forest products--cubic feet to board feet, board feet to cords, cubic feet to cords

2. Selected problems in the use of desk calculators

   a. Four basic operations

   b. Rounding-off

   c. Significant digits

3. Require the students to present basic data in curve and graph form and to identify the variables

III. Volume Measurement

A. Units of Instruction

1. Cubic content

   a. Basal area calculations

   b. Types of log forms

c. Volume by geometric formulae

2. Commercial methods of log measurement

   a. Scaling

   b. Weight

3. Log rules used based upon cubic content of logs

4. Cordwood measurements

   a. Utility and current practices in the region

   b. Measurement by weight

   c. Units of stacked or cord measurement

   d. Solid cubic contents

   e. Deduction for defects in logs and piling

   f. Conversions of cubic volume to board measure

5. Form class measurement

   a. Construction of form class tables

   b. Use in modifying local volume tables

B. Laboratory Projects

1. Determine the cubic volume of felled trees using several approximation formulas

2. Determine the form class of a sample number of trees in a forest stand and compute the volume of timber in a selected area using appropriate standard volume tables as

modified by the form class data gathered

3. Determine the gross and net cord volume of a number of ranks of cordwood piled in the woods, roadside and on slopes

IV. Log Rules and Log Scaling

A. Units of Instruction

1. Factors causing variation in sawed output of logs
2. Diagram rules, construction and use
3. Formula rules, construction and use
4. Log rules based on mill tally
    a. Overrun and underrun
    b. Waste from saw kerf and slabs
5. Scaling straight sound logs
    a. Diameter measurement
    b. Lengths
    c. Bark thickness considerations
    d. Standards of accuracy necessary
6. Scaling defects as they affect volume
    a. Crook or sweep
    b. Exterior defects
    c. Interior defects
    d. Merchantable vs. cull logs
7. Scaling records and check scaling

B. Laboratory Projects

1. Identify various species of logs by bark and wood characteristics under field conditions
2. Demonstrate the use of various log rules and their applicability in local regions
3. Scale a number of selected hardwood and softwood logs on the brow, in the woods and at the mill landing; determine gross and net volume
4. Saw a selected number of logs after determining net volume and compare log tally with mill tally
5. Discuss defects as they appear in the log and the lumber

V. Measurement of Diameter and Heights of Standing Trees

A. Units of Instruction

1. Total height vs. merchantable height
2. Use and advantages of various height measuring devices
   a. Hypsometer
   b. Abney level
   c. Haga altimeter
   d. Spiegel Relaskop
   e. Trigonometric methods
3. Major errors in height determination

4. Tree diameter measurements
    a. Diameter tape
    b. Biltmore stick
    c. Calipers
    d. Dendrometers
5. Major errors associated with the use of the above devices

B. Laboratory Projects
1. Measure the heights and diameters of selected tree species by using the above instruments
2. Set up a problem in which the students will be required to measure tree heights and diameters under adverse conditions such as varying stand densities and slopes

VI. Log and Tree Grading

A. Units of Instruction
1. Introduction to lumber grades and grading rules
2. Basic principles of log grading of local species
    a. Requirements of grades
    b. Grading defects
    c. Softwood log grades
    d. Hardwood log grades

B. Laboratory Projects
1. Examine a selected group of logs at the

landing and at the sawmill for log defects; discuss defects as they affect grade

2. Diagram a selected group of logs for defect characteristics

3. Set up a control area of locally commercial species and require the students to grade selected trees

4. Require a report, stressing the economic aspects of tree and log grading. This report should include the student's tree grading results under item 3.

VII. Factors Affecting the Growth of Trees

A. Units of Instruction

1. Climatic cycles
2. Normal mortality
3. Characteristics of growth
    a. Age of trees
        (1) Increment cores
        (2) Total and seedling age
    b. Height growth based on age
    c. Diameter growth based on age and other factors
4. Factors affecting growth
    a. Site index
    b. Site quality

(1) Reading site index curves

(2) Evaluation of site quality

(3) Species indicators

c. Site classification

B. Laboratory Projects

1. Determine the site index of one or two local commercial species in selected areas exhibiting site index differences

2. Determine the average age and the density and quality of selected stands on different sites and compare them; construct site index curves for the areas studied

Texts and References

Chapman and Meyer. Forest Mensuration.

----------. Converting Factors and Tables of Equivalents Used in Forestry.

Dressler. Review Text in Preliminary Mathematics.

----------. "Grade Defects in Hardwood Timber and Logs."

----------. "A Guide to Hardwood Log Grading."

----------. "A Guide to Log Diagramming for Eastern Softwoods."

Husch. Forest Mensuration and Statistics.

----------. National Forest Log Scaling Handbook.

Visual Aids

U. S. Department of Agriculture, Forest Service,

Washington, D. C.

How We Grade Northern Hardwood Trees. A slide tape program.

The Forest Service Scaler. A slide tape program.

APPLIED SILVICULTURE

Hours Required

Class, 2; Laboratory, 6

Course Description

Applied Silviculture is a basic course in the biological laws. It includes the economic objectives underlying the principles of silviculture and the factors which govern the application of the principles.

The subject matter consists of the various treatments given a forest stand to maintain and increase forest production.

The major objective of forestry is economic and therefore a student must be able not only to obtain maximum growth and quality from trees, but also to estimate the economic potential at the same time. The technician must be trained to produce more useful forests than nature does, in a shorter period of time.

The laboratory segments of this course must be given in as practical a plane as is possible by providing field observations and practices. Extensive time allocation must be given to technical students under field conditions to develop leadership qualities and abilities. The practice of silviculture lends itself well to the development of supervisory ability and should be emphasized insofar as is possible.

Major Divisions

		Hours	
		Class	Laboratory
I.	Introduction and History	2	8
II.	Regulation of Stand Composition	6	22
III.	Regulation of Stand Growth Through Thinning	6	16
IV.	Pruning	2	6
V.	Regeneration of Forest Stands	6	24
VI.	Specialized Tree Production	2	8
VII.	Silvicultural Systems	4	12
VIII.	Commercial Forest Regions of the United States	4	
	TOTAL	32	96

I. Introduction and History

A. Units of Instruction

1. Objectives of silviculture

a. Control stand density

b. Control stand composition

c. Protection and salvage

d. Control length of rotation

e. Protection of site

f. Restocking

3. History of silviculture and past management considerations

a. European

b. Early systems and their evolution to present United States systems

B. Laboratory Projects

1. Observe and discuss the different stand types and specie composition in stands within easy traveling distance from the school

2. Choose one mixed-composition stand of sufficient area and thoroughly ground the students in the principles of specie occurrance on a particular site and the environmental influences on growth and composition. Discuss market conditions affecting the growing and cutting of local commercial species.

3. Have students present a technical report on the discussion as it pertains to the production of commercially valuable timber in the local area

II. Regulation of Stand Composition

A. Units of Instruction

1. Type of release cuttings
    a. Liberation cut
    b. Cleaning (weeding)
2. Trees to be removed
3. Stand age and composition
4. Volume removed
5. Herbicides
    a. Types by chemical composition, trade name and concentration
    b. How the herbicide causes tree mortality
    c. Mixture, rate and time of application
    d. Recording pertinent data when using herbicides
6. Methods utilized
    a. Tools
    b. Herbicides
        (1) Frill
        (2) Basal spray
        (3) Tree injector
        (4) Mist blowing
        (5) Aerial spraying
        (6) Soil sterilants
        (7) Chemical debarking
    c. Problems associated with the use of chemicals

(1) Safety hazards to man and animals

(2) Corrosion of equipment

(3) Sprouting

(4) Epicormic branching of hardwoods

B. Laboratory Projects

1. Demonstrate the mixing of chemicals, the tools used, and the technique of manipulating these various tools under field conditions to alter or control specie composition in a stand

2. Give the students an extended field exercise covering several laboratory periods, in the techniques of using each tool. Allow each student to use each tool and to become thoroughly familiar with its advantages and disadvantages under various forest type conditions.

3. Require a report explaining the layout of the work, stand composition, species treated, acreage, and other pertinent factors making up the exercise

III. Regulation of Stand Growth Through Thinning

A. Units of Instruction

1. Thinning in relation to individual tree growth

a. Tree form

b. Crown classification

c. Live crown ratio

2. Effect of thinning on:

a. Economic yield of stand

b. Diameter growth and yield of the stand

c. Other physiological responses

3. Methods of thinning

a. Low thinning

(1) Purpose

(2) When applied

(3) Advantages and disadvantages

(4) Effect on stand growth and reproduction

b. Crown thinning

(1) Purpose

(2) When applied

(3) Advantages and disadvantages

(4) Effect on stand growth and reproduction

c. Selection

(1) Purpose

(2) When applied

(3) Advantages and disadvantages

(4) Effect on stand growth and reproduction

d. Mechanical

(1) Purpose

(2) When applied

(3) Advantages and disadvantages

(4) Effect on stand growth and reproduction

e. Free thinning

(1) Purpose

(2) When applied

(3) Advantages and disadvantages

(4) Effect on stand growth and reproduction

4. Regulation of stand density through thinning

a. Thinning schedule development--rotation periods

b. Percent of stocking (stand density)

c. Spacing estimates

d. Economic thinning schedules

5. Effect of thinning on forest protection--susceptibility vs. vulnerability

a. Insect

b. Disease

c. Fire

d. Wind damage

6. Thinning relationship to conflicting forest uses

a. Watershed value

b. Wildlife management

c. Recreation

B. Laboratory Projects

1. Take a field trip to a series of plantations exhibiting high, low, selection and mechanical thinning techniques. Discuss the advantages and disadvantages of each system as it pertains to the economics of harvesting and merchandising. Discuss disease and insect problems as they pertain to stand composition.
2. Set up strips for student thinning in pre-commercial stands. Appoint two or three man crews. Allow the students to mark potential crop trees, trees to be removed in an intermediate thinning, and those to be removed immediately. Temporarily mark these trees with a lime sock.
3. Have students thin the pre-commercial stand by hand axe or chain saw. Determine volume to be removed by basal area tabulation.
4. Set up a selected area which has been thinned next to an unthinned area and have students classify a number of trees in both areas for vigor, crown classification, quality and volume. Discuss harvesting and merchandising problems. Take increment borings to determine rate of growth.

5. Have the students mark a stand for a commercial thinning. Compare these results with the pre-commercial operation in a biotic and economic sense

6. Write a report comparing these methods, stressing the economic and biotic relationships.

IV. Pruning

A. Units of Instruction

1. Natural pruning

a. How death occurs and healing rate

b. Defects

c. Types of knots formed

(1) Unsound knots

(2) Sound knots

2. Artificial pruning

a. Effects on tree

b. Species, size and age of trees to prune

c. Height and number per acre

d. Economics involved

e. Methods

(1) Methods currently used

(2) Research progress

B. Laboratory Projects

1. Under field conditions, show and discuss

natural pruning and the lack of it in various timber types. Discuss the formation of knots and knot-free lumber by having a series of sawn logs available, both pruned and unpruned.

2. Have student crews select crop trees for pruning, keeping all silvicultural aspects in mind
3. Have students prune these selected crop trees after a thorough discussion and critique by the class and instructor
4. Require a report indicating the economic returns possible as well as the cost of pruning. Charts and graphs depicting the speed and cost of pruning by various species should be included.

V. Regeneration of Forest Stands

A. Units of Instruction

1. Natural regeneration
    a. Seed supply
    b. Insects
    c. Disease
    d. Micro-environmental factors
        (1) Soil temperatures
        (2) Moisture requirements

2. Artificial regeneration

a. Direct seeding

(1) Control of seed eating birds and animals

(2) Site preparation and modification

(3) Seed sources and genetics

(4) Seed orchards and pollination

(5) Seed storage

(6) Seed treatment and testing

b. Methods of seeding

(1) Broadcast--aerial and ground

(2) Strip and spot seeding

c. Tree planting

(1) Adaptation of species to site requirements

(2) Selection and handling of planting stock

(3) Spacing

(4) Season of planting

(5) Site preparation

(6) Methods and economics of planting--hand and machine

d. Protection of new plantings

(1) Biotic causes of destruction

(2) Atmospheric causes of destruction

(3) Fertilization of plantations

3. Site preparation

a. Effects of logging slash

(1) Effects of slash on reproduction

(2) Slash effects on the soil

(3) Slash in relation to insects and disease

b. Disposal of slash

(1) Broadcast burning

(2) Spot burning

(3) Pile burning

(4) Lopping and scattering of slash

c. Seed bed preparation

(1) Prescribed burning

(a) Species affected

(b) Controlling competing vegetation

(c) Methods of burning

(2) Mechanical treatment

(a) Scarification by harrows and rakes

(b) Rolling brush cutters

(c) Brush rakes and anchor chains

B. Laboratory Projects

1. Make an on-site inspection field trip to see

planting techniques by hand and machine. If possible, visit an area undergoing machine site preparation and prescribed burning. Have the resource person in charge discuss his reasons for doing this preparation as well as the economical aspects, methods and results desired.

2. Prepare a seed lot for direct seeding by hand methods and, setting up crews of men, re-seed a selected area by hand
3. Visit a direct seeding project in the locale and discuss site preparation, seed preparation and seed distribution by aircraft. With the resource person available, discuss and demonstrate methods of seeding from aircraft.
4. Take a field trip to a forest nursery. Discuss and demonstrate seed certification, seeding, transplanting, lifting, sorting, bundling, and shipping
5. Select a planting site and have the students plant a number of species by hand
6. Present a report on the seeding and planting systems in the local area, discussing economics, species, site and methods

VI. Specialized Tree Production

A. Units of Instruction

1. Christmas tree production
2. Maple syrup and sugar production
3. Naval stores operation

B. Laboratory Projects

1. Visit a local Christmas tree farm and demonstrate or discuss planting or seeding, cultural practices, harvesting and merchandising of Christmas trees
2. Visit a local maple syrup industry; observe and discuss the phases of the operation
3. Visit a local naval stores operation; observe and discuss the phases of the operation
4. Require a report concerning all aspects of the items discussed and observed at the industry visited

VII. Silvicultural Systems

A. Units of Instruction

1. Clearcut method
   a. Clearcutting with artificial regeneration
   b. Clearcutting with natural regeneration
   c. Methods of clearcutting
2. Seed tree method
   a. Number and distribution of seed trees

b. Cultural operations

c. Advantages and disadvantages of seed tree method

3. Shelterwood method

a. Type of forest produced

b. The shelterwood method

c. Modifications of the method

(1) Uniform system

(2) Strip-shelterwood system

(3) Group-shelterwood system

4. Selection method

a. Basic procedure

b. Form of stand produced

c. Modifications of the method

(1) Single tree selection

(2) Group selection

(3) Strip selection

d. Advantages and disadvantages of the method

B. Laboratory Projects

1. Visit as many harvesting operations as possible in the local area, choosing selected areas exhibiting the various silvicultural cutting systems

2. Conduct a thorough on-site discussion of the cutting system, method of marking, timber

harvesting problems, economic and reproduction problems

3. Require a report of each student on each of the systems discussed and shown. This report should indicate the best system to use by species in the local area as well as the economics involved.

VIII. Commercial Forest Regions of the United States

A. Units of Instruction

1. Northern coniferous forest
    a. Major commercial species
    b. Silvical characteristics
    c. Silvicultural management
2. Mixed coniferous--deciduous broadleaf forest
    a. Major commercial species
    b. Silvical characteristics
    c. Silvicultural management
3. Central hardwood forest (cove hardwoods)
    a. Major commercial species
    b. Silvical characteristics
    c. Silvicultural management
4. Mixed coniferous--evergreen hardwood forest of the Southeastern United States
    a. Major commercial species
    b. Silvical characteristics

c. Silvicultural management

5. Coniferous forest of Rocky Mountain and Great Basic ranges, including inland empire
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
6. Chaparral and evergreen broadleaved forest of California
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
7. Coniferous forests of Sierra Nevada chain
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
8. Coniferous forest of the northern Pacific Coast
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
9. Coniferous forest of Alaskan coast
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management

B. Laboratory Projects

None

Texts and References

Barrett. Regional Silviculture of the United States.

----------. "Christmas Trees--A Technical Manual for Farmers."

----------. Forest Cover Types of North America.

Hawley and Smith. The Practice of Silviculture.

Preston. Developing Farm Woodlands.

----------. Silvics of Forest Trees of the United States.

Sloan. "Christmas Trees--A Cash Crop."

Smith. The Practice of Silviculture.

Sowder. "Christmas Trees: The Tradition and Trade."

Spurr. Forest Ecology.

----------. Woody-Plant Seed Manual.

Visual Aids

McGraw-Hill Book Company, Text-Film Department, 330 West 42nd Street, New York, New York 10018

The Deciduous Forest. 28 minutes, color, sound. Depicts physical factors limiting deciduous forest distribution in eastern U. S. Explains adaptations of vegetation inhabiting the deciduous forest. Describes important subdivisions of the deciduous forest in the eastern U. S.

Rarig's, Inc., Film Production Division, 5510 University Way, Seattle, Washington 98105

Reforestation. 14½ minutes, black and white, sound. This is the story of 14 million young trees. Students will learn how farmers and other landowners can get nursery stock for spring and fall planting projects. Proper hand and machine planting techniques are discussed and shown.

State Board of Education, Commonwealth of Virginia, Richmond, Virginia

Pines from Seedlings. 20 minutes, black and white, sound. Acquaints the student with reforestation problems and developments. Shows the various land belts suited to a forest crop. Illustrates methods of seeding.

State of Oregon, Department of Forestry, Salem, Oregon 97310

Tree Planting. 20 minutes, color, sound. Describes the mechanics of hand tree planting. Includes all operations from transportation of crews and proper clothing to the actual step-by-step training of a planter and illustrations of good and bad planting "spots."

State University of New York, College of Forestry, Department of Forest Extension, Syracuse, New York

A Tree Grows for Christmas. 11 minutes, black and white or color, sound. Tells the story of the Christmas tree in history and legend and of the Christmas tree industry today. Shows how trees are cut and marketed and how a tree should be handled after being purchased.

U. S. Forest Service, Washington, D. C. 20250

Even-Aged Silviculture of Upland Hardwoods (In the Central States.) Slide tape program, 139 slides, 45 minutes. Discusses the silvicultural management, economics and biotic factors of upland hardwoods.

TIMBER HARVESTING

Hours Required

Class, 2; Laboratory, 6.

Course Description

This course is designed to teach the following: (1) the application of safety methods in harvesting operations; (2) the correct application of logging tools, equipment and machinery; (3) non-engineering aspects of forest road location and layout; (4) the basic skills and techniques of felling, bucking, limbing and skidding; (5) the application of harvesting systems and techniques to varying conditions; (6) a basic understanding of harvesting costs; and (7) the interrelationship between harvesting methods, silviculture and general forest management.

Major Divisions		Hours	
		Class	Laboratory
I.	Regional Harvesting Practices	1	4
II.	Examples of Harvest Crew Organizations	2	4
III.	Planning the Timber Harvest	3	8
IV.	Skidding Systems	9	30
V.	Loading Methods	1	4
VI.	Land Transportation	6	30
VII.	Water Transportation	1	0
VIII.	Costs and Records	9	16
	TOTAL	32	96

I. Regional Harvesting Practices

A. Units of Instruction

1. Harvesting practices in the major geographic regions of the United States will be discussed using the topics listed below.
    a. The forest
    b. Labor
    c. Felling and bucking
    d. Bunching and skidding
    e. Loading
    f. Transportation
2. Northeast
3. Southeast
4. Lake States
5. West

B. Laboratory Projects

1. Safety in harvesting timber crops
2. Importance of safety
3. Types of accidents
4. Causes of accidents
5. Personal clothing and equipment
6. Safety devices for machinery, tools and equipment
7. A logging safety program
8. First aid

II. Examples of Harvesting Crew Organizations

A. Units of Instruction

1. Pine sawlog harvesting operation in Louisiana
2. Pine pulpwood operation in southern Georgia
3. Unit of pulpwood production for many operations in Maine
4. Tree-length pulpwood operation with a machine bucker in Maine
5. Hardwood and hemlock sawlog harvesting operation in northern Michigan
6. A northeastern Oregon pine operation
7. An Alaskan operation
8. A southern Washington clear-cut Douglas fir operation

B. Laboratory Project

Correct use of basic harvesting tools and equipment demonstrated and practiced:

1. Axe
2. Power saws
3. Wedges
4. Peavy and cant hook
5. Pulp hook
6. Logging chains and cable chokers
7. Wire rope

III. Planning the Timber Harvest

A. Units of Instruction

1. Harvesting--area data

   a. Location and accessibility

   b. Distribution of timber and topography

2. Factors that influence the choice of operating method

   a. Size of product

   b. Daily and annual output required

   c. Volume per acre

   d. Labor

   e. Duration

   f. Integrated use

   g. Existing facilities

   h. Legal limitations

   i. Policy of owner

   j. Stand improvement

3. Type of operation possible

B. Laboratory Projects

1. Observation of a small, local logging job showing the use of a small crawler with scoot and boom or a team of horses with scoot.

2. An alternative would be a demonstration of the planning that is done for the student logging operations. This would involve a brief

introduction and the use of boundary survey maps, topographic maps, aerial photos. Road location and location of skid trails and landings in relation to volume per acre should be covered.

IV. Skidding Systems

A. Units of Instruction

1. Factors which influence the choice of system
    a. Production requirements
    b. Topography
    c. Products being harvested
    d. Economics
2. Cable systems
    a. High lead
    b. Skyline
    c. Modifications of the two main types
3. Crawler tractors
    a. Arch skidding
    b. Pan skidding--other anti-friction devices
    c. Scoot and boom; sled skidding
    d. Ground skidding; cable or chains; tongs
4. Rubber-tired and rubber-tracked vehicles
    a. Capabilities
    b. Makes of machines
    c. Choice of machines

5. Harvesting machines
6. Animals
7. Latest harvesting systems

B. Laboratory Projects

1. A demonstration and practical application of the correct procedures to use in felling timber
   a. Sizing up the tree
   b. Making the undercut
   c. Making the backcut
   d. Use of wedges
   e. Effects of wind and topography
   f. Leaning and lodged trees
   g. Direction of fall based on terrain and logging system used
   h. Safety precautions
2. A demonstration and practical application of the correct procedures to use in bucking timber
   a. Specifications and grade requirements for different products
   b. Log grades of different species
   c. Hardwood log grades
   d. Bucking procedure
   e. Trim allowance
3. A demonstration and practical application of several skidding techniques that can be used

economically in the local area and on the student logging operation.

4. After the introduction of felling, bucking and skidding techniques, students will continue to gain skill and be trained in the correct procedures while conducting a student logging job.

V. Loading Methods

A. Units of Instruction

1. Hand methods
2. Loggers' dream
3. Cross haul
4. Hydraulic loaders
5. Cranes and shovel loaders

B. Laboratory Project

Observe a medium-sized mechanized logging job showing mechanized skidding and loading operations.

VI. Land Transportation

A. Units of Instruction

1. Skid trails and landings
    a. Locations
    b. Maintenance
2. Logging roads
    a. Purpose of the road--single or multiple
    b. Locating the road

c. Soil and water protection

d. Maintenance and rights-of-way

3. Trucking

   a. Types of trucks for logging

   b. Legal limitation

   c. Trucking costs

B. Laboratory Projects

1. Have a small, practical problem involving the location of a logging road in relation to skid trails, landings, drainages, and volume of timber.

2. Have students design and build a small bridge out of local materials.

3. Have the students design and build a box culvert for drainage.

4. Have the students lay out a short stretch of logging road to include flagging, swamping out and rough grading. Layout would involve the use of the Abney level and hand compass.

5. Take a trip to a trucking garage and have the manager explain the various factors that must be considered in equipping a truck for hauling logs.

VII. Water Transportation

A. Units of Instruction

1. River driving
2. Barging
3. Rafting
4. Fluming

B. Laboratory Projects

None

VIII. Costs and Records

A. Units of Instruction

1. Machine rate calculations
2. Cost factors of harvesting timber
    a. Felling and bucking
    b. Skidding
    c. Loading
    d. Trucking
    e. Overhead
    f. Management costs
3. Time and cost studies of a harvesting operation
4. Cost analysis of the tools, equipment and various phases of logging

B. Laboratory Projects

1. Observe a large, integrated logging chance showing rubber-tired skidders, crawlers, hydraulic and crane loaders, woods camp, logging roads

and all other phases of a jobber or company-operated harvesting operation.

2. Conduct time studies on a local logging job, collecting enough data to have a cost analysis of the different steps involved in a timber harvesting operation.

Texts and References

American Pulpwood Association Technical Releases.

Brown. Logging.

"Chain Saw Safety."

Cobb. "Skidding with Rubber-tired Wheel Tractors in the Tennessee Valley."

Donnelly. "A Technique for Relating Logging Costs to Logging Chances."

"Estimating Log-making Costs in the Central States."

Forbes. Forestry Handbook.

"Forest Industries." Selected articles.

"Forest Products Journal." Selected articles.

"Fundamentals of Logging."

"Hardwood Logging Methods and Costs in the T.V.A."

"Logging Facts for Sawmill Operators."

"Logging Farm Wood Crops."

McCraw. "Relative Skidding Production of Track and Wheel Skidders."

"Motor Vehicle Laws."

"Northeastern Loggers' Handbook."

"Northern Logger." Selected articles.

"Permanent Logging Roads for Better Woodlot Management."

Preston. Developing Farm Woodlands.

"Pulpwood Truck Driving."

"Small Crawler Operator's Handbook."

Wackerman. Harvesting Timber Crops.

Wheeland. Bibliography of Timber Products Harvesting in Eastern United States and Canada.

Winer. "Multi-Product Logging Opportunities and Problems."

Audio-Visual Aids

American Pulpwood Association, 605 Third Avenue, New York, New York.

Pulpwood Logging. $23\frac{1}{2}$ minutes, 16 mm., sound, color.

Brown Company, Woodlands Division, 650 Main Street, Berlin, New Hampshire 03570

The Forest and the Woodsman. 30 minutes, 16 mm., sound, color.

Canadian Pulp and Paper Association, 2280 Sun Life Building, Montreal 2, Canada

Logging Systems and Machines Concepts. 25 minutes, 16 mm., color.

Deere and Company, Moline, Illinois 61265. Request from nearest John Deere dealer.

Increasing Your Profit in Logging (northeast version, southeast version). 22 minutes, 16 mm., sound, color.

Forest Products Accident Prevention Association, 90 Harbour Street, Toronto, Ontario, Canada.

Bushmaster. 10 minutes, 16 mm., sound, color.

Chain Saw Safety Pays Off. 25 minutes, 16 mm., sound, color.

Horse Sense. 10 minutes, 16 mm., sound, color.

Garrett Enumclaw Company, 800 Stevenson Avenue, Enumclaw, Washington 98022.

Tree Farmer Tractor. 24 minutes, 16 mm., sound, color.

Hiab Hydraulics, Inc., 3410 Lancaster Pike, Wilmington 5, Delaware.

Road Transport. 16 mm., sound, color.

Pettibone-Mulliken Corporation, 4700 West Division Street, Chicago 51, Illinois.

Cary Lift on Pulpwood and Logging. 16 mm., sound, color.

Pettibone Master 12 Skidder. 15 minutes, 16 mm., silent, color.

Rarig's Inc., Film Production Division, 5510 University Way, Seattle, Washington.

Falling and Bucking Timber. 15 minutes, 16 mm., sound, color.

Hauling Logs. 23 minutes, 16 mm., sound, color.

Yarding Logs. 21 minutes, 16 mm., sound, color.

U. S. Department of Agriculture, U. S. Forest Service, Center Building, 6816 Market Street, Upper Darby, Pennsylvania 19082.

Easier Ways of Logging. 26 minutes, 16 mm., sound, color.

ADVANCED FOREST SURVEYING

Hours Required

Class, 1; Laboratory, 6.

Course Description

This course is designed to follow a basic or elementary surveying course. The operation of the more precise engineering instruments and their application to forestry problems is developed, including the ability to compute problems often confronted when using these instruments.

Engineering levels, transits, and plane tables and alidades are the major pieces of equipment taught. The proper care, minor adjustments, and correct handling of these instruments is covered as well as the advantages and disadvantages of any one piece of equipment for a particular task. At least two-thirds of the total laboratory time should be spent in the field, operating the instruments in practical problem assignments.

Field books should be kept by each student and correctly filled in for all field work. All books should be collected immediately after an outside assignment and graded by the instructor for neatness, clarity, completeness and adherence to normal surveying practices.

Problems directed toward horizontal and vertical curves and areas and volume computations are covered in indoor laboratories. The relationship between data collected in the field and its use in office computation should be stressed.

Major Divisions		Hours Class	Hours Laboratory
I.	Engineering Level	3	18
II.	Transit	6	36
III.	Plane Table and Alidade	2	12
IV.	Stadia	1	6
V.	Curves	2	12
VI.	Areas and Volumes	2	12
	TOTAL	16	96

I. Engineering Level

A. Units of Instruction

1. General

a. Definition of terms

b. Theory

c. Methods

d. Types of instruments

e. Level rods

f. Verniers

g. Operation of levels

2. Differential leveling

   a. Definitions

   b. Operation

   c. Field book

3. Profile leveling

   a. Definitions

   b. Cross sections

   c. Field book

4. Level circuits

   a. Precision

   b. Adjustment

   c. Sources of error

   d. Problems

B. Laboratory Project

   1. With the use of an engineering level, level rod, ribbon tape and stakes, determine if the line of sight of the level is parallel to the axis of the bubble tube.

   2. With the use of an engineering level and allied equipment, complete a bench mark survey. Record all pertinent data in a field book to be checked by the instructor.

   3. With the use of a level and allied equipment, acquire field data for a profile plan and also for cross section plans at each full station.

4. With the use of a level and allied equipment, set slope stakes for a road bed.

II. Transit

A. Units of Instruction

1. General

a. Types

b. Parts

c. Verniers

d. Handling

2. Operation

a. Measuring direct angles

b. Laying off angles

c. Deflection angles

d. Azimuths

e. Prolonging a straight line

f. Random lines

g. Laying out curves

h. Problems

3. Traversing

a. Open traverses

b. Closed traverses

c. Field party

d. Notes

e. Closure

f. Problems

B. Laboratory Projects

1. With the use of a transit and other necessary equipment, run a straight line for several hundred feet with a minimum of four instrument setups. Record information in field book and have straightness of the line checked by the instructor.
2. With a transit and other equipment, set stakes in the shape of a triangle and compute the length of one side using triangulation. Check the computed length by taping and record all information in field book.
3. Run a complete traverse, measuring interior, exterior and deflection angles at each of the transit stations. Record information in field book.
4. Locate the center line for a forest haul road setting stakes at each full station. Set slope and grade stakes and recommend locations for erosion control structures. Record all information in field book.
5. Using a transit and other equipment, lay out a horizontal curve for a log haul road.
6. With the aid of a transit, locate the proper places for foundation forms for a building. Record information in field book.

III. Plane Table and Alidade

A. Units of Instruction

1. Telescopic Alidades

a. Operation

b. Traversing

c. Advantages

2. Peepsight Alidade

a. Operation

b. Traversing

c. Problems

B. Laboratory Projects

1. With a telescopic alidade and plane table, make a topographic map of a specified field area.

2. Plot a closed traverse of a designated area and also include topographic features with the aid of an alidade and plane table.

3. With an alidade and plane table, map the necessary natural features for a preliminary campsight investigation showing contour lines, vegetation, and locations of ponds and streams.

IV. Stadia

A. Units of Instruction

1. Theory

2. Horizontal sights

3. Inclined sights
4. Stadia rod
5. Beaman arc
6. Problems

B. Laboratory Project

Using a transit and stadia rod, traverse a given area recording angles and distances. Check distances obtained by stadia with engineer's tape. Record information in field book.

V. Curves

A. Units of Instruction

1. Horizontal curves
    a. General
    b. Formulas
    c. Examples
    d. Problems
2. Vertical curves
    a. General
    b. Examples
    c. Problems

B. Laboratory Projects

1. With given information from a text or other source, work problems in the area of horizontal curves from the designing of the curve through the necessary computations for field layout.

2. With given problem information, compute the necessary data for field layout of vertical curves.

VI. Computing Areas and Volumes

A. Units of Instruction

1. Areas

a. Triangles

b. Offsets

c. Simpson's 1/3 Rule

d. Trapezoidal Rule

e. Polar planimeters

f. Dot grid methods

2. Volumes

a. Average end area

b. Prismoidal formula

B. Laboratory Projects

1. With profile paper, plot the profile of a log haul road using data from a previous outdoor laboratory project. In designing the road, stay within allowable slopes for safety and economy.

2. Plot cross sections of a typical log haul road (such as No. 1 above) and determine the volume of cut and fill necessary to construct the road.

3. Plot a traverse from field data or a text and compute the area enclosed using the offset rule, the Simpson's 1/3 Rule and the Trapezoidal Rule.

Texts and References

Boucher and Moffit. Surveying.

Breed and Bone. Surveying.

Breed and Hosmer. Elementary Surveying.

Brinker and Taylor. Elementary Surveying.

Brown. Boundary Control and Legal Principles.

Brown and Eldridge. Evidence and Procedure for Boundary Location.

Davis. Elementary Plane Surveying.

Fogel. Introduction to Engineering Computations.

Kissam. Surveying.

Low. Plane Table Mapping.

Meyer. Route Surveying.

Pofford. Handbook of Survey Notekeeping.

Rubey, Lommel and Todd. Engineering Surveys.

Tracey. Plane Surveying.

OUTDOOR RECREATION

Hours Required

Class, 1; Laboratory, 6

Course Description

The major areas of outdoor recreation are identified; the supply and demand for them and their economic possibilities are discussed. Requirements for planning, developing, and managing a recreational area as a product of the forest are given. Additional income potentials are suggested. This course emphasizes the fact that outdoor recreation is a business. Students select and develop a detailed recreation plan for an undeveloped forest area.

Major Divisions

	Hours Class	Hours Laboratory
I. Leisure and the Demand for Outdoor Recreation	1	12
II. Kinds of Outdoor Recreational Enterprises	3	12
III. Campgrounds, Picnic Areas and Sports Areas	3	6
IV. Selecting the Recreation Enterprise	2	12

V.	Implementing Plans and Developing the Recreation Enterprise	1	39
VI.	Maintaining and Operating the Enterprise	2	9
VII.	Managing Recreational Enterprises	2	3
VIII.	Technical and Financial Assistance Available	1	0
IX.	Merchandising Recreational Activities	1	3
	TOTAL	16	96

I. Leisure and the Demand for Outdoor Recreation

A. Units of Instruction

1. Leisure--basic in the culture of man

2. Demand for outdoor recreation

a. Findings of the Outdoor Recreation Resources Review Commission, 1962

b. Local situation

3. Survey of available outdoor recreational facilities within the region

a. National parks

b. Forest Service

c. State parks and forests

d. Private enterprises

B. Laboratory Projects

1. Field trip to a national park
2. Field trip to a national forest recreation area
3. Field trip to a state park
4. Field trip to several private outdoor recreational enterprises

II. Kinds of Outdoor Recreational Enterprises

A. Units of Instruction

1. Demand for
    a. Fishing areas
    b. Hunting areas
    c. Shooting preserves
    d. Scenic, historic and natural areas
    e. Winter sports areas
    f. Land-use rights
    g. Cabin sites
2. Income potentials for recreation enterprises such as those listed above
3. Sources of additional income, such as
    a. Boat rental; bait and tackle sales and rentals for fishing areas
    b. Guide services, cabin rentals for hunting areas

c. Kennels, shooting range, game sales for shooting preserves

d. Lodge, snack bar, horse rental for scenic and natural areas

e. Ski lessons, rental of snow mobiles for winter sports areas

4. Special requirements for recreational concerns such as those listed above

5. Management of recreational enterprises such as those listed above

6. Special problems, such as

a. Weed control and fish management for fishing areas

b. Game and wildlife habitat for hunting areas

c. Licensing and state game regulations for shooting preserves

d. Vandalism in natural, historic and scenic areas

e. Lack of snow in winter sports areas

f. Zoning for land-use rights

g. Building permits for cabin sites

B. Laboratory Projects

Field trips to several local private outdoor recreational enterprises such as shooting preserves, fishing areas and winter sports areas

III. Campgrounds, Picnic Areas and Sports Areas

A. Units of Instruction

1. Contrast the philosophy of the national parks, national forests, state parks, and private enterprises as reflected by campground, picnic and sports area development
2. Demands for campgrounds, picnic and sports areas on
    a. National parks
    b. National forests
    c. State parks
    d. Private forest enterprises
3. Income potential for each of the above
4. Requirements peculiar to each of the above
5. Management peculiar to each of the above

B. Laboratory Projects

1. Guest speaker explains to the class the organization of his agency and expresses the philosophy of the organization as it pertains to outdoor recreation and land use
2. Field trip to study the facilities and managerial aspects of a private or public

campground. Resource personnel are used extensively on field trips of this nature to present to the student the agency's policies on developing and managing campgrounds.

IV. Selecting the Recreational Enterprise

A. Units of Instruction

1. Land ownership and land use

2. Evaluation of potential land use

3. Reconnaissance

a. Maps

b. Aerial photographs

c. Ground survey

4. Selection of a site for a campground

a. Physical features

(1) Water

(2) Topography

(3) Potable water

(4) Vegetation

(5) Natural attractions

(6) Vista

(7) Forest pests

(8) Animal and bird life

(9) Climate and microclimate

b. Socio-economic factors

(1) Geographic location

(2) Economic and business management

(3) Proposed campground facilities

B. Laboratory Projects

1. Make a rating of an existing successful campground based on physical and socio-economic factors

2. Make a similar rating of an undeveloped campground site and compare the rating with the above

3. Deliniate on existing maps and aerial photos the boundaries of a proposed campground development, paying close attention to topographic and vegetative features

V. Implementing Plans and Developing the Recreation Enterprise

A. Units of Instruction

1. Outdoor recreation in the forest management plan

2. Detailed mapping of an undeveloped campground area

3. Actual campground layout using detailed plans as provided

a. Location of camp sites

(1) Tent or trailer site

(2) Parking area

(3) Picnic table

(4) Fireplace

b. Location of roads

c. Location of improvements

(1) Sanitation facilities

(2) Potable water facilities

(3) Barriers and entrance gates

(4) Directional signs

(5) Trails and paths

(6) Other buildings

B. Laboratory Projects

1. Surveying and drawing of a detailed topographic map of a campground area
2. Relate features on the ground to points on the map
3. Grade staking a sewer and/or water system in the campground in compliance with health and sanitation regulations
4. Locating and developing self-guided nature trails
5. Actual construction of tent sites and parking areas using different size requirements
6. Actual construction of picnic tables and fireplaces using different designs

VI. Maintaining and Operating the Enterprise

A. Units of Instruction

1. Sanitation

a. Sewerage

b. Refuse disposal

c. Vermin control

2. Water supply

3. Electric supply

4. Vegetation control

5. Vegetation establishment

6. Public relations

a. Rules and regulations

b. Attitude and goodwill of employees

c. In-service training of employees

7. Customer relations

a. Registering of guests

b. Hospitality

B. Laboratory Projects

1. Field trip to sewerage disposal plant

2. The formulation and application of an appropriate insecticide for comfort control

3. Demonstration of the use of specialized tree expert equipment

VII. Managing Recreational Enterprises

A. Units of Instruction

1. Business management procedures
2. Available capital for development and operation
3. Tax assessment and structure
4. Public relations with consumers and in the community where the facility is located
5. Competition
    a. Favorable
    b. Unfavorable
6. Legal restrictions
    a. Zoning regulations
    b. Water and sanitation regulations
    c. Fire regulations
    d. Law enforcement regulations

B. Laboratory Projects
1. View and discuss management procedures with a public or private recreational enterprise
2. Review the management requirements of an established recreational enterprise, paying particular attention to legal restrictions dictated by the local government in which the business is located

VIII. Technical and Financial Assistance Available

A. Units of Instruction
1. The Bureau of Outdoor Recreation

2. The Soil Conservation Service

3. The Forest Service

4. The Farm Home Administration

5. The Cooperative Extension Service

6. Others

B. Laboratory Projects

None

IX. Merchandising Recreational Activities

A. Units of Instruction

1. Publicity, promotion and advertising

2. Brochures

B. Laboratory Projects

1. Designing and writing of a brochure

2. Writing advertising copy for an outdoor recreational enterprise

Texts and References

Allison. "Evaluating Forest Campground Sites."

----------. "Bibliography of Selected Publications on Rural Recreation as a Business."

Brock, C. Frank. Recreational Use of Wild Lands.

----------. "Budgeting Farm and Ranch Recreation Enterprises."

----------. "Campfire Chatter."

----------. "Campgrounds for Many Tastes."

Clawson, Marion. Land and Water for Recreation.

Delphendahl, Johannes. "Outdoor Recreation in Maine."

----------. "Environmental Health Practices in Recreational Areas."

----------. "Federal Assistance in Outdoor Recreation."

----------. "Forest Recreation for Profit."

----------. Guidelines to Planning, Developing and Managing a Rural Recreation Enterprise.

----------. "Handbook of Outdoor Recreation Enterprises in Rural Areas."

----------. Handbook of Public and Private Agencies and Services for Income Producing Outdoor Recreation Enterprises.

----------. "How to Develop a Campground."

----------. "How to Plan the Recreation Enterprise."

----------. "Manual of Individual Water Supply Systems."

----------. "Manual of Septic Tank Practice."

----------. "National Survey of Fishing and Hunting, 1960."

----------. "New Jersey Private Campground Code."

----------. "Opportunities for Private Campgrounds as an Alternative Use of Land."

----------. Outdoor Recreation for America.

----------. "Outdoor Recreation in the National Forests."

----------. "Outdoor Recreation Phenomenon."

----------. "The Park Practice Program--Grist, Guideline, Design, Trends."

----------. "A Primer on Ground Water."

----------. "Recreation Opportunities and Problems in the National Forests in Northern and Intermountain Regions."

----------. "Rural Recreation--A New Family Farm Business."

----------. "Rural Recreation Enterprises for Profit."

----------. "Rural Recreation--New Opportunities on Private Land."

Schmedemann, et. al. "Outdoor Recreation . . . Potential in East Texas."

Smith, et. al. Rural Recreation for Profit.

----------. "State Regulations Governing the Sanitation of Juvenile Recreational Camps."

----------. "State Regulations Pertaining to Public Swimming Pools and Bathing Places."

----------. "Summaries of Selected Publications on Rural Outdoor Recreation."

Wilson. "Family Camping Manual."

----------. "Working Drawings of Basic Facilities for Campground Development."

Visual Aids

Michigan Department of Conservation, East Lansing, Michigan.

Forests and Recreation.

State University of New York, College of Forestry, Syracuse, New York.

Introduction to Forest Adventuring.

The Wilderness Trail.

U. S. Department of Agriculture, Forest Service, Washington, D. C.

Ski Area Planning. A slide program.

U. S. Department of the Interior, Washington, D. C.

Our Public Lands.

University of Illinois, Champagne, Illinois.

Free Horizons--A Story of Our National Parks.

FOREST PRODUCTS UTILIZATION

Hours Required

Class, 2; Laboratory, 6

Course Description

The objectives of this course are to give the students an appreciation of how wood is utilized after being grown and harvested. The use of different wood species for various products is stressed. The reasons why woods have extreme ranges in value and utility are demonstrated by studying the multitude of products manufactured. This is done in the classroom and on laboratory field trips. Log grades and lumber grades are correlated and studied in depth by the practical application of grading rules.

Industrial manufacturing is taught using the lumber industry as an example. Mechanization, automation, material flow, productivity and costs are presented. Quality control of the manufactured product is introduced and utilized.

Utilization of waste generated in the wood manufacturing process is studied in depth. This includes general problems associated with the product; quantities of waste material produced; machinery required for converstion to a useable product; machinery costs;

conversion costs; handling and transportation; and the available markets.

The correct techniques of handling, seasoning and storing of lumber are taught, including air-drying and kiln-drying practices. Preservation of wood is introduced to give the students an appreciation of how the useful life of wood may be economically extended.

Major Divisions

		Hours	
		Class	Laboratory
I.	Primary Wood Products	1	4
II.	Manufacturing Processes Other Than Lumber	3	8
III.	Lumber Grading	4	12
IV.	Lumber Manufacturing	4	18
V.	Evaluating the Manufacturing Process	4	10
VI.	Utilization of Wood Waste	4	8
VII.	Quality Control in the Manufacturing Process	4	12
VIII.	Seasoning Lumber	5	16
IX.	Wood Preservation	3	8
	TOTAL	32	96

I. Primary Wood Products

A. Units of Instruction

1. Sawlogs
2. Veneer logs
3. Pulpwood
4. Boltwood
5. Posts, poles and piling
6. Tie logs and mine timbers
7. Firewood
8. Specialty products

B. Laboratory Projects

1. Field trip to a multi-product harvesting operation to study the opportunities and problems in producing different products at their source
2. Field trip to a concentration yard which has two or more different wood products in it; discuss, observe and study the techniques in operating such a yard
3. Require a verbal or written student evaluation of the operation

II. Manufacturing Processes Other Than Lumber

A. Units of Instruction

1. Boxboard production and manufacturing
2. Cooperage

3. Turnings
4. Dimension squares
5. Pallet
6. Veneer and plywood
7. Furniture
8. Papermaking
9. Particle and flakeboard
10. Specialty products
    a. Pencils
    b. Matches
    c. Toothpicks
    d. Excelsior

B. Laboratory Project

Field trip to at least two of the above named industries to study their manufacturing procedures. Emphasis should be placed on source and use of wood as a raw material, competitiveness with other materials, economics of the operation, problems associated with the industry to include merchandising and marketing the product.

III. Lumber Grading

A. Units of Instruction

1. Use classification
2. Size classification
3. Product classification

4. Grading rules for softwood lumber

5. National Hardwood Lumber Association Rules

B. Laboratory Projects

1. Conduct a practical exercise on grading softwood lumber

2. Conduct a practical exercise on grading hardwood lumber

3. Give a practical examination on grading hardwood and softwood lumber

4. Give a written examination on the lumber grading rules

5. Field trip to observe lumber being graded by a certified hardwood or softwood lumber inspector

6. Have a certified lumber grader conduct a practical exercise on grading lumber

7. Require a written or verbal evaluation of the industry visited

IV. Lumber Manufacturing

A. Units of Instruction

1. Historical development

2. Economic importance

3. Kinds of sawmills

4. Sawmill machinery

5. Sawmill layout

6. Principles of sawing

7. Changing sawmill industry

    a. Demand for lumber

    b. Portable vs. stationary

    c. Size of mills

    d. Machinery

    e. Log supply and methods of procurement

B. Laboratory Projects

1. Conduct a log scale-lumber tally comparison at a sawmill, preferably one owned by the institution. The objective of this exercise is to increase the student's ability to scale logs accurately. A minimum of 50 to 100 logs should be scaled.

2. Conduct a log grade-lumber grade study at a sawmill, preferably one owned by the institution. The objective is to have the student become proficient in grading logs and lumber.

3. Take field trips to small, medium and large sawmills. The mills should be varied as to types--portable and stationary; kinds--circular, band or sash gang; and should show an extreme variation in the amount of machinery and equipment incorporated in the manufacturing process.

4. Require a verbal or written evaluation of the sawmills visited
5. Conduct a field study of the techniques of hardwood grade sawing. Hardwood logs should be studied and graded, observed being sawn, and the lumber graded separately for each log, correlating the log grade with lumber grade.

V. Evaluating the Manufacturing Process

A. Units of Instruction

1. Efficiency in production
2. Production costs
3. Non-productive time--delay time
4. Kinds and arrangement of machinery
   a. Effect of production
   b. Effect on efficient flow of materials
5. Mechanization
6. Automation

B. Laboratory Projects

1. Conduct a time study to collect data on the various processes required to manufacture lumber. This could also be done with other manufacturing processes.
2. Use the collected data to make a cost analysis of the operation; graphical presentation of the data should be required

VI. Utilization of Wood Waste

A. Units of Instruction

1. Pulp chips

a. History of pulp chipping program

(1) Producer's viewpoint

(2) Consumer's viewpoint

b. Factors influencing volume of waste produced

c. Debarking logs, slabs and edgings

(1) Type of debarkers

(2) Cost of owning and operating

(3) Case examples

d. Cost of owning and operating a chipper

e. Possibilities of chipping low valued lumber and short logs

2. Fuels

a. Heating plant and/or drying lumber

b. Generating electricity

c. Local firewood market

3. Hogged wood

a. Wood composition markets

b. Mulch

c. Animal bedding

4. Utilization of bark

B. Laboratory Projects

1. Make a time study of handling waste material either at the institution's mill or a production mill. Practical experience should be gained in handling and disposing of wastes generated in the manufacture of lumber.

2. Visit a centralized chipping plant to study and observe their operating procedures. Pertinent information on costs of operating and maintaining the facility should be acquired as well as on the procurement and marketing problems.

3. Visit a lumber manufacturing plant that has a chipper; contrast this with a centralized chipping plant

4. Visit a plant that utilizes its wastes in a manner other than chipping, such as fuel or composition board markets

5. Require the student to give a verbal or written evaluation of the facilities studied

VII. Quality Control in the Manufacturing Process

A. Units of Instruction

1. Function and purpose

2. Statistical basis

3. Control charts and bar graphs

4. Analysis of chart data

5. Usefulness of charts

B. Laboratory Projects

1. Collect quality control data at the institution's sawmill or one producing in the area; lumber thickness, length, width or some other measure of quality may be made

2. Construct control charts and bar graphs from the data collected in the previous laboratory

3. Analyze the charts and graphs to determine if the manufacturing process is in control. If not, determine what caused the process to be out of control and how it may be brought under control. If the sawmill owned by the institution is studied, a practical laboratory may be conducted to correct the faulty manufacturing process.

4. Require a written or verbal report on the quality control study

VIII. Seasoning Lumber

A. Units of Instruction

1. Air-drying lumber

a. Objectives

b. Principles

c. Site selection

d. Yard layout

e. Pile foundations

f. Methods of piling

g. Air-drying defects and their control

2. Kiln-drying lumber

a. Kiln types and construction

b. Relation of temperature, relative humidity, air circulation, and equilibrium moisture content

c. Kiln schedules

d. Kiln samples

e. The complete kiln run

f. Equalizing and conditioning treatments

g. Special problems associated with drying various species

B. Laboratory Projects

1. Give a demonstration of and have the students practice the correct stacking techniques

2. Visit an air-drying yard which practices the correct seasoning procedures and which has a good yard layout

3. Visit an air-drying yard which does not practice the correct drying procedure; make a simple study to determine loss in value

due to improper seasoning practices

4. Conduct a practical kiln-drying exercise on a sample load of lumber, assuming the institution owns a small drying cabinet or a larger capacity kiln. Various species and thicknesses should be dried to give the student practical experience in these problem areas.
5. Visit a kiln-drying facility to observe the procedures used and the problems involved in kiln-drying lumber
6. Conduct a simple cost study on kiln-drying lumber which is both air-dried and green
7. Require a written or verbal evaluation of the visits or studies made

IX. Wood Preservation

A. Units of Instruction

1. Introduction
2. Natural durability of wood
3. Wood preservatives
    a. Oils and oil-borne preservatives
    b. Water-borne preservatives
    c. Patented preservatives
4. Preparing timber for treatment
5. Wood preservative processes

a. Non-pressure methods

b. Pressure methods

B. Laboratory Projects

1. Dip-treat posts, lumber and other small products in the facility owned by the institution

2. Visit a wood preservation plant to observe and study the products being treated and the method of treatment used

3. Conduct a simple in-service study of treated material

4. Visit a research study on preservative plots at a nearby institution if available

5. Require a written or verbal evaluation of the visits or studies made

Texts and References

Applefield and Bois. "Thickness Variation of Hardwood Lumber Produced in 1963 by Circular Sawmills in North Carolina."

Brown and Bethel. Lumber.

Butler. "Chip Markets: Potentials and Problems for Sawmills and Plywood Plants."

Church. "Railroad Crossties--Opportunities for Improving the Manufacture and Serviceability."

Cuppett. "Air-Drying Practices in the Central Appalachians."

__________. "How to Determine Seasoning Degrade Losses in Sawmill Lumberyards."

Dowdel and Bain. "Lumber or Chips?"

Field. "Types and Arrangement of Equipment and its Affect on Grade Recovery."

Gillies. "Comments on Some of the Factors Affecting the Grade and Quality of Lumber Production."

----------. "A Guide to Hardwood Log Grading."

Hamlin, et. al. "The Pulp Chipping Program in the Northeast."

Heebink. "Suitability of Seven West Coast Species for Pallets."

__________ and Fobes. "Hardwood Pallet Manufacturing."

Hooker. "Techniques of Sawing for Grade Recovery."

----------. "An Introduction to the Grading and Measurement of Hardwood Lumber."

Lehman. <u>The Changing Sawmill Industry</u>.

__________. <u>Utilizing Pine Sawmill Residue for Pulp Chips</u>.

Lewis. "Wood Residue Utilization."

Lockard. "Grade Defects in Hardwood Timber and Logs."

Malcolm. "What has Research Done for the Sawmill?"

McCauley. "Cause and Cost of Production Delay at Hardwood Circular Sawmills in Kentucky and Ohio."

Morgan. "Wood Chips from Sawmill Residues."

----------. "New Hampshire Forest Market Report."

Niskala and Church. "Cutting Hardwood Cants Can Boost Sawmill Profits."

----------. "Northeastern White Pine--Its Grades and Uses."

Panshin, et. al. Forest Products.

Peck. "Air-Drying of Lumber."

----------. "Quality Control in Circular Sawmill Operation."

Row, et. al. "Improving Sawmill Profits Through Operations Research."

----------. "Rules."

Schmidt. "Lumber--Quality? Grade?" Part I.

__________. "Lumber--Quality? Grade?" Part II.

----------. "Specifications and Grades for Warehouse, Permanent or Returnable Pallets."

----------. "Specifications and Grades for Warehouse, Permanent or Returnable Pallets of West Coast Woods."

----------. "Standard Grading Rules for Northern White Pine."

Telford. "Small Sawmill Operator's Manual."

Vaughan, et. al. "Hardwood Log Grades for Standard Lumber."

Verrall. "Building Decay Associated with Rain Seepage."

__________. "Preserving Wood by Brush, Dip, and Short-Soak Methods."

Wangaard. The Mechanical Properties of Wood.

Whittaker. "A Cost-Accounting System for Small Sawmills."

__________ and McCauley. "Costs and Returns for Hardwood Lumber Production in the Appalachian Region of Kentucky and Ohio."

----------. "Wood. . .Colors and Kinds."

----------. Wood Handbook.

FOREST PROTECTION

Hours Required

Class, 2; Laboratory, 3

Course Description

This course is divided into three segments--diseases, insects and fire protection. Each category is considered to be separate and distinct from the others and as such is thought of as a "short course" within the total course. The limited time allocated for each segment necessitates that only specific agencies be studied without having a prior foundation in the fundamentals involved in the subjects of pathology, entomology, and forest fire technology. The disease portion introduces the major disease problems of the forest to the student. First, an overall view of the major forest disease problems is discussed and the current research being conducted to reduce timber losses from these agencies. Pathological terminology is introduced to give the student a working basis for understanding the literature, and to give him a vocabulary with which to speak intelligently about the subject. Classification and identification of the more important tree diseases and their resultant damage are covered. Emphasis is placed on associating and identifying the sporophores of major rot-causing fungi.

The classification, structure, identification and development of insects are presented. Special emphasis is placed on learning about the destructive insects that cause the major portion of damage to forest trees. Recognition of damage and the association of the causal insect are emphasized. Ecological and control factors are introduced, but not covered in depth.

Fire protection is covered by discussing fire prevention, pre-suppression and suppression techniques. Knowledge of fire behavior, and the effects which fuel, weather and topography have on burned forest areas are presented. Planning and organizing pre-suppression methods, and implementing suppression techniques used in state, federal, and private organizations to combat fires are covered in depth.

Major Divisions

		Hours	
		Class	Laboratory
I.	Important Tree Disease Problems	1	0
II.	Introduction, Terminology and Classification of Tree Diseases	2	6
III.	Study and Recognition of Major Rot-Causing Fungi	2	4

IV.	Decays, Discolorations and Logging Wounds in Hardwoods	2	4
V.	Study of Important Rust, Stem, Foliage and Root Diseases	3	2
VI.	Introduction to Insects	1	0
VII.	Classification, Structure and Development of Insects	5	2
VIII.	Forest Insect Damage	2	6
IX.	Insect Control Measures	1	4
X.	Regional Survey of Forest Insect Pests of Economic Importance	1	4
XI.	Introduction to Fire Protection	1	0
XII.	Fire Behavior and Effects	2	3
XIII.	Fire Prevention and Pre-Suppression Measures	2	3
XIV.	Suppression Measures	5	6
XV.	Fire Prevention Planning	2	4
	TOTAL	32	48

I. Important Tree Disease Problems

A. Units of Instruction

1. Why study tree diseases

2. Areas of emphasis in forest disease research

3. Disease priorities

a. High

b. Medium

c. Low

B. Laboratory Projects

None

II. Introduction, Terminology and Classification of Tree Diseases

A. Units of Instruction

1. Review of important tree diseases to be studied

2. Explanation of disease terminology

3. Classification of tree diseases

a. Causal organisms

b. Symptoms

c. Hosts

d. Part of plant infected

B. Laboratory Projects

1. If the season of year permits, conduct a field trip to locate, observe and field identify, if possible, some of the more important seedling, shade or forest tree diseases. Concentrate on symptoms and signs of diseases other than rot-causing fungi.

2. An inside laboratory may be used to identify and discuss sample collections of tree diseases that cannot be seen under actual field conditions

3. Have a recognized pathologist give a slide-lecture presentation of tree and seedling diseases. This may include the more important shade tree diseases.

III. Study and Recognition of Major Rot-Causing Fungi

A. Units of Instruction

1. Introduction to fungi
2. Classification of fungi
3. Symptoms and signs of the more important rot-causing fungi
    a. Fomes annosus
    b. Fomes pini
    c. Fomes pinicola
    d. Fomes fomentarius
    e. Fomes applanatus
    f. Fomes ignarius
    g. Polyporus betulinus
    h. Polyporus balsameus
    i. Polyporus schwentzii
    j. Poria obliqua

B. Laboratory Projects

1. Schedule a field trip to locate, study and collect some of the more important rot-causing fungi. Emphasis should be placed on the recognition, association and extent of rot

as indicated by external signs of the sporophore and symptoms on the tree.

2. An indoor laboratory should include a study of sporophores for identification and an explanation given on the damage associated with them

IV. Decays, Discolorations and Logging Wounds in Hardwoods

A. Units of Instruction

1. Internal defects associated with pathogenic organisms
2. Infection counts on living trees
3. Causal organisms of decays and discolorations
4. How succession of organisms moves in living trees
5. Confinement of decay column at time of wounding
6. Physiological heartwood compared to pathological heartwood

B. Laboratory Projects

1. Visit a pathology laboratory to see and have explained the procedure used for isolating and culturing pathogenic organisms. Ideally, extensive dissections of tree samples, properly preserved, should be available for study and an explanation given on how decays and dis-

coloration organisms enter and move throughout the living tree.

2. Field dissection with chain saw of trees that show visible signs and symptoms of decay to study and trace how decay organisms move throughout the tree

V. Study of Important Rust, Stem, Foliage and Root Diseases

A. Units of Instruction

1. Study and identification of important forest tree diseases

2. Suggested list of northeastern disease problems

a. Etiology of ash and maple decline

b. Beech bark disease--_Nectria coccinea_ var. _Faginata_

c. Strumella canker--_Strumella coryneoidea_

d. Nectria canker--_Nectria galligena_

e. Root rots of seedlings--_Phytophthora_

f. Oak wilt--_Chalara quercina_

g. Nematodes

h. Anthracnoses--_Gnomonia_ and _Glomerella_

i. Rhabdocline needle cast--_Rhabdocline pseudotsugae_

j. White pine blister rust--_Cronartium ribicola_

B. Laboratory Projects

1. Have a representative from the state or federal plant pest division give a presentation on the state's organization and operational procedures used to combat major tree disease problems

2. Field trip to study disease plots established by a forestry organization

VI. Introduction to Insects

A. Units of Instruction

1. Damage caused by insects

a. Direct

b. Indirect

2. Evaluation of the damage caused by insects

3. History of control measures

4. Insects in general

a. Beneficial aspects

b. When an insect becomes a pest

B. Laboratory Projects

None

VII. Classification, Structure and Development of Insects

A. Units of Instruction

1. Classification

a. Phylum

b. Class

c. Orders

(1) <u>Coleoptera</u>

(2) <u>Lepidoptera</u>

(3) <u>Hymenoptera</u>

(4) <u>Hemiptera</u>

(5) <u>Isoptera</u>

2. Structure

a. Body wall

b. Head

c. Thorax

d. Abdomen

3. Life Cycle

a. Fertilization

b. Egg

c. Pupa

d. Larva

e. Adult

B. Laboratory Project

Dissect a live or preserved typical insect to study its external structure for future field identification. A knife, hand lens and large hat pin are the only equipment needed. Dissection may be done either in a typical classroom or in a laboratory.

VIII. Forest Insect Damage

A. Units of Instruction

1. Leaf-eating insects
2. Innerbark boring insects
3. Woodboring insects
4. Sapsucking insect
5. Tip feeding insects
6. Root feeding insects
7. Cone and seed destroying insects

B. Laboratory Projects

1. Slide-lecture talk by a forest entomologist on the more important forest insect pests and the damage caused by them
2. Conduct an indoor laboratory using examples of typical damage caused by forest insects
3. Show and discuss a series of films on how major insect epidemics occured and were controlled by public and private agencies

IX. Insect Control Measures

A. Units of Instruction

1. Direct control
   a. Mechanical
   b. Biotic
   c. Chemical

2. Indirect Control

    a. Biotic

    b. Silvicultural practices

    c. Chemical

    d. Statutory regulations

B. Laboratory Projects

1. Field trip to state, federal or educational research and survey plots for explanation of the nature of control, evaluation and experimental work being conducted

2. Field trip to a pesticide laboratory where pesticides are being tested or formulated for control of insect pests

3. Have a cooperative extension representative discuss his role in educating and assisting the public in the correct application and care of pesticides

4. Have a representative from a noted shade tree company explain their procedures for protecting ornamental and shade trees from insects and diseases. This should include the correct methods in using and storing pesticides.

X. Regional Survey of Forest Insect Pests of Economic Importance

A. Units of Instruction

1. Conifer defoliators
2. Hardwood defoliators
3. Tip feeders
4. Sap feeders
5. Cambium feeders
6. Flat head wood borers
7. Round head wood borers
8. Ambrosia beetles
9. Termites
10. Carpenter ants
11. White grubs
12. Seed destroyers

B. Laboratory Projects

1. Field exercise to locate, capture and identify forest insect pests. Nature and extent of damage should be noted and studied.
2. Have a representative of a public or private agency present an indoor laboratory on the methods and procedures used to observe and combat major forest insect pests

XI. Introduction to Fire Protection

A. Units of Instruction

1. Broad scope of fire protection

a. Prevention

b. Pre-suppression

c. Suppression

d. Economic importance

2. Relationship to insects and diseases

3. Use of fire as a silvicultural tool

B. Laboratory Projects

None

XII. Fire Behavior and Effects

A. Units of Instruction

1. Principles of combustion

2. Forest fuels

3. Weather

4. Topography

5. Effects on vegetation and soil

B. Laboratory Projects

1. Show and discuss the U. S. Forest Service fire training films, "Introduction to Fire Behavior" and "Fire in the Forest"

2. Field exercise demonstrating the effects fuel, weather and topography have on an actual fire. This should be a well organized

and supervised exercise in order to keep the fire under control.

XIII. Fire Prevention and Pre-Suppression Measures

A. Units of Instruction

1. Reduction of risk
    a. Major causes of fires
    b. Frequency of occurances
    c. When and where fires are started
    d. Why fires occur
2. Prevention methods
    a. Understanding, reaching and influencing people
    b. National Cooperative Forest Fire Prevention Campaign
    c. Keep Green Program
3. Reduction of hazard
    a. Fire breaks
    b. Area fuel reduction

B. Laboratory Projects

1. Have a U. S. Forest Service fire control officer present the Forest Service's fire protection methods
2. Have a state fire control supervisor present the state's fire protection methods

XIV. Suppression Measures

A. Units of Instruction

1. Methods and tactics of control

   a. Direct control

   b. Indirect control

2. Line crew organization

3. Building the fire line

   a. One lick method

   b. Progressive method

   c. Rotary method

4. Use of hand tools and equipment

5. Use of water

   a. Back pack pumps

   b. Power pumps

   c. Gravity systems

   d. Aerial tankers

B. Laboratory Projects

1. Practical training building fire lines using the different methods and hand tools

2. State or federal fire training officer to instruct and conduct practical training on building fire lines

3. Use and elaboration on U. S. Forest Service fire training films:

   a. "Building the Fire Line"

b. "Crew Boss"

c. "Fire Plow Performance and Use"

d. "Water on the Fire"

e. "Air Tanker Attack"

f. "Fire vs. Fire"

XI. Fire Prevention Planning

A. Units of Instruction

1. Problems of fire danger rating

a. Fire danger rating system

b. Burning index

c. Build-up index

2. Fire control planning

a. Rate of spread

b. Resistance to control

B. Laboratory Projects

1. Conduct a practical exercise on using the fire danger rating system

2. Conduct a field problem developing a fire plan for a forest area. The three basic factors of fuel, weather and topography should be considered. The area should be sized up to determine the rate of spread a potential fire will have and the resistance to control it will offer.

3. Conduct a simulated fire suppression problem implementing a fire plan. A situation is stipulated in which weather, manpower availability, tool and supplies availability, and equipment availability are given.

Texts and References

Anderson. Forest and Shade Tree Entomology.

Boyce. Forest Pathology.

Craighead. Insect Enemies of Eastern Forests.

Davis. Forest Fire: Control and Use.

Doane. Forest Insects.

----------. Forest Experiment Station publications on diseases, insects and fire.

----------. Forest Fire Fighting Fundamentals.

----------. Forest Insect Conditions in the United States--1962.

Graham and Knight. Principles of Forest Entomology.

----------. Insect Manual (4-H Club).

----------. Manual for Forest Fire Control.

Marsh and Brower. Insect Primer.

----------. Plant Diseases, The Yearbook of Agriculture.

Shenefelt and Benjamin. Insects of Wisconsin Forests.

Silverborg. Northern Hardwoods Cull Manual.

__________. Tree Diseases in New York State Plantations.

Stevens. Disease in Plants.

----------. Tree Diseases of Eastern Forests and Farm Woodlands.

Visual Aids

Rarig's Inc., 2100 North 45th Street, Seattle, Washington 98103

The Enemy is Fire. 25 minutes, color, sound. Shows methods of organizing a logging operation for the prevention and suppression of fire. Considers such factors as temperature and humidity.

U. S. Department of Agriculture, Motion Picture Service, Washington, D. C. 20250

Air Tanker Attack. 20 minutes, color, sound. An in-Service training film for supervisory and other forest management and fire suppression personnel. Shows how the air tanker, properly managed and coordinated according to established safety requirements, is used as an effective tool in control of forest fires.

Battle of the Beetles. 15 minutes, black and white, sound. Documentary film of Engelmann spruce bark beetle control project in western Colorado. Shows damage done by the beetles, and how the Forest Service, with technical assistance of other agencies, has been working to stop the spread of this infestation. At stake are several million acres of healthy Engelmann spruce on the National Forests and National Parks.

Building the Fire Line. 27 minutes, color, sound. Typical fire problem and tactics required by fire boss, foreman and crews; including locating fire line, choice of control and suppression measures in Pennsylvania.

Crew Boss. 35 minutes, color, sound. In-Service training film designed to assist in training forest fire crew bosses. It dramatizes a crew boss and a project work crew on their first shift on a fire line from which they emerge as a disciplined high-morale team. A good fire camp, fire line practice, and the characteristics of a good supervisor are covered. Discussion leaders' guide available.

Eastern White Pine. 19 minutes, color, sound. White pine is important in the forest economy of eastern communities. It is a winner in the market, where it brings a higher price than other comparable softwoods. The film portrays the work of a "service" or "farm" forester, who gives technical advice to a private woodland owner. Shows values that follow good management practices and control of pests. Explains diagnosis.

Fire in the Forest. 22 minutes, color, sound. Shows the effect of fuel, wind, slope, moisture, natural and man-made features on the spread of a forest fire. Explains the use of the instruments in a fire weather station and how the burning index is found. Shows the daily and seasonal changes that affect fire behavior.

Fire Plow Performance and Use. 14½ minutes, color, sound. An in-Service fire control training film designed to show the advantages of mechanized fire-line-building equipment over the use of hand tools. Demonstrates the types of plows evolved through experimentation and experience, as well as the modern transports available to get them on the line quickly. The ways in which such equipment, when operated and managed by trained personnel, saves timber stands and reduces suppression costs are stressed.

Fire vs. Fire. 20 minutes, 16 mm., color, sound. To assist fire-control managers in developing abilities to know when and why fire should be used in fire control and the technical requirements of using fire in this way. For Forest Service cooperator personnel responsible for fire suppression, tactical decisions, and implementation.

Gypsy Moth. 28 minutes, color, sound. Shows how the gypsy moth, a foreign insect, threatens the forested regions of North America. Tells how Federal-State activity has limited this foliage-feeding pest to New England and eastern New York and is slowly but surely reducing its area of infestation.

Introduction to Fire Behavior. 16 minutes, color, sound. An in-Service training film for fire fighters, and initial attack foremen. By means of animation and table top photography interspersed with actual fire scenes, it shows the basic fundamentals of combustion and the influences of fuel, weather, and topography on fire behavior. Emphasizes the many factors that make a fire burn the way it does and demonstrates how strategy can be planned from knowledge of this behavior.

Silent Killer. 12 minutes, 16 mm., color, sound. Choice spruce and fir forests are attacked by the spruce budworm, a silent killer that can wreck a forest. A control project in southern Idaho is carried out by Federal and State agencies cooperating with the landowners. Film shows how they bring this epidemic under control.

Water on the Fire. 27 minutes, 16 mm., color, sound. For training forest fire fighters in the most effective use of water when extinguishing various types of burning fuels on the forests of Eastern United States. (Locale: New England.)

ADVANCED FOREST MEASUREMENTS

Hours Required

Class, 2; Laboratory, 8

Course Description

This course is an extension of Elementary Forest Measurements requiring the student to build upon and put into practice the principles and skills previously learned.

Forest inventory is an attempt to describe the quantity, type and quality of forest trees as well as the land characteristics upon which the stand grows. A technician must be skilled in the intelligent management of forest areas by gathering and utilizing information on volumes, growth rates, stand conditions, location of stands and topography in terms of economical harvesting operations.

Emphasis in this course is placed on the statistical determination of cruising accuracy, forest inventory techniques, construction and use of volume tables and forest type mapping.

It is necessary that sufficient land area of various timber types and topography be available for cruising.

Major Divisions

		Hours	
		Class	Laboratory
I.	Introduction to Forest Inventory	2	4
II.	Basic Statistical Methods	5	12
III.	Volume Table Use and Construction	6	16
IV.	Type Mapping	7	20
V.	Timber Inventory	12	76
	TOTAL	32	128

I. Introduction to Forest Inventory

A. Units of Instruction

1. Reasons for inventories
2. Uses of inventory methods
3. Types of inventory measurements

B. Laboratory Projects

1. Demonstrate to the students the use of various timber inventory tools in the field
2. Review the use of instruments previously learned in Elementary Forest Measurements
3. Require a report discussing forest inventory uses and requirements. Emphasize the use of the proper tools and techniques for the economic objectives of the inventory.

II. Basic Statistical Methods

A. Units of Instruction

1. Accuracy of measurement

2. Population and samples

a. Finite

b. Infinite

c. Sampling

d. Stratification

3. Frequency distribution

a. Normal

b. Skewed

4. Measures of central tendency

a. Mean--weighted and arithmetic

b. Mode

c. Median

5. Measures of dispersion

a. Range

b. Standard deviation

c. Standard error

(1) Number of observations required for a given degree of accuracy

(2) Normal curve and distribution

B. Laboratory Projects

1. Give practical demonstrations to the students

in indoor laboratory periods in the use of statistics in designing a cruise

2. Give the students selected practical problems in statistical computations
3. Take a field trip to a company or firm which has a computer and explain to the students how computers are operated and how they are utilized in forest management operations

III. Volume Table Use and Construction

A. Units of Instruction

1. Problems with volume tables
    a. Standard
    b. Local
2. Gathering and developing data for volume table constructicn
    a. Standard volume table construction
    b. Local volume table construction
        (1) Trial curves
        (2) Balanced curves
    c. Cumulative volume table construction and use
    d. Form class volume table construction and use

B. Laboratory Projects

1. Students will gather local volume table data

and assemble it into useable form using at least three local commercial specie groups

2. In an indoor laboratory, students will construct local volume tables for species studied; volumes will be curved and adjusted for later use

3. Require a report of each student on the creation of local volume tables and their use in comparison to standard volume tables

IV. Type Mapping

A. Units of Instruction

1. Recognizing forest types
   a. Ground observations
   b. Photo interpretive observations
2. Reasons for stratification
   a. Utilization--markets--stumpage value
   b. Quantities per acre
   c. Heights based on d.b.h. differences
   d. Area by volume and type
3. Site quality affecting types
4. Cover types
   a. Composition
   b. Age
   c. Density
5. Volume and density corrections

6. Varying the percentage covered by strips or lines in different cover types

7. Mapping of stand types

    a. Stock and stand tables

    b. Acreage calculations

B. Laboratory Projects

1. Make an on-site inspection of a forest area and observe the type differences by species and age; evaluate these differences due to site differences

2. Run a series of short cruise lines through a forest stand and allow the students to classify it by the stratification of species and ages

3. Break the group into crews of two or three men and assign them an area of forest land. Have them run a boundary survey of the area by staff compass and tape. Students will then draft the map in preparation for later use.

4. Allow the students to use aerial photos of their area and observe the bounds and timber types

V. Timber Inventory

A. Units of Instruction

1. History and present status
2. Factors influencing timber estimates
    a. Purpose
    b. Size of area
    c. Time allocation
    d. Cost estimates
    e. Timber value
    f. Topography
3. Method of data tabulation and presentation
    a. Field tally sheets
    b. Punch card data and mark sense cards
4. Sources and limits of error in timber estimating
5. Total estimates
    a. Where and when utilized
    b. Method of operation
6. Sampling procedures
    a. Size and shape of sampling unit
    b. Systematic sampling
    c. Random sampling
    d. Startified random sampling
    e. Intensity of sampling
    f. Design of a cruise to fit a price
    g. Punch card and mark sense tables

7. Cruise techniques and operations

   a. Strip cruise

      (1) Number of strips and spacing to fit statistical requirements

      (2) Method of operations

      (3) Errors in strip cruising

   b. Plot and line plot techniques

      (1) Cruise line spacing, plot size and number

      (2) Method of operations

      (3) Errors involved

   c. Bitterlich (point sampling) method

      (1) Line and variable plot method

      (2) Random plot method

      (3) Volume computations

      (4) Errors involved

8. Continuous forest inventory

   a. Reasons and history

   b. Requirements of data gathering

   c. Method of presentation

9. Cruise reports

   a. Significance

   b. Requirements

      (1) Volume

      (2) Types

(3) Quality

(4) Topography

(5) Mapping

(6) Written and tabular presentation

B. Laboratory Projects

1. Assign crews of two or three men to an area and, using the boundary control maps constructed in the previous exercise, have the students design and execute a strip cruise of the area
2. Require a cruise report of each student containing all the available information gathered in the field
3. Assign crews of two or three men to a sizeable tract and have them design and execute a line plot cruise
4. Submit a complete cruise report of the area covered
5. Explain the use of prisms under field conditions and allow the students to calibrate their prisms
6. Using local volume tables derived in a previous laboratory, have the students construct volume-basal area ratio tables
7. Assign crews of two or three men to the

same block they cruised under item 3. Students will design and execute a line-variable plot cruise on this area.

8. Submit a complete cruise report of the line-variable plot cruise with comparisons as to time, accuracy and other factors with the more conventional line-plot system completed under 2 above

Texts and References

Avery and Herrick. Field Projects and Classroom Exercises in Basic Forest Measurements.

Bruce. Prism Cruising in the Western United States and Volume Tables for Use Therewith.

__________ and Schumacher. Forest Mensuration.

Chapman and Meyer. Forest Mensuration.

Dilworth. Log Scaling and Timber Cruising.

__________ and Bell. Variable Plot Cruising.

Fryer. Elements of Statistics.

Hedlund and Christopher. "Southern Forest Survey Field Instructions."

Hovind and Rieck. Basal Area and Point-Sampling: Interpretation and Application.

Huntsberger. Elements of Statistical Inference.

Husch. Forest Mensuration and Statistics.

Kulow. Elementary Point-Sampling.

Meyer. Forest Mensuration.

Shain and Rudolph. Continuous Forest Inventory.

Spurr. Forest Inventory.

Visual Aids

U. S. Forest Service, c/o Chief, Forest Service,
Washington, D. C. 20250

Angles in Timber Cruising. 176 slides. Discusses the theory of variable plot cruising techniques.

FOREST PHOTO-INTERPRETATION

Hours Required

Class, 1; Laboratory, 6.

Course Description

This course is intended to provide a student with the basic techniques of aerial photo-interpretation. No attempt is made to cover complex subjects such as topographic mapping or the operation of expensive stereo-plotting instruments. Proficiency in photo-techniques can only be developed by directed practice over an extended period of time. The student is introduced to the arrangement of aerial photos for stereoscopic viewing, determination of scale, ground distance, acreage, bearings, object heights, and timber volumes and timber types.

It is desirable that this course consist of one hour of lecture followed by a three-hour laboratory session, preferably at the beginning of the week, with another three-hour laboratory later in the week. The student should have completed course work in Surveying, Drafting and Mensuration prior to enrolling.

The instructor should have readily available three aerial photos per student with forward overlap of 60 percent made with a precision aerial camera whose focal length is 8-1/4". U. S. Agriculture Department 9" x 9" photos at a scale of 1:15840 of a local area are adequate. If photographs are obtainable from federal or private agencies, a photogrammetry laboratory kit may be used.

The instructor should have a number of stereograms showing various landforms and man-made structures for identification purposes in studying cover types.

Major Divisions		Hours Class	Hours Laboratory
I.	Development and Application of Aerial Photography--Stereoscopy	1	6
II.	Aerial Photo Specifications	2	12
III.	Season of Photography--Films and Filters	1	6
IV.	Forest Cover Types--Identification and Keys	2	12
V.	Photographic Scale and Horizontal Measurements	2	12
VI.	Displacement in Single Aerial Photographs	1	6
VII.	Displacement in Stereopairs	2	12
VIII.	Area Determination	1	6
IX.	Mapping and Road Location	2	12
X.	Forest Inventory	2	12
	TOTAL	16	96

I. Development and Application of Aerial Photography

   A. Units of Instruction

      General discussion of the history and development of aerial photography

      1. Development of aerial photography and photogrammetry

         a. Daguerreotype

         b. Mapping

         c. Eastman film

         d. Wright Brothers flight

         e. World War I and II

      2. Applications of aerial photographs

         a. Topographic and planimetric maps

         b. Uses in forestry

            1. Mapping

            2. Inventory

            3. Administration

            4. Geology

            5. Land use changes

   B. Laboratory Projects

      1. Discussion and demonstration of film components

      2. Have students conduct standard stereoperception test

3. Map reading

    a. Orientation by topographic maps

    b. Information on topographic maps

4. Using a topographic map

    a. Determine true and magnetic meridians

    b. Lay off magnetic bearing using declination

    c. Determine height of a ridge using contour lines

    d. Determine ground distance between two points and compare results to bar scale

II. Aerial Photographic Specifications--Stereoscopy

A. Units of Instruction

1. Angle of photography

2. Cameras

    a. Lenses and mounting

    b. Multiple camera photography

3. Special purpose photography

4. Method of flying

    a. Overlap

    b. Crab

    c. Tilt

    d. Time of day

    e. Weather

5. Photographic prints

    a. Available weights and types of photos

b. Advantages and disadvantages of each

6. Information on prints

7. Marking prints

8. Stereoscopy

   a. Monocular

   b. Binocular

   c. Stereoscopic

9. Types of stereoscopes

10. Orientation of photos for stereoscopic study

B. Laboratory Projects

1. Orientation of stereopairs--locate and mark principle and conjugate principle points

2. Discuss and demonstrate information on prints: how to mark, storage and filing problems

3. Determine photo base lines and lengths

4. Lay off true meridians on stereopairs

5. Demonstrate various types of stereoscopic devices

6. Demonstrate pseudoscopic images

III. Season of Photography

A. Units of Instruction

1. Climatic cycles

2. Interpretation needs varied by season

3. Types of emulsions--spectrum discussion

B. Laboratory Projects

1. Discuss and demonstrate various film and filter combinations with seasonal vegetation changes

2. Field trip to an agency handling varied film and filter types and discussion of their uses. Stereoscopic viewing of prints from film and filter combinations.

IV. Forest Cover Types--Identification and Keys

A. Units of Instruction

1. Object recognition through shape and dimension

2. Tone--variability

3. Texture--variability due to object

4. Shadows--influence on texture--errors due to shadows

5. Human factor in photo-interpretation

   a. Visual acuity

   b. Mental acuity

6. Equipment factors in photo-interpretation

B. Laboratory Projects

1. Demonstrate and explain the above factors using photographs

2. Using elimination keys, identify objects on photos

3. Make field tour with photos and pocket stereoscopes to coordinate aerial photo objects with actual ground observed objects
4. Student problems in timber typing and cultural features

V. Photographic Scale and Horizontal Measurement

A. Units of Instruction

1. Determination of photo scale
2. Variation in scale
   a. Focal length
   b. Flying height
   c. Tilt
3. Geometry of scale
4. Selection of scale
5. Determination of flying height when focal length is known
6. Determination of horizontal measurements on vertical photographs with ground checks

B. Laboratory Projects

1. Field problem for finding the scale of a photograph without resorting to topographic maps
2. The office calculation of scale using 1:24000 or 1:62500 scale topographic maps
3. Demonstration of scale transfer tables

4. Calculation of flying height of photographs for use in differential parallax measurements
5. Determination of the ground distance between two points by computing photo scale reciprocal
6. Student problems in scale
7. Set up student problem for the determination of bearings by establishing a true bearing meridian on the photos. Using a protractor and engineer's scale, determine the true or magnetic bearings and distances from various points of origin to objectives.

VI. Displacement in Single Aerial Photographs

A. Units of Instruction

1. Sources of displacement on vertical photographs
2. Displacement due to photographic equipment
3. Displacement due to topography
4. Determination of height from topographic displacement
5. Effects on displacement due to relief and tilt
6. Shadow length measurements on single photos
7. Determination of height from topographic displacement on single photos
8. Student problems in displacement

B. Laboratory Project

With the use of the engineer's scale, determine the heights of various objects on single photos by shadow length and topographic displacement

VII. Displacement on Stereopairs

A. Units of Instruction

1. Absolute stereoscopic parallax
2. Micrometer floating--mark devices and principles
3. Variations in elevation of two principle points in a stereopair
4. Determining elevation by parallax wedge and Abrams height finder
5. Accuracy of height measurements of stereoscopic parallax
6. Measurement of slope per cent on aerial photos

B. Laboratory Projects

1. Carefully measure differential parallax with an engineer's scale between two points. Then determine the difference in elevation of these two points by the parallax formula after first computing the photo base length and photo scale.
2. Compute the heights of various photo objects by stereometer or Abrams height finder using the differential parallax formula. Check these heights by ground measurements for a comparison of results.

VIII. Area Determination

A. Units of Instruction

1. Effect of variations in scale on area

a. Relief

b. Tilt

c. Slope

2. Accuracy of measurements

3. Methods of area measurements

a. Planimeters

b. Transects

c. Dot grid

B. Laboratory Project

Students will make acreage determinations by above three methods on selected areas on their stereo-pairs. This will necessitate the students' use of scale and proportional theory.

IX. Mapping and Road Location

A. Units of Instruction

1. Rectangular coordinate systems

2. Ground control

3. Type maps

4. Uncontrolled maps

5. Controlled maps

6. General Land Office plats

7. Importance of short access roads in forest management
8. Preliminary lines
9. Deductions as to:
    a. Soil
    b. Rock
    c. Slope
    d. Timber extraction
10. Costs of aerial vs. ground techniques

B. Laboratory Project

Using student stereo-pairs, determine the parallax difference in 0.001 inch for a specific per cent slope after computing parallax factor at various points on your forest access road. Determine elevations at point A and point B and determine air line distance. Lay out a preliminary road location on the photo and record. Move up or down slope as required to meet specifications. Show the final location in red pencil or ink.

X. Forest Inventory

A. Units of Instruction

1. Future of forest inventory in management
    a. Mapping for ground control
    b. Individual measurement of trees and stands

2. Limitations

   a. Stem diameter

   b. Cull factor

   c. Growth

   d. Identification of species

3. Coordination of ground and aerial methods of inventory

4. Stand measurements vs. individual measurements

5. Crown closure percent as reflected in stocking

   a. Shadows

   b. Small holes

6. Adjusting photo volume by field checks

7. Reliability of photo volumes

B. Laboratory Projects

   1. Volume of individual trees

      a. Collect data on five to ten dominant and co-dominant trees 6.0 inches in diameter and larger. Data should consist of stem diameters, crown diameters, merchantable heights, and total heights. Span a wide range of diameters and heights. Obtain these measurements in readily identifiable trees in an open area, preferably areas readily seen on the photos.

b. Obtain crown diameter to the nearest foot possible using photos and crown diameter scales. Obtain heights of these trees using parallax or shadow length.

c. Compute volumes by local cubic foot aerial volume tables

d. Compare with field volumes

2. Volume of forest stands

   a. Locate 1/2 acre plots on photos

   b. Determine average total tree heights, average crown diameter and per cent of crown closure. Using these values, obtain gross cubic volumes from a local aerial volume table.

   c. Precisely locate each plot on the ground and obtain field volumes

   d. Construct a regression line by plotting field volumes over corresponding photo volumes and adjust each plot volume.

Texts and References

Avery. Interpretation of Aerial Photographs.

Baker. Elements of Photogrammetry.

Eichler and Tubis. Photogrammetry Laboratory Kit.

Moessner. Basic Techniques in Forest Photo-Interpretation.

REGIONAL FOREST PRACTICES AND UTILIZATION

Hours Required

Class, 0; Laboratory, 120

Course Description

One objective of this course is to extend the students' knowledge acquired in each major area of forestry during their two years of formal course work. This is hopefully achieved by exposing them to a variety of field observations and different resource personnel. It should cover major areas of forestry such as: the federal and state approach to forest management; the techniques and methods of forestry as practiced by private consulting foresters; industrial foresters' approaches to forest management; recreation, wildlife and multiple-use management as practiced by the various agencies; forest research studies being conducted by experimental foresters; tree nursery operations; federal, state and municipal watershed management; and harvesting methods, machinery and equipment.

A further objective is to introduce and contrast primary and secondary wood utilization. This is an expansion or continuation of the Forest Products Utilization course. Industries are observed which are either too distant from the educational institution or too involved for the time allotted in the course. Industries such as paper companies, veneer and plywood plants, furniture manufacturing firms and other specialty industries such as bobbin factories, dowell plants, and dimension square plants are visited. Two industries manufacturing identical products such as pallets, boxes and crates or turnings are contrasted with one another to give the students two different viewpoints on how management produces the product. One firm could have been studied in the Utilization course and the other visited during the tour.

Major subject divisions of the three-week tour are not listed as in other course syllabi. A typical schedule is presented as a substitute. Texts, references and handouts are assigned for the particular subject matter being covered. Additional handouts are distributed when required <u>prior</u> to making the visit. It is felt that more benefit will be derived at each stop and from each resource person by having the students mentally prepared and forewarned as to what will be seen and discussed at the location. Further, this will give them a better understanding and appreciation of what is being seen.

Major Divisions

The scheduled three-week tour.

Texts and References

Panshin. Forest Products.

REGIONAL FOREST PRACTICES

Day and Date	Name of Agency 1/	Subject 2/	Location
Monday, May 9	Massabesic Experimental Forest, USFS	White Pine Silviculture	Alfred, Maine
Tuesday, May 10	Bear Brook State Park (a.m.)	State Recreation	Allenstown, N.H.
	Bear Brook State Park (p.m.)	State Forest Management	Allenstown, N.H.
Tuesday evening, May 10	Instructors and Students Discussion	7:00-9:00 p.m.	Classroom
Wednesday,	Manchester Waterworks (a.m.)	Municipal Watershed Management	Auburn, N.H.
	Caron Box & Lumber Co. (a.m.)	Boxboard Manufacture	Manchester, N.H.
Thursday, May 12	State Forest Nursery (a.m.)	Nursery Operations	Gerrish, N.H.
	Kear-Wood, Inc. (p.m.)	Consulting Forestry	Wilmot, N.H.
Thursday evening	Overnight Stop--Plymouth State Teachers' College,		Plymouth, N.H.
Friday, May 13	Russell Pond Campground, USFS (a.m.)	Federal Recreation	North Woodstock, N.H.
	Woodsville Chipping Plant (p.m.)	Centralized Chipping	Woodsville, N.H.
Friday evening, May 13 to Monday morning, May 23		Headquarters, Colebrook, N. H.	
Saturday, May 14	Groveton Paper Company	Papermaking	Groveton, N.H.
Sunday, May 15	Layover, Colebrook, New Hampshire		

Day and Date	Name of Agency 1/	Subject 2/	Location
Monday, May 16	Washburn's Sawmill (a.m.)	Hardwood Band Mill	North Stratford, N.H.
	Plywood Products (p.m.)	Hardwood Plywood	North Stratford, N.H.
Monday evening, May 16	Instructors and Students Discussion	6:00-8:00 p.m.	Headquarters
Tuesday, May 17	Beechers Falls Furniture Manufacturing	Furniture Making	Beechers Falls, Vermont
Tuesday evening, May 17	Vermont Department of Forests and Parks	State Recreation	Headquarters
Wednesday, May 18	St. Regis Paper Company	Timber Inventory and Recreation	West Stewartstown, N.H.
Thursday, May 19	St. Regis Paper Company	Harvesting and Wildlife Management	West Stewartstown, N.H.
Friday, May 20	Cree's Christmas Tree Farm	Christmas Tree Production	Colebrook, N.H.
Saturday, May 21	EXAMINATION 8:00-10:00 a.m. first two weeks	Covers material presented in the	
Sunday, May 22	Layover, Colebrook, New Hampshire		
Monday, May 23	Brown Company	Harvesting Operations	Seven Islands, N.H.
Monday evening, May 23	Dolly Copp Campground, USFS Instructors and Students Discussion and Review of Exam	Overnight Stop	Gorham, N.H. Headquarters
Tuesday, May 24	Dolly Copp Campground, USFS (a.m.)	Federal Recreation	Gorham, N.H.
	Eastern Slopes Campground (p.m.)	Private Recreation	Conway, N.H.

Day and Date	Name of Agency 1/	Subject 2/	Location
Tuesday evening,	May 24 to Friday morning, May 27 Headquarters, Eastern Slopes Campground		Conway, N.H.
Wednesday, May 25	Bartlett Experimental Forest USFS	Hardwood Silviculture	Bartlett, N.H.
Wednesday evening, May 25	Instructors and Students Discussion 6:00-8:00 p.m.		Headquarters
Thursday, May 26	Diamond International Logging and Milling Corporation		Fryeburg, Maine
Friday, May 27	Saco Ranger District	Timber Inventory and Timber Sales	Conway, N.H.
Friday afternoon, May 27	Return to University of New Hampshire, Durham, New Hampshire		

1/ Each student will be required to give a formal report on what was observed and discussed at one of the agencies visited.

2/ Assignments from text, Forest Products, handouts as required and material presented in formal courses.

MATHEMATICS AND SCIENCE COURSES

TECHNICAL MATHEMATICS (Algebra and Trigonometry)

Hours Required

Class, 4; Laboratory, 0.

Course Description

This course is designed to insure that the student has the mathematics necessary to understand and work with the principles covered in the technical courses. Care has been taken to develop the various topics in mathematics before the student is required to use them in the concurrent technical courses.

As the various topics are introduced, the meaning and underlying principles of each and the role each plays in forest technology should be considered before the subject itself is explored. Practical problems following the exposition of each major topic will help motivate the student and will strengthen his understanding of the principles involved.

Note: Use of the slide rule is not taught in this course since it is the consensus of industrial personnel that facility with the slide rule is not necessary, although it may be desirable if a student has the propensities for mastering this instrument. The use of the desk calculator however, is introduced early in the course to provide the student with skill in its use as a tool in solving mathematical problems without delaying his progress in learning fundamental mathematical principles necessary to understand forest measurements.

Major Divisions

		Class Hours
I.	Fundamental Concepts and Operations	9
II.	Functions and Graphs	7
III.	Trigonometric Functions	6
IV.	Linear Equations and Determinates	6
V.	Factoring and Fractions	6
VI.	Quadratic Equations	5
VII.	Trigonometric Functions of any Angle or Number	7
VIII.	Exponents and Radicals	5
IX.	Logarithms	5
X.	Properties of the Trigonometric Functions	8
	TOTAL	64

I. Fundamental Concepts and Operations

Units of Instruction

1. Numbers and literal symbols
2. Fundamental laws of algebra
3. The law of signs
4. Operations with zero

5. Exponents and radicals
6. Additions and subtractions of algebraic expressions
7. Multiplication and division of algebraic expressions
8. Equations and formulas
9. Problems
10. Questions
11. Examination

II. Functions and Graphs

Units of Instruction

1. Functions
2. Cartesian coordinates
3. Graphing functions
4. Zeros of a function
5. Problems
6. Questions
7. Examination

III. Trigonometric Functions

Units of Instruction

1. Angles
2. The right triangle
3. The trigonometric functions
4. Values of the trigonometric functions
5. Use of tables
6. Problems

7. Questions

8. Examination

IV. Linear Equations and Determinates

Units of Instruction

1. Linear equations
2. Graphical solution of systems of two linear equations with two unknowns
3. Algebraic solution of systems of two linear equations with two unknowns
4. Solution by determinates of systems of two linear equations with two unknowns
5. Algebraic solution of three linear equations with three unknowns
6. Solution by determinates of systems of three linear equations with three unknowns
7. Problems
8. Questions
9. Examination

V. Factoring and Fractions

Units of Instruction

1. Special products
2. Factoring
3. Simplifying fractions
4. Multiplication and division of fractions
5. Addition and subtraction of fractions

6. Problems

7. Questions

8. Examinations

VI. Quadratic Equations

Units of Instruction

1. Quadratic equations. Solution by factoring

2. Completing the square

3. The quadratic formula

4. Problems

5. Questions

6. Examination

VII. Trigonometric Functions of any Angle or Number

Units of Instruction

1. Signs of the trigonometric function

2. Radian

3. Applications of the use of radian measure

4. Trigonometric functions of any angle

5. Problems

6. Questions

7. Examination

VIII. Exponents and Radicals

Units of Instruction

1. Positive integers as exponents

2. Zero and negative integers as exponents

3. Fractional exponents

4. Simplest radical form
5. Addition and subtraction of radicals
6. Multiplication and division of radicals
7. Problems
8. Questions
9. Examination

IX. Logarithms

Units of Instruction

1. Exponential and logarithmic functions
2. Properties of logarithms and exponents
3. Logarithms to the base 10
4. Computations using logarithms
5. Problems
6. Questions
7. Examination

X. Properties of the Trigonometric Functions

Units of Instruction

1. Fundamental trigonometric identities
2. Sine and cosine of the sum and difference of two angles
3. Double angle formulas
4. Half angle formulas
5. Trigonometric equations
6. Review of right triangles

7. Extension of functions for angles greater than ninety degrees
8. Graphs of the six functions
9. Problems
10. Questions
11. Examination

Texts and References

Adams. Intermediate Algebra.

Andres, Miser and Reingold. Basic Mathematics for Science and Engineering.

Combellack. Introduction to Elementary Functions.

Corrington. Applied Mathematics for Technical Students.

Dressler and Rich. Reviewing Trigonometry.

Hall and Kattsoff. Unified Algebra and Trigonometry.

Juszli and Rogers. Elementary Technical Mathematics.

Lennhardy. College Algebra.

Rossweiler and Harris. Mathematics and Measurement.

Visual Aids

Coronet Films, Inc., Coronet Bldg., Chicago, Illinois 60604.

Pythagorean Theorem, The Cosine Formula, 1960, 5-1/2 minutes, 16 mm., sound, black and white, $30.00. Shows how the Pythagorean Theorem may be applied to acute angled triangles in addition to right triangles and how this approaches a right angle and its cosine approaches zero, so that the Pythagorean Theorem reappears.

Pythagorean Theorem, Proof by Area. 5-1/2 minutes, 16 mm., sound, black and white, $30.00. Animated diagrams demonstrate the principles of geometric movement and transformation by showing how the square of each side of a right triangle may be transformed to a parallelogram of equal area and how these may be proved to be equal in area to the square of the hypotenuse.

International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60604.

Axioms in Algebra, 13 minutes, 16 mm., sound, color, purchase $135.00, rent $6.00. Produced by Visual Education Films. Presents the fact that an axiom is a statement accepted as true without proof, and then demonstrates the addition, subtraction, multiplication and division axioms as applied to solving practical problems by utilizing pictographic equations.

Knowledge Builders, Visual Education Center Building, Floral Park, New York.

Areas, Circles, Ratio and Proportion.

AUXILIARY OR SUPPORTING

TECHNICAL COURSES

BOTANY

Hours Required

Class, 2; Laboratory 3

Course Description

A thorough study of plant anatomy, physiology and reproduction. Class work and laboratory work are calculated to increase the student's basic and useful working knowledge of plants and to prepare him with certain techniques needed in controlling plant growth.

The main objective of this course is to encourage a thorough understanding of plant parts, functions, reaction to certain stimuli and reproduction. The information and experiences gained enable the technician to more adequately handle various propagation practices, such as nursery bed seeding; scarification, stratification, budding, grafting; certain parts of plant protection; the basic ground work for further advancement in wood technology; and any work that is based on a knowledge of plant nutrition.

In order to accomplish these objectives, we feel that a single micro-projector which will project slides on a screen, would take care of the needs for microscopes in studying cells, tissues, divisions, etc.

We are convinced that the best visual aids are the actual organs or organisms which we are studying. Technician work involves actual participation. For this reason, most of the laboratory exercises have been set up on the basis of actually handling plants and plant parts. Although provisions have been made for three hours of laboratory classes per week, the arrangement of the periods should be left to the instructor. This would allow for more flexibility in scheduling.

Films that seem to fit into a course of this type are included as part of the suggested references.

Major Divisions

	Hours Class	Hours Laboratory
I. Plant Structure and Functions (Anatomy and Physiology)	10	12
II. Plant Reaction to Certain Stimuli	10	14
III. Plant Propagation	12	22
TOTAL	32	48

I. Plant Structure and Functions

A. Units of Instruction

1. Definitions and terminology
2. Cell structure and functions

a. Part

b. Division

(1) Mitosis

(2) Meiosis

c. Enlargement

d. Maturation and differentiation

3. Tissues and functions

a. Meristem

b. Parenchyma

c. Conductive

d. Mechanical

e. Protective

f. Callus

4. Organs and functions

a. Roots

b. Stems

c. Leaves

d. Flowers

B. Laboratory Projects

Plant parts and functions

1. Study of cells, callus tissue, plasmolysis

2. Study of plant organs--roots and stems

3. Study of woody stems--growth in length and diameter. Importance of such tissues as phloem, xylem, cambium, callus. Field trip.

4. Study of plant parts--leaves and flowers

II. Plant Reactions to Certain Stimuli

A. Units of Instruction

1. Light

a. Intensity

b. Quality

c. Requirements for photosynthesis

(1) Carbon dioxide and oxygen

(2) Water

(3) Light as a source of energy

(4) Chlorophyll

d. Light duration or photoperiod

(1) Photoperiodism

(2) Types of photoperiodic responses

(3) Phytochrome

2. Temperature--plant reactions to

a. Maximum, minimum, optimum

b. Dormancy, rest periods

c. Growth periods

3. Moisture functions and requirements

a. Water requirements of plants

b. A plant constituent

c. Transpiration

d. Absorption

e. Water deficits

4. Carbon dioxide as a limiting factor

5. Growth substances (auxins)

    a. Flower and fruit set

    b. Fruit thinning or removal

    c. Weed control--herbicides

    d. Growth stimulants--Giberellin

    e. Growth retardants

    f. Root-inducing chemicals

B. Laboratory Projects

1. Light requirements of plants--quality, photoperiod, intensity, phytochrome

2. Temperature requirements--field trip to study various exposures and plant reactions. Exercise on effect of temperatures on the breaking of dormancy in plant parts.

3. Moisture requirements

4. Nutrient requirements--optimum deficiencies, excesses, carbon dioxide

5. Study of controlled environment growth of plants--phytotrons, greenhouses

III. Reproduction of Plants

A. Units of Instruction

1. Sexual propagation in higher plants

    a. Pollination in seed plants

    b. Formation of gametes and zygotes

c. Seed parts and functions

d. Seed germination

Requirements for normal germination

(1) Temperature

(2) Moisture

(3) Proper gases

(4) Light in many cases

2. Asexual propagation in higher plants

a. Reasons for propagating vegetatively

b. Some important types

(1) Cuttage

(2) Layerage

(3) Graftage

3. Propagating media

a. Functions

b. Desirable characteristics

c. Examples

4. Aids to propagation

a. Mist systems

b. Bottom heat

c. Polyethylene covers

5. Propagating structures

a. Outdoors

(1) Frames

(2) Beds

b. Greenhouse structures

B. Laboratory Projects

1. Field trip to Forest Tree Nursery--land preparation, seed beds, shading, planting, storage of seeds, and young seedlings
2. Study of seed parts and functions--seed laws
3. Seeding laboratory. Seed protection, scarification, stratification, seeding
4. Propagation by cuttage and layerage
5. Propagation by grafting, budding, stool layering
6. Use of various synthetic auxins:
   a. Rooting various plant parts
   b. Seedless fruit
   c. Chemical thinning
   d. Growth retardants
   e. Herbicides
   f. Stimulants
7. Field trip to wholesale propagating nursery--media, structures, propagation aids, methods

Texts and References

Avery and Johnson. "Hormones and Horticulture".

Crafts and Robbins. "Weed Control".

Cook. Reproduction, Heredity and Sexuality.

Emerson. Basic Botany.

Emerson and Shields. Laboratory and Field Exercises in Botany.

Jensen. The Plant Cell.

Kains and McQuesten. Propagation of Plants.

King. Weeds of the World: Biology and Control.

Kramer and Koslowski. Physiology of Trees.

Mahlstede and Haber. Plant Propagation.

Muller. Botany: A Functional Approach.

Northern. Introductory Plant Science.

Sinnott and Wilson. Botany: Principles and Problems.

Woodford and Evans. Weed Control Handbook.

----------. Woody-Plant Seed Manual.

Visual Aids

Churchill Films, Inc., 622 North Robertson Boulevard, Los Angeles, California 90069.

Photosynthesis and Respiration Cycle. 13 minutes, 16 mm., color, sound.

Coronet Films, Coronet Building, Churchill, Illinois

How Green Plants Make and Use Food. 11 minutes, 16 mm., color, sound.

Encyclopedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois

The Flowering Plants. 21 minutes, 16 mm., color, sound.

Fungi. 16 minutes, 16 mm., color, sound.

Growth of Plants. 21 minutes, 16 mm., color, sound.

Gymnosperms. 17 minutes, 16 mm., color, sound.

Heredity. 11 minutes, 16 mm., black and white, sound.

Mitosis. 24 minutes, 16 mm., color, sound.

Osmosis. 14 minutes, 16 mm., black and white, sound.

Photosynthesis. 21 minutes, 16 mm., black and white, sound.

Roots of Plants. 11 minutes, 16 mm., black and white, sound.

Seed Germination. 15 minutes, 16 mm., color, sound.

McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, New York 10036

Cell Respiration. 28 minutes, 16 mm., color, sound.

Cell Reproduction (Mitosis). 28 minutes, 16 mm., color, sound.

Chlorophyll. 28 minutes, 16 mm., color, sound.

Flower Structures. 28 minutes, 16 mm., color, sound.

Green Plants. 10 minutes, 16 mm., color, sound.

Leaves. 28 minutes, 16 mm., color, sound.

Life of the Angiosperm. 28 minutes, 16 mm., color, sound.

Meiosis. Genetic series. 30 minutes, 16 mm., black and white, sound.

Plant Reproduction. 28 minutes, 16 mm., color, sound.

The Role of Green Plants. 28 minutes, 16 mm., color, sound.

Roots. 28 minutes, 16 mm., color, sound.

Stems. 28 minutes, 16 mm., color, sound.

University of California, Los Angeles, California.

Organellas in Living Plant Cells. 26 minutes, 16 mm., color, sound.

University of Indiana, Bloomington, Indiana

Asexual Reproduction. 10 minutes, 16 mm., color, sound.

TECHNICAL REPORTING

Hours Required

Class, 3; Laboratory, 0.

Course Description

A natural extension of Communication Skills intended to help the student achieve greater facility in his basic skills previously acquired. The student is introduced to the practical aspects of preparing reports and communicating within groups. The use of graphs, charts, sketches, diagrams, and drawings used to present ideas and significant points is an important part of this course.

Emphasis should be placed upon techniques for collecting and presenting scientific data by means of informal and formal reports, and special types of technical papers. Forms and procedures for technical reports should be studied, and a pattern established for all forms to be submitted in this and other courses.

Much of the subject matter for this course may be necessary reports written for technical courses.

The subject matter taught in this course should be coordinated with material learned in courses studied concurrently.

Major Divisions	Class Hours
I. Reporting	6
II. Writing Technical Reports	12
III. Illustrating Technical Reports	5
IV. The Research Paper	6
V. Oral Reporting	10
VI. Group Communication and Participation	9
TOTAL	48

I. Reporting

Units of Instruction

1. Nature and types of reports
2. Objective reporting
3. The problem concept
4. The scientific method
    a. Meaning of the method
    b. Characteristics of the scientific method
    c. Essentials of scientific style
    d. Importance of accuracy and intellectual honesty in observation and recording
    e. Legal importance of recorded data and log books
5. The techniques of exposition
    a. Definitions
    b. Progression

c. Elements of style

d. Analysis of examples

e. Methods of slanting a report

6. Critical evaluation of a report

II. Writing Technical Reports

Units of Instruction

1. Characteristics of technical reports

2. Report functions

3. Informal reports--short-form reports

   a. Memorandum reports

   b. Business letter reports

   c. Progress reports

   d. Outline reports

4. The formal report

   a. Arrangement

      (1) Cover and title page

      (2) Table of contents

      (3) Summary of abstracts

      (4) Body of the report

      (5) Bibliography and appendix

      (6) Graphs, drawings, or other illustrations

   b. Preparation

      (1) Collecting, selecting, and arranging material

      (2) Writing and revising the report

5. Special types of papers

   a. The abstract

   b. Process explanations

   c. The case history

   d. The book review

III. Illustrating Technical Reports

Units of Instruction

1. Illustrations as aids to brevity and clarity
2. Use of technical sketching and drawings
3. Use of pictoral drawings and sketches
4. Use of diagrammatic representation
   a. Electrical diagrams and symbols
   b. Process flow diagrams
   c. Instrumentation diagrams
   d. Bar charts, pie diagrams and similar presentation of data
5. Graphical presentation of data
   a. Graphs - types of paper
   b. Choice of scale
   c. Points and lines; use of data from graphs
6. Use of photographs
7. Selection of appropriate illustrations
   a. Availability
   b. Cost of preparation
   c. Maximum brevity and clarity of presentation

IV. The Research Paper

Units of Instruction

1. Subject and purpose
2. Source materials: bibliographical tools; periodical indices; the library
3. Organizing the paper
    a. A working bibliography
    b. Notes and the outline
    c. The rough draft
    d. Quoting and footnoting
    e. The final paper
4. Oral and written presentation of the paper

V. Oral Reporting

Units of Instruction

1. Organization of material for effective presentation
2. Formal and informal reports
3. The use of notes
4. The use of slides, exhibits
5. Proper use of the voice
6. Elimination of objectionable mannerisms
7. Introductions

VI. Group Communication and Participation

Units of Instruction

1. The problem-solving approach
    a. Stating and analyzing the problem

b. Proposing solutions

c. Selecting and implementing a solution

2. Participating in group communication

a. The chairman--duties and qualifications

b. Rules of order

c. The panel discussion and symposium

d. Group investigation

Texts and References

Baird and Knower. Essentials of General Speech.

---- and -------. General Speech: An Introduction.

Bordeaux. How to Talk More Effectively.

Crouch and Zetler. A Guide to Technical Writing.

Dean and Bryson. Effective Communication.

Harwell. Technical Communications.

Hicks. Successful Technical Writing.

Kegel and Stevens. Communication: Principles and Practices.

Marder. The Craft of Technical Writing.

McCrorie. The Perceptive Writer, Reader, and Speaker.

Perrin and Smith. Handbook of Current English.

Rhodes. Technical Report Writing.

Roget. New Roget's Thesaurus of the English Language.

Schutte and Steinberg. Communication in Business and Industry.

Souther. Technical Report Writing.

Thompson. Fundamentals of Communication.

Warriner and Griffith. English Grammar and Composition: A Complete Handbook.

Witty. How to Become a Better Reader.

Young and Symonik. Practical English: Introduction to Composition.

Zetler and Crouch. Successful Communication in Science and Industry.

Visual Aids

McMurry-Gold Productions, 139 South Beverly Drive, Beverly Hills, California 91603

Person To Person Communication. 13 minutes, 16 mm., black and white, sound.

National Educational Television Film Service, Audio-Visual Center, Indiana University, Bloomington, Indiana 47405

Experience as Give and Take. 29 minutes, 16 mm., black and white, sound. Produced by Hayakawa. (Language in Action Series)

Talking Ourselves into Trouble. 29 minutes, 16 mm., black and white, sound. Produced by Hayakawa. (Language in Action Series)

Words That Don't Inform. 29 minutes, 16 mm., sound. Produced by Hayakawa. (Language in Action Series)

National Safety Council, 425 N. Michigan Avenue, Chicago, Illinois 60601

It's An Order. 12 minutes, 16 mm., black and white, sound.

FOREST SOILS

Hours Required

Class, 2; Laboratory, 3

Course Description

The purpose of this course is to show the student the importance of soil in relation to forest tree growth. Relevant classroom, laboratory and field exercises will demonstrate to the student the variety of soils; their physical, chemical and biological properties; soil development and formation; the survey and classification of soils; the problems of soil loss and its control by soil conservation practices; the nutrient requirements of forest vegetation; and the integration of these factors in the proper management of forest growth, in whatever state of development. Appropriate exercises will develop in the student the ability to conduct simple tests and procedures to determine the more basic properties of soil and its suitability for tree growth and reforestation.

Major Divisions		Hours Class	Hours Laboratory
I.	Introduction to Soil Science	1	3
II.	Soil Survey and Classification	3	6
III.	Physical Aspects of Mineral Soils	3	6

IV.	Soil Water	3	6
V.	Chemical Aspects of Mineral Soils	4	3
VI.	Biological Aspects of Mineral Soils	3	0
VII.	Soil Formation and Development	3	6
VIII.	Nutrient Requirements and Mineral Nutrition of Forest Vegetation	3	6
IX.	Organic Soils	2	0
X.	Soil Erosion and its Control	3	6
XI.	Forest Soil Management	4	6
	TOTAL	32	48

I. Introduction to Soil Science

A. Units of Instruction

1. Definitions of soil
2. Scope and importance of soil science
3. History of the study of the soil

B. Laboratory Project

Visit several soil pits and examine the major differences in development, drainage, parent material, and profile

II. Soil Survey and Classification

A. Units of Instruction

1. History and development of soil classification

2. Criteria used in classification systems
3. Classification systems currently used
4. The Seventh Approximation--the newly adopted classification system
5. Soil series, type, phase, association and catena
6. Soil survey and mapping
7. Soil survey reports
8. Land-use capability classification
9. Forest site classification and woodland suitability groups

B. Laboratory Projects

1. Discussion and examination of soil survey reports
2. Compilation of assigned data from a soil survey report
3. Discussion of symbols and techniques used in soil mapping
4. Using a soil map, locate several soil series in the field; collect samples from future testing
5. Discussion and examination, in detail, of a soil type in a pit whose profile has been completely described

III. Physical Aspects of Mineral Soils

A. Units of Instruction

1. Soil separates and soil texture
2. Soil structure and consistence
3. Particle density, bulk density and pore space
4. Soil air and soil temperature

B. Laboratory Project

1. Prepare soil sample for testing
2. Mechanical analysis of soil sample using Bouyoucos method
3. Separate sand fractions into various components by sieving
4. Determine percentage composition and make textural classification using textural triangle
5. Determination of texture by touch
6. Use core sampler to collect samples for bulk density determination
7. Prepare soil cores for testing and calculate bulk density and per cent pore space
8. Field examination of various soil structural types and classes

IV. Soil Water

A. Units of Instruction

1. Classification and energy relations of soil water
2. Movement of water into and within the soil
3. Soil moisure determinations
4. Soil moisture losses
5. Soil moisture in relation to plant growth
6. Soil drainage
    a. Open ditch
    b. Tile
    c. Other methods
7. Irrigation
    a. Surface
    b. Subsurface
    c. Sprinkler
    d. Water sources

B. Laboratory Projects

1. Determination of soil moisture content by
    a. Tensiometer
    b. Resistance blocks
    c. Gravimetric method
2. Laboratory determination of permeability rate
3. Demonstration of water movement within the soil using glass-sided box
4. Laboratory determination of field capacity and wilting point

5. Field inspection of irrigation system

6. Field inspection of drainage system

V. Chemical Aspects of Mineral Soils

A. Units of Instruction

1. Soil reaction: pH, acidity and alkalinity

2. Clay minerals and colloids

3. Cation exchange

4. Other soil chemical reactions

B. Laboratory Projects

1. pH determination by potentiometric and colorimetric tests

2. Determination of active and reserve hydrogen

3. Individual preparation of evidence of cation exchange in soil

4. Extraction of soil humus

5. Show cation exchange properties of humus

6. Show dispersing and flocculating properties of variously charged cations

VI. Biological Aspects of Mineral Soils

A. Units of Instruction

1. Plant and animal organisms in the soil

2. Activities and functions of soil organisms

3. Accumulation and loss of soil organic matter

4. Decomposition of organic matter and humus formation

B. Laboratory Projects

1. Observe activities of soil macro-organisms in glass-sided soil observation box
2. If equipment is available, examine prepared microscopic slides of soil micro-organisms

VII. Soil Formation and Development

A. Units of Instruction

1. Geologic classification of parent materials
2. Weathering of rocks and minerals
3. Primary factors of soil formation
4. Principal soil-forming processes
5. The soil profile and diagnostic horizons

B. Laboratory Projects

1. Study and describe hand samples of the more important rocks and minerals.
2. Laboratory exercise on mechanical weathering
3. Laboratory exercise on chemical weathering, showing release of nutrients through chemical reaction
4. Examine soil monoliths for diagnostic horizons used in classification and soil forming processes and soil profiles foreign to the area

5. Field examination of selected sites showing the effect on soil formation of differing conditions of parent material, vegetation, relief and time
6. The use of indicator plants in determining soil characteristics in the field

VIII. Nutrient Requirements and Mineral Nutrition of Forest Vegetation

A. Units of Instruction

1. Elements essential to plant growth and their sources
2. The phenomenon of nutrient uptake
3. Functions of essential elements in the plant
4. Soil physical conditions and plant nutrition
5. Nutrient deficiency symptoms and problems

B. Laboratory Projects

1. Filmstrip and slide illustrations of deficiency symptoms
2. Examine plants grown in controlled nutrient deficient media
3. Conduct rapid soil tests for essential elements
4. Conduct plant tissue tests for nutrients

IX. Organic Soils

A. Units of Instruction

1. Origin, distribution and importance of organic soils

2. Classification and use of organic soils

3. Properties and management of organic soils

B. Laboratory Projects

1. Field examination of peat and muck soils

2. Laboratory examination of samples of organic soils to determine original plant sources and certain physical properties

3. Test organic soil samples for pH and selected elements

X. Soil Erosion and its Control

A. Units of Instruction

1. Agents of erosion

2. Erosion processes

3. Control of erosion caused by water

4. Control of wind erosion

5. Erosion and forest vegetation

B. Laboratory Projects

1. Examine various erosion control practices and structures on the site

2. Study the conduct of logging operations and the relation of logging road layout as related to soil properties and erosion hazards

3. Study the use of soil maps, woodland suitability groups, topographic maps and aerial photos in laying out operations

XI. Forest Soil Management

A. Units of Instruction

1. Soil amendments and their uses
2. Management of forest nursery soils
3. Management of forest plantation soils
4. Management of soils under natural forest stands

B. Laboratory Projects

1. Laboratory study of soil reaction and its modification
2. Examine fertilizer materials. Make calculations related to fertilizer formulation and application
3. Visit a forest nursery and observe soil management problems and techniques. Prepare report of observations
4. Visit a managed plantation, observe soil management practices, and report on visit
5. Visit a managed natural woodland; observe soil management practices; and write report on visit. Visit unmanaged woodlot and make written report of suggested soil management practices

Texts and References

Bear. Soils in Relationship to Crop Growth.

Berger. Introductory Soils.

Black. Soil-Plant Relationships.

Buckman and Brady. Nature and Properties of Soils.

Bunting. The Geography of Soil.

Cook. Soil Management for Conservation and Production.

----------. Forest-Soil Relationships in North America.

Foster. Approved Practices in Soil Conservation.

Jackson and Raw. Life in the Soil.

Kramer and Kozlowski. Physiology of Trees.

Lutz and Chandler. Forest Soils.

Millar, Turk and Foth. Fundamentals of Soil Science.

Russell. Soil Conditions and Plant Growth.

Schwab. Elementary Soil and Water Engineering.

----------. Soil: The Yearbook of Agriculture.

----------. Soil Classification: A Comprehensive System, Seventh Approximation.

----------. Soils and Men: The Yearbook of Agriculture.

----------. Soil Survey Manual.

Tisdale and Nelson. Soil Fertility and Fertilizers.

Wilde. Forest Soils.

Visual Aids

Encyclopedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois

Erosion: Leveling the Land. 22 minutes, color.

Our Soil Resources. 11 minutes, black and white.

What is Soil. 13 minutes, black and white or color.

Marian Ray, 36 Villiers Avenue, Surbiton, Surrey, England

Soils: Part I: Rocks and Erosion. A filmstrip.

Soils: Part II: Plants and Decay. A filmstrip.

Soils: Part III: Soil Profiles and their Formation. A filmstrip.

Soils: Part IV: Composition of Soil. A filmstrip.

Soils: Part V: Soil and Farming. A filmstrip.

Ward's Natural Science Establishment, Inc., P. O. Box 1712, Rochester, New York 14603

Weathering and Erosion.

Note: Soil samples of various soil types, hand samples, rocks and minerals, slides of micro-organisms and such related material may be obtained from Ward's Natural Science Establishment, Inc., P. O. Box 1712, Rochester, New York 14603

TECHNICAL DRAWING

Hours Required

Class, 0; Laboratory, 6

Course Description

This course is designed to introduce the student to basic drafting techniques. The student should develop the ability to produce clear, neat and legible drafting work. Lettering, drafting tools and techniques, graphs and charts, and mapping are the main areas covered. Since this is a laboratory course, the student is required to learn by drafting under instructor supervision. Some work may have to be completed outside of regular laboratory periods. Any time required for lecturing is usually taken at the beginning of a laboratory class. More advanced work might be completed within the scope of other forestry courses, thereby eliminating the need for an advanced course in this specific area.

Major Divisions

		Laboratory Hours
I.	Lettering	18
II.	Instruments and Basic Techniques	12
III.	Projections	24
IV.	Visual Aids and Reproduction	12
V.	Mapping	30
	TOTAL	96

I. Lettering

A. Units of Instruction

1. Types
2. Pencils
3. Guide Lines
4. Strokes
    a. Order
    b. Direction
5. Spacing
6. Vertical
7. Inclined
8. Title blocks
9. Inking

B. Laboratory Projects

1. Practice the basic vertical, horizontal, slanted and curved strokes necessary in making letters and numerals
2. Practice printing each of the letters of the alphabet and the numerals several times in upper and lower case figures. Do this in vertical and slant lettering forms.
3. Copy a famous quotation in upper and lower case letters in the form that is most comfortable. (Vertical or inclined letters.) Pay close attention to spacing between letters and sentences.

4. Practice lettering and spacing of several title blocks using upper and lower case figures. Use ink on these after they have been penciled in correctly.

II. Instruments and Basic Techniques

A. Units of Instruction

1. Drafting tools

a. Drawing papers

b. Drawing board

c. Pencils

d. T-square

e. Triangles

f. Scales

g. Instrument kit

h. Curves

i. Drafting machines

2. Geometrical construction

a. Bisecting angles

b. Perpendicular lines

c. Polygons

d. Arcs

e. Curves

f. Tangents

g. Spirals

3. Dimensioning

    a. Lines

    b. Arrowheads

    c. Figures

    d. Leaders

    e. Finish marks

    f. Contours

    g. Irregular curves

B. Laboratory Projects

1. Practice with the drawing instruments by drawing lines, curves and figures.

2. Draw several figures to varying scales and label the scale under each.

3. Practice constructing angles, circles, and other geometric figures with the drawing tools.

4. Draw lines of various thicknesses, arrowheads, and finish marks for practice.

5. Draw irregular curves with the aid of the curve instruments.

III. Projections

A. Units of Instruction

1. Orthographic

    a. Primary planes and views

    b. Revolving the planes

c. Third angle projection

d. Miter lines

e. Alternate positions

f. Dimensioning

2. Isometric

a. Axes

b. Positions

c. Non-isometric lines

d. Circles and arcs

3. Oblique

a. Axes

b. Positions

c. Cavalier style

d. Cabinet style

e. Circles and arcs

4. Perspective drawings

a. Station points

b. Vanishing points

c. Measurements

d. Circles

5. Freehand

a. Tools

b. Sketching straight lines

c. Classification of lines

d. Hidden lines

e. Circle and arc

f. Treatment of rounded forms and edges

B. Laboratory Projects

1. Draw orthographic projections of specified objects and dimension the various views.

2. Draw isometric and oblique views of specified objects.

3. Make perspective drawings of forestry buildings using both one and two point techniques.

4. Sketch orthographic, isometric and oblique views freehand, using only a pencil and coordinate paper.

IV. Visual Aids and Reproduction

A. Units of Instruction

1. Visual aids

a. Graphs

b. Charts

c. Nomographs

2. Reproduction

a. Printing processes

b. Tracings

c. Copies

B. Laboratory Projects

1. Draw a graph showing the vertical growth of a timber stand over a period of several years. Use data from a forestry text.

2. Draw bar and pie charts from data related to the field of forestry.
3. Construct a nomograph related to information from some field of forestry.
4. Trace on tracing paper a drawing that has previously been inked.
5. Students may be required to write a report on the several methods of reproducing drafting work.
6. Draw a flow diagram of a large sawmill operation showing buildings, machinery location, and yard layout. Dimension and label completely.

V. Mapping

A. Units of Instruction

1. Conventional symbols
    a. Vegetation
    b. Water
    c. Transportation routes
    d. Buildings
    e. Others
2. Mapping details
    a. Titles
    b. Scales
    c. Borders
    d. North points

3. Mapping techniques

   a. Horizontal traverses

   b. Profiles

   c. Topographic maps

B. Laboratory Projects

1. Plot a traverse using the protractor and scale method. Include all details necessary for registering the plot in the county Registry of Deeds office.

2. Draw a profile of a forest park road. Show such details as drainage, slopes, elevations, and a typical cross section of the finished road bed.

3. Make a topographic map of a large recreation area. Include contour lines, high points and water ways. Show water, vegetation routes and buildings with different colors and draw a legend to indicate these.

Texts and References

Arnold and others. Introductory Graphics.

French and Vierck. Fundamentals of Engineering Drawing.

----------. General Drafting.

Giesecke, Mitchell, and Spencer. Technical Drawing.

Hoelscher and Springer. Engineering Drawing and Geometry.

_________, _________, and Dobrovolny. Basic Drawing for Engineering Technology.

Huey. Introductory Drafting and Mapping Workbook for Students in Business and Science.

Luzadder. Basic Graphics.

Matson. Elements of Mapping.

Paré. Engineering Drawing.

Spencer. Basic Technical Drawing.

Springer, Bullen, Kleinhenz, and Palmer. Basic Graphics: Drawing and Descriptive Geometry.

Zozzora. Engineering Drawing.

Visual Aids

Chicago Board of Education, 228 North LaSalle Street, Chicago, Illinois.

The Draftsman. 11 minutes, 16 mm., black and white, sound.

Coronet Films, Coronet Building, Chicago, Illinois.

The Language of Graphs. 14 minutes, black and white.

Jam Handy Organization, 2900 East Grand Boulevard, Detroit, Michigan.

T-Squares and Triangles, Part 1 and 2.

Technical Lettering. Five filmstrips of 59, 53, 59, 77, and 57 frames, 35 mm., black and white.

McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, New York 10036.

According to Plan: Introduction to Engineering Drawing. 9 minutes, black and white.

Pictorial Sketching. 11 minutes, black and white.

Orthographic Projection. 18 minutes, black and white.

Selection of Dimensions. 18 minutes, black and white.

The Drawing and the Shop. 15 minutes, black and white.

Scales: Flat and Triangular. 35 mm., filmstrip, 37 frames, black and white.

Pennsylvania State College, Film Library, State College, Pennsylvania.

Drafting Tips. 28 minutes, 16 mm., black and white, sound.

Purdue Research Foundation, Lafayette, Indiana.

Freehand Drafting. 12 minutes, 16 mm., black and white, silent.

Testing of T-Square and Triangles. 11 minutes, 16 mm., black and white, silent.

Use of T-Square and Triangles. 20 minutes, 16 mm., black and white, silent.

Capital Letters. 21 minutes, 16 mm., black and white, sound.

Lowercase Letters. 17 minutes, 16 mm., black and white, silent.

Applied Geometry. 17 minutes, 16 mm., black and white, silent.

Ink Work and Tracing. 31 minutes, 16 mm., black and white, silent.

Sectional Views. 22 minutes, 16 mm., black and white, silent.

Pictorial Drawing. 22 minutes, 16 mm., black and white, silent.

FOREST BUSINESS METHODS

Hours Required

Class, 2; Laboratory, 3

Course Description

The organization and operation of the forest as a business enterprise. Basic terminology used in forest business is presented. This is a survey course designed to acquaint the student with record keeping, timber sales, management costs, and stumpage valuation. The importance of keeping records is stressed. Various kinds of taxes are identified and compared. The student learns how to report timber receipts and expenditures when making out a Federal Income Tax report. Laws as they relate to a forest enterprise are briefly considered. The state's forest laws are considered in some detail. The real estate business as related to the sale and leasing of a forest property is briefly discussed. The services that can be provided by consulting foresters, attorneys, bankers, accountants and business consultants are identified and discussed.

Major Divisions

	Hours Class	Hours Laboratory
I. The Nature of Forest Business	17	27

II.	The Nature of Taxation	5	6
III.	The Nature of Forest Law	5	6
IV.	The Nature of Real Estate	5	9
	TOTAL	32	48

I. The Nature of Forest Business

A. Units of Instruction

1. Forest Business Records
   a. Bookkeeping records
   b. Labor records
   c. Equipment records
   d. Inventory records
   e. Timber tract records
   f. Cutting and forest improvement records
   g. Maps
2. Timber sales
   a. Preparation of sale data
   b. Sealed bids
   c. Lump-sum sales
   d. Closing the sale
3. Miscellaneous income
   a. Minerals
   b. Leases
   c. Rights-of-way
4. Management costs
   a. Forest management costs

b. Insurance costs

c. Planting and cultural work costs

d. Fire prevention, pre-suppression and suppression costs

e. Interest and discount

f. Depreciation

5. Stumpage value and appraisal

a. Overturn method

b. Investment method

c. Fair market value

B. Laboratory Projects

1. Practical problems on:

a. Bookkeeping

b. Inventory of the equipment assigned to the Forest Technology Department or to a local forestry organization

c. Indexing a series of maps

d. Analysis of several kinds of timber sales

e. Determining the interest rate and depreciation on several pieces of heavy equipment

f. Calculating the stumpage value on a tract of timber using the overturn method

2. Field trip to the office of a large forestland owner to observe the methods of record keeping

II. The Nature of Taxation

A. Units of Instruction

1. Property tax
2. Sales tax
3. Income tax
4. Ad Valorem tax
5. Yield tax
6. Tax assessments

B. Laboratory Projects

1. Field trip to local Tax Assessor's office
2. Demonstration of tax assessing techniques
3. Calculating a hypothetical federal income tax for a forest enterprise
4. Comparison of an Ad Valorem tax to a yield tax for a forest property

III. The Nature of Forest Law

A. Units of Instruction

1. Contracts
   a. Basic requirements
   b. Objectives
   c. Provisions
   d. Options
   e. Leases
   f. Licenses
   g. Contracting

h. Trespasses

i. Review of state forest laws

B. Laboratory Projects

1. Field trip to the office of a local attorney

2. Compile a summary of the forest laws of the state

3. Case examples of how forest law applies to the management and operation of public or private forest agencies

IV. The Nature of Real Estate

A. Units of Instruction

1. Deeds

2. Sale contracts

3. Mortgages

4. Options

5. Recording

6. Title searching and abstracting of title

B. Laboratory Projects

1. Field trip to local Recorder of Deeds office

2. Make a title search of a forest property

3. Write an abstract of title for a forest property

4. Analyze deeds for forest properties

Texts and References

Babb. Business Law.

Bauer, et. al. Elementary Accounting.

Coughlin. Your Introduction to Law.

Duerr. Forest Economics.

Falk. Timber and Forest Products Law.

Ragan. Financial Recordkeeping for Small Stores.

Semenow. Questions and Answers on Real Estate.

----------. The Why and What of Bookkeeping.

Vardaman. Tree Farm Business Management.

WILDLIFE ECOLOGY

Hours Required

Class, 1; Laboratory, 4

Course Description

This course is an introductory course in wildlife ecology upon which the management of our wildlife resources are based. It is intended as a rounding-out process for the forest technician to assist in matching his forest management practices and basic ecological ideas with wildlife management practices. Emphasis is placed upon the terrestrial communities and predominantly on the wildlife of forest and range lands.

This course should provide a good balance of theory, wildlife populations and manipulations with practical, interesting field exercises or problems in order to have full impact. The field exercises can be manipulated or varied by regions to take maximum advantage of current species management in the area in which the course is given. No serious attempt should be made to duplicate the field exercises herein described since they are particularly adapted to a local area.

Major Divisions

	Hours Class	Laboratory
I. History of Wildlife Management and Values	1	4
II. The Biotic Community and Ecosystem	2	8
III. Wildlife Habitat	2	8
IV. Types of Game Animals and Birds in the Local Area	4	16
V. Characteristics of Wildlife Populations	2	4
VI. Methods of Studying Wildlife Populations	2	14
VII. Wildlife Management and Public Relations	3	10
TOTAL	16	64

I. History of Wildlife Management and Values

A. Units of Instruction

1. Early European attempts at management

2. Colonial Management

a. Extinction of some species

b. Establishment of Wildlife Protective Association

3. Establishment of game as a recreational unit

4. Value to local and state economy in dollars by species
5. Scientific value
6. Establishment of various funds for research and management

B. Laboratory Projects
   1. Make a field trip to the state Fish and Game headquarters or some other unit with management responsibilities and discuss how the unit operates. Economic operations should be stressed.
   2. Have each student submit a report on the operations of the state department or unit which was discussed

II. The Biotic Community and Ecosystem
   A. Units of Instruction
      1. Function of the ecosystem
      2. Hydrologic cycle
      3. Development of communities
         a. Climax vegetation
         b. Successional vegetation
      4. Biotic communities
         a. Faunal regions and characteristic game mammals
         b. Biomes and game mammals

B. Laboratory Projects

1. Using standard identification keys, identify several common game mammals and furbearers by skull characteristics
2. Using standard identification keys, identify several common upland game birds and waterfowl
3. Submit a report of the known habits and characteristics of the upland game birds and mammals studied
4. Identify furbearers and game animals by tracks, fur remnants, and habitat requirements under field conditions
5. Establish the identity of waterfowl and upland game birds by field observation

III. Wildlife Habitat

A. Units of Instruction

1. Carrying capacity
    a. Food requirements
    b. Effects on plant growth
    c. Dietary requirements
    d. Food values
    e. Disturbance of vegetation and food production
    f. Improvement of food supplies

g. Cover requirements

h. Water requirements

2. Limiting Factors

3. Hydroseres and aquatic animals

4. Grassland succession and game abundance

5. Forest succession and game abundance

B. Laboratory Projects

1. Investigate food plots placed by forest industries or game management agencies under field conditions

2. Discuss and report on species being managed, including the economic results in terms of numbers and utility of plots

3. If available, investigate big game animal exclosures as they affect vegetative growth

4. Construct brush piles in forest cutting areas and improve the fish habitat in a local stream or river through the creation of obstructions

IV. Types of Game Mammals and Birds in the Local Area

A. Units of Instruction

1. Farm game populations

a. Types of game found in the community

b. Feeding habits, cover requirements and breeding ground

c. Conservation practices and laws

2. Forest game and furbearers

    a. Types found in local area

    b. Food habits and breeding grounds

    c. Conservation practices and laws

3. Migratory game birds and waterfowl

    a. Types found in community and state

    b. Feeding and breeding grounds

    c. Federal and state laws

4. Fresh water fisheries

    a. Types of game fish in the state

    b. Habitat requirements and reproduction

    c. State laws and practices

5. Upland game birds

    a. Types found in the state

    b. Feeding and breeding areas and habits

    c. State laws and conservation practices

B. Laboratory Projects

1. With a representative of the state or federal wildlife agency, make a trip into areas where the various types of wildlife or evidences of wildlife can be seen such as a beaver pond, where discussions on furbearers, trout, waterfowl and forest management and their relationships can occur on site.

2. Report on the various management activities required for the reproduction and management of species associations

3. Make a field trip to a state or federal fish hatchery to discuss fishery management and research being conducted

4. In season, man a deer checking station, if available, and classify as to sex, condition, and age of the deer reported

5. Make an economic evaluation, if possible, on the businesses supported by big game species in the area

V. Characteristics of Wildlife Populations

A. Units of Instruction

1. Density

2. Structure

a. Clutch and litter size

b. Numbers of litters and clutches

c. Breeding characteristics

d. Sex ratios and age

e. Predation

f. Disease and parasites

g. Accidents

h. Weather

i. Starvation

j. Stress due to overpopulation

k. Hunting

3. Interaction of population characteristics

a. Turnover

b. Productivity and yield

c. Stability

d. Stocking methods and costs

e. Law and enforcement

B. Laboratory Projects

1. Visit a state or federal wildlife agency experimental area and determine the effects of various factors upon numbers of upland game birds and game mammals

2. Write a report on a selected species as to its characteristics and rate of survival in the local area

3. Make a field trip with a representative of the federal or state Fish and Game Department to observe various methods and costs of stocking game animals and game fish

VI. Methods of Studying Wildlife Populations

A. Units of Instruction

1. Census

a. Waterfowl

b. Tracks and sign

c. Sample area counts

2. Wildlife movement

a. Seasonal migration

b. Emigrations

c. Electronic tracking

B. Laboratory Projects

1. Using state Game Department aerial photographs or Fish and Wildlife Service photographs, make a census of waterfowl in a given waterway by direct enumeration

2. Submit a report on this method of census and discuss its accuracy and cost as opposed to field methods

3. Using the drive technique, make a direct enumeration census of rabbits in a given area

4. Using the drive technique, make a direct enumeration census of the deer population in a given area. This could be done in the fall to give an estimate of the sex ratio.

VII. Wildlife Management and Public Relations

A. Units of Instruction

1. Management problems

a. Native species management

b. Stocking techniques

c. Posting of lands

d. Law enforcement

2. Landowner problems

   a. Insurance requirements

   b. Vandalism

   c. Nuisance

   d. Conservation practices and game management

3. Sportsmen problems

   a. Understanding landowner problems

   b. Understanding game management costs, practices and enforcement

   c. License fees

4. Cooperative arrangements

   a. Rental and leasing

   b. Public acquisition

   c. Preserves

B. Laboratory Projects

1. Students should work in groups of two and conduct interviews with conservation officers, game biologists, at least five landowners, and five sportsmen. Construct a representative list of questions designed to assist the student in understanding the principles of game management and the underlying problems of landowner-sportsmen relations.

2. Split the class into four groups of two men each, each quarter to interview one of the above groups of people

3. Present a class report explaining the significance of the findings and possible changes which could be made to bring about more and better understanding

Texts and References

Allen. Our Wildlife Legacy.

Burt and Grossenheider. A Field Guide to the Mammals.

Cahalane. Mammals of North America.

Dasmann. Environmental Conservation.

__________. Wildlife Biology.

Graham. Natural Principles of Land Use.

Leopold. Game Management.

__________. A Sand Country Almanac.

Murie. Field Guide to the Mammals.

----------. Our Crowded Planet.

Peterson. A Field Guide to the Birds.

Trefethen. Wildlife Management and Conservation.

Trippensee. Wildlife Management, Volume I.

__________. Wildlife Management, Volume II.

----------. The Wildlife Society: Manual of Game Investigational Techniques.

Wing. Practices of Wildlife Conservation.

Visual Aids

Contemporary Films, Inc., 267 West 25th Street, New York, New York 10001

Quetico. 22 minutes, color, sound. The telling of a simple story about the virtues and significance of the wilderness area. A camping trip into the heart of the Quetico-Superior Wilderness which shows native animals in their natural habitat.

International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60604

Conservation and Balance in Nature. 18 minutes, color, sound. This film investigates the balance in natural ecological systems as related to what man is doing to his environment. A wide variety of animal adaptations are shown and their significance to community balance discussed.

McGraw-Hill Book Company, Text-Film Department, 330 West 42nd Street, New York, New York 10018

Plant and Animal Distribution. 28 minutes, color, sound. Defines population, community and ecosystem. Emphasizes plant and animal distribution in regions with favorable survival conditions.

World in a Marsh. 22 minutes, color, sound. Life forms which dwell beneath the water's surface; recording habits as well as habitat of water creatures. Visualization of the balance of nature plus an emphasis on the interrelationships between plants and animals.

Motion Picture Production, University of California Extension, Berkeley, California

Polar Ecology. 23 minutes, color, sound. Introduction to flora and fauna of Arctic regions which discusses food chains, predator-prey relationships and population fluctuations.

Ohio Department of Natural Resources, Information and Education Department, 1106 Ohio Departments Building, Columbus, Ohio 43215

Wildlife at Home. 14½ minutes, color, sound. This film lists the pollution of water, dumping of wastes, drainage of marshland and the thoughtless use of chemical pesticides as major problems in wildlife conservation.

U. S. Department of Agriculture, Forest Service, Motion Picture Service, Washington, D. C. 20250

Wildlife and the Human Touch. 19 minutes, black and white or color, sound. Shows characteristics of forest animals in their natural habitat and management by the Forest Service to make a better habitat.

Wisconsin Conservation Department, Film Library, Madison, Wisconsin.

Red 14. 28 minutes, color, sound. A fine presentation of game management. Shows the importance of conserving our game. Presents many scenes of various game research projects.

GENERAL COURSES

COMMUNICATION SKILLS

Hours Required

Class, 3; Laboratory, 0.

Course Description

The course places emphasis throughout on exercises in writing, speaking and listening. Analysis is made of each student's strengths and weaknesses. The pattern of instruction is geared principally to helping students improve skills in areas where common weaknesses are found. The time allotments for the various elements within major divisions will depend upon the background of the class.

A brief consideration of technical reporting is included early in the course because of its importance in the orientation of the technician to his development and use of communication skills.

Major Divisions

		Class Hours
I.	Communication and the Technical Specialist	2
II.	Sentence Structure	6
III.	Using Resource Materials	4
IV.	Written Expression	20
V.	Talking and Listening	10
VI.	Improving Reading Efficiency	6
	TOTAL	48

I. Communication and the Technical Specialist

Units of Instruction

1. Why the technical specialist must be proficient in the art of communication
2. Why written communication is an essential skill
    a. Statements and facts
    b. Expression of ideas
    c. Technical reporting
        (1) Formal
        (2) Informal
    d. Use of graphics to illustrate written communications
3. Why oral communication is an essential skill
    a. Person to person expression of ideas and thoughts
    b. Verbal reporting
4. Diagnostic tests

II. Sentence Structure

Units of Instruction

1. Review of basic parts of speech
2. What makes complete sentences
3. Use and placement of modifiers, phrases, and clauses
4. Sentence conciseness
5. Exercises in sentence structure

III. Using Resource Materials

Units of Instruction

1. Orientation in use of school library
    a. Location of reference materials, _Readers Guide_, etc.
    b. Mechanics for effective use
    c. Dewey Decimal System
    d. Library of Congress System
2. Dictionaries
    a. Types of dictionaries
    b. How to use dictionaries
    c. Diacritical markings and accent marks
3. Other reference sources
    a. Technical manuals and pamphlets
    b. Bibliographies
    c. Periodicals
    d. _Industrial Arts Index_
4. Exercises in use of resource materials
    a. _Reader's Guide_
    b. Atlases
    c. Encyclopedias
    d. Others

IV. Written Expression (emphasis on student exercises)

Units of Instruction

1. Diagnostic test

2. Paragraphs

    a. Development

    b. Topic sentence

    c. Unity of coherence

3. Types of expression

    a. Inductive and deductive reasoning

    b. Figures of speech

    c. Analogies

    d. Syllogisms

    e. Cause and effect

    f. Others

4. Written exercises in paragraph

5. Descriptive reporting

    a. Organization and planning

    b. Emphasis on sequence, continuity, and delimitation to pertinent data of information

6. Letter writing

    a. Business letters

    b. Personal letters

7. Mechanics

    a. Capitalization

    b. Punctuation--when to use

        (1) Period, question mark, and exclamation point

        (2) Comma

        (3) Semicolon

(4) Colon

(5) Dash

(6) Parentheses

(7) Apostrophe

c. Spelling

(1) Word division--syllabification

(2) Prefixes and suffixes

(3) Word analysis and meaning--context clues, phonetics, etc.

8. Exercises in mechanics of written expression

V. Talking and Listening (emphasis on student exercises)

Units of Instruction

1. Diagnostic testing
2. Organization of topics or subject
3. Directness in speaking
4. Gesticulation and use of objects to illustrate
5. Conversation courtesies
6. Listening faults
7. Taking notes
8. Understanding words through context clues
9. Exercises in talking and listening

VI. Improving Reading Efficiency

Units of Instruction

1. Diagnostic test

2. Reading habits

    a. Correct reading posture

    b. Light sources and intensity

    c. Developing proper eye span and movement

    d. Scanning

    e. Topic sentence reading

3. Footnotes, index, bibliography, cross references, etc.

4. Techniques of summary

    a. Outline

    b. Digest or brief

    c. Critique

5. Exercise in reading improvement

    a. Reading for speed

    b. Reading for comprehension

Texts and References

Baird and Knower. Essentials of General Speech.

----- and -------. General Speech, An Introduction.

Beardsley. Thinking Straight.

Bordeaux. How to Talk More Effectively.

Buckler and McAvory. American College Handbook of English Fundamentals.

Crouch and Zetler. Guide to Technical Writing.

Dean and Bryson. Effective Communication.

DeVitis and Warner. Words in Context: A Vocabulary Builder.

Gerber. The Writer's Resource Book.

Harwell. Technical Communication.

Kegel and Stevens. Communication: Principles and Practices.

Lee. Language Habits in Human Affairs.

McCrorie. The Perceptive Writer, Reader, and Speaker.

Marder. The Craft of Technical Writing.

Perrin and Smith. Handbook of Current English.

Roget. New Roget's Thesaurus of the English Language.

Schute and Steinberg. Communication in Business and Industry.

Stewart and others. Business English and Communication.

Strunk and White. The Elements of Style.

Thompson. Fundamentals of Communication.

Tracy and Jennings. Handbook for Technical Writers.

Warriner and Griffith. English Grammar and Composition: A Complete Handbook.

Witty. How to Become a Better Reader.

Young and Symonik. Practical English, Introduction to Composition.

Zetler and Crouch. Successful Communication in Science and Industry

Visual Aids

Coronet Films, Inc., Coronet Building, Chicago, Illinois 60601.

Improve Your Punctuation. 11 minutes, 16 mm., sound, black and white or color. Summary: Guides teacher and class work on punctuation trouble spots, covering the chief uses of the comma, the semi-colon, the colon, the question mark, and the quotation mark. Stresses the use of punctuation as a means of clarifying written communication.

National Education Television Film Service, Audio-Visual Center, Indiana University, Bloomington, Indiana 47405.

The Definition of Language. 29 minutes, 16 mm., sound. Produced by Henry Lee Smith. (Language in Linguistics Series).

Dialects. 29 minutes, 16 mm., sound. Produced by Henry Lee Smith. (Language in Linguistics Series).

How to Say What You Mean. 29 minutes, 16 mm., sound. Produced by S. I. Hayakawa. (Language in Action Series).

Language and Writing. 29 minutes, 16 mm., sound. Produced by Henry Lee Smith. (Language in Linguistics Series).

The Task of the Listener. 29 minutes, 16 mm., sound. Produced by S. I. Hayakawa. (Language in Action Series).

What is the Meaning? 29 minutes, 16 mm., sound. Produced by S. I. Hayakawa. (Language in Action Series).

DuArt Film Laboratories Inc., 245 West 55th Street, New York, New York 10019.

Effective Writing. 19 minutes, 16 mm., sound, black and white. U. S. Department of the Air Force. Order No. TF 1-5072. Summary: Describes communication from the concrete symbols of the cave man to the prolexities and ambiguities of some current government writing. Explains the rules for organizing material and gives various examples of ineffective writing with recommendations for improvement. May be borrowed from U. S. Air Force, Film Library Center, 8900 South Broadway, St. Louis, Mo. 63125.

Practical English Usage, Lecture 1: The Tools of Language. 30 minutes, 16 mm., sound, black and white. U. S. Department of Defense. Summary: Discusses the parts of speech--nouns, pronouns, verbs, adjectives, adverbs, conjunctions, prepositions, and interjections--and describes the use of words as different parts of speech.

Practical English Usage 1, Lecture 10: Writing Clear Sentences: Making Words Agree. 30 minutes, 16 mm., sound, black and white. U. S. Department of Defense.

Summary: Explains agreement of subject and verb, of pronoun and antecedent, and explains the need for agreement in special cases.

Practical English Usage I, Lecture 13: Dressing Up Sentences: Parallelism: Avoidance of Shifts. 30 minutes, 16 mm., sound, black and white. U. S. Department of Defense. Summary: Explains the use of parallel ideas in parallel form, coordinated ideas and correlative constructions, and incomplete parallelism in sentences; discusses avoidance of shifts in subject and verb and the use of the passive voice of verbs.

Practical English Usage I, Lecture 14: Dressing Up Sentences: Word Economy (Word Reduction). 30 minutes, 16 mm., black and white. U. S. Department of Defense. Summary: Discusses the elimination of superfluous words and repetition in sentences, and the use of double negatives, the reduction of clauses to phrases and phrases to words, and the use of suitable words.

Practical English Usage I, Lecture 15: Dressing Up Sentences: Variation. 30 minutes, 16 mm., sound, black and white. U. S. Department of Defense. Summary: Explains how to vary a sentence by beginning with a transposed appositive, a modifier, or a phrase; discusses the use of subordination, complex sentences, and variation in sentence length.

Practical English Usage I, Lecture 16: Dressing Up Sentences: Vocabulary. 30 minutes, 16 mm., sound, black and white. U. S. Department of Defense. Summary: Explains how to avoid trite expressions and mixed figures of speech in a sentence and discusses the use of idiomatic and appropriate words.

ELEMENTARY BUSINESS MANAGEMENT

Hours Required

Class, 2; Laboratory, 3

Course Description

A study of the underlying principles of the organization and management of business enterprises. In addition, specialized business activities such as data processing, application of computers, business ethics, personnel management, marketing, credit management, and production control are introduced and utilized from a pragmatic standpoint.

As the various topics are introduced, the meaning and underlying principles of each and the role each plays in forest technology should be considered as much as possible before the subject proper is explored.

As part of the course, students should be encouraged to seek out, examine, and interpret selected forest enterprises with reference to their organizational and managerial effectiveness.

Guest lecturers from local industries are invited to discuss practical illustrations of principles under consideration in the course. Laboratory sessions are used to allow time for questions and student participation.

Field trips to area establishments are conducted to observe offices and procedures, as well as to hear presentations by management personnel.

In addition to guest lecturers and trips at appropriate times, the laboratory sessions involve workbook study and discussion of those topics presented in the lectures.

Major Divisions

		Hours Class	Hours Laboratory
I.	Introduction to Business and Our Economic System	2	3
II.	Forms of Business Ownership	3	3
III.	The Organizational Structure and Management Processes of Business	4	9
IV.	Tools of Decision-Making	4	6
V.	Labor-Management Relations	4	6
VI.	Acquisition and Organization of the Factors of Production	5	9
VII.	The Marketing Process	8	9
VIII.	Institutions Affecting Business	2	3
	TOTAL	32	48

I. Introduction to Business and Our Economic System

A. Units of Instruction

1. Why business exists

a. Historical need and growth of business

b. Classifications of business organizations

c. Opportunities in the business field

2. The American economic system

a. The nature of economics

b. Measures of economic activity

(1) Gross national product

(2) National income

(3) Disposable personal income

(4) Employment and unemployment

c. Characteristics of modern business

(1) Specialization

(2) Interdependence

(3) Mass production

(4) Business cycles

B. Laboratory Project

In the introductory unit, the student workbook provides the basis for the laboratory, with additional local illustrations by the instructor and students

II. Forms of Business Ownership

A. Units of Instruction

1. The small business enterprise

a. Single proprietorship and partnership

b. Corporations and the joint stock company

c. Business trusts, joint ventures and cooperatives

2. Problems of owning and operating your own business

3. Sources of business information

a. Private

b. State

c. Federal

4. The small business and the future

B. Laboratory Projects

1. Complete the workbook unit

2. Visit a local proprietorship and a local partnership, if available; this will add much information and realism to the nature and benefits of each type of organization. A written report on information obtained should be prepared by each student.

III. The Organizational Structure and Management Processes of Business

A. Units of Instruction

1. Selecting the form or organization

a. Concepts of organizational planning

b. Formal and informal organizations

2. Line and staff function--organizational charts

3. General management functions

a. Management guides

b. Qualities of leadership

4. Office administration

a. Physical facilities

b. Office operations

c. Automation and its affect on the office

B. Laboratory Projects

1. Complete the workbook unit

2. Guest speaker from a local corporation to discuss organizational charts, procedures and the advantages of each

IV. Tools of Decision-Making

A. Units of Instruction

1. Accounting records and business

a. The function of accounting

b. Types of data furnished by the accounting department

(1) Income statement

(2) Balance sheet statement

(3) Tax statements

c. The use of budgets

(1) Analysis of budgets

(2) Budgeting and linear programming

2. Research and statistics

a. Research aids in decision-making

b. Forecasting

c. Use of statistical data--averages

(1) Mean

(2) Median

(3) Mode

3. Risk and uncertainty

a. Decision-making under risk and uncertainty

b. Uncertainty precautions--defenses against

B. Laboratory Projects

1. Complete the workbook unit

2. Visit the accounting department of a local business to see forms and procedures used; a written report is required of each student

V. Labor-Management Relations

A. Units of Instruction

1. Personnel management

a. Job analysis

b. Employee selection and placement

c. Employee training

2. Wage and salary administration

a. Theory of wages

b. Methods of wage payments

c. Fringe benefits

d. Maintaining high morale

3. The labor movement today

a. Growth and development of labor unions

b. Labor legislation

c. Collective bargaining

d. Settlement of labor disputes

B. Laboratory Projects

1. Complete the workbook unit

2. Invite the personnel manager of a local business to discuss their application of various management techniques

3. If a local industry is unionized, a guest speaker from the local union will add to the students' understanding of labor-management relations

VI. Acquisition and Organization of the Factors of Production

A. Units of Instruction

1. The acquisition of capital

a. The role of capital

b. The amount of capital to use

c. The basis for credit

d. Sources of credit

(1) Security exchanges

(2) Long-term capital securities

(3) Businesses and banks

(4) Public and other sources

2. The acquisition of a business
    a. Choice of location
    b. Buying a business
    c. Renting a business
    d. Business plant layout
    e. Costs and returns as related to size of business
3. Factors of production
    a. Plant operational layout
    b. Characteristics of production
        (1) Raw material purchasing
        (2) Inventory control
    c. Production processes
    d. Production control
    e. Horizontal vs. vertical diversification production processes

B. Laboratory Projects
1. Complete the workbook unit
2. Invite a representative of a local bank to discuss capital sources and limitations
3. A field trip to a local production unit to study layout, materials handling, and production control. A written report from each student will aid his understanding of the principles observed.

VII. The Marketing Process

A. Units of Instruction

1. Functions of marketing--channels of distribution

2. Costs of marketing

   a. Pricing in merchandising

   b. Pricing by wholesalers--market spread between wholesale and retail levels

   c. Expense control in merchandising and retailing

3. The consumer market

   a. Customer relations

   b. Merchandising

      (1) Retailer

      (2) Wholesaler

   c. Service businesses

   d. Characteristics of retailing

      (1) Classification of retail outlets

      (2) Functions performed by the retailer

   e. Market research

4. Sales management

   a. Personal selling in modern business

   b. Fundamentals of selling

   c. Types of sales organizations

   d. Trends in sales management

B. Laboratory Projects

1. Complete the workbook unit
2. Visit a local lumber yard to learn pricing policies, sales plans and promotional techniques. A report from each student is required.
3. Invite the sales manager of a local industry to discuss his sales organization

VIII. Institutions Affecting Business

A. Units of Instruction

1. Government and Business
   a. The function of government
   b. Government regulation of business
   c. Government aids to business
   d. Taxation
2. Business law and ethics
   a. Modern business and the law
   b. Ethics and morality in business practice
   c. Making business more professional

B. Laboratory Projects

1. Complete workbook unit
2. Appropriate discussion and illustration by the instructor

Texts and References

Broom and Longenecker. Small Business Management.

Eels. The Meaning of Modern Business.

Glos and Baker. Introduction to Business.

__________ and __________. Teacher's Manual for Introduction to Business.

__________ and __________. Workbook for Introduction to Business.

Hart. Business in a Dynamic Society.

Kelley and Lawyer. How to Organize and Operate a Small Business.

Newman and Summer. The Process of Management.

Shilt and Wilson. Business Principles and Management.

__________ and __________. Teacher's Manual for Business Principles and Management.

__________ and __________. Workbook for Business Principles and Management.

Yoder. Personnel Management and Industrial Relations.

Visual Aids

Business Education Films, 4607 16th Avenue, Brooklyn 4, New York

It's Good Business. 35 minutes, 16 mm., 115 frames.

Modern Talking Picture Service, Inc., 235 Stuart Street, Boston 16, Massachusetts

Credit--Man's Confidence in Man. 30 minutes, 16 mm., sound.

PERSONNEL MANAGEMENT

Hours Required

Class, 3; Laboratory, 0

Course Description

This course covers the basic principles of organization for effective leadership and personnel management. The history and development of personnel management in our industrial society will be explored as they pertain to selection of personnel; delegation of responsibility; psychology of motivating, training and directing people; morale; and dealing with unions and other organizational groups. One of the major objectives of the course is to provide the student with a knowledge of those personnel management principles and practices which have proved sound in the light of research and company experiences. Extensive use of case studies will be made.

Major Divisions

		Class Hours
I.	Role of Personnel Management	1
II.	The Personnel Program	2
III.	Organization of Personnel	2
IV.	Organization of the Job	3
V.	Staffing the Organization	2

VI.	Selection of Personnel	2
VII.	Orientation and Training	4
VIII.	Changes in Employee Placement	2
IX.	Supervisory Development	2
X.	Performance Evaluation	3
XI.	Motivation	4
XII.	Communications	2
XIII.	Supervision	3
XIV.	The Working Group	1
XV.	Employee Adjustment and Morale	3
XVI.	Discipline	3
XVII.	Union and Its Role	2
XVIII.	Union-Management Relations	2
XIX.	Remuneration	3
XX.	Security of Employees	2
	TOTAL	48

I. Role of Personnel Management

Units of Instruction

1. Contributions of personnel management
2. Nature and development of the personnel field
3. Personnel management as a field of study

II. The Personnel Program

Units of Instruction

1. Management process

2. Nature of the personnel program

3. Developing the program

4. Translating the personnel program into practice

III. Organization of Personnel

Units of Instruction

1. Nature and function of an organization

2. Organizational structure

3. Line and staff relationships

4. Organizational and human behavior

IV. Organization of the Job

Units of Instruction

1. Nature and function of the job

2. Work organization and the job

3. Describing the job

4. Job analysis

V. Staffing the Organization

Units of Instruction

1. Anticipating personnel requirements

2. Locating qualified personnel

3. Policies relating to recruitment

VI. Selection of Personnel

Units of Instruction

1. Role of personnel program in selection

2. Employment interviewing

3. Other methods of selection

4. Employment decision

VII. Orientation and Training

Units of Instruction

1. Orientation
2. Training program
3. Psychology of learning
4. Evaluation of training effectiveness

VIII. Changes in Employee Placement

Units of Instruction

1. Nature of placement changes
2. Seniority considerations
3. Policies and procedure relating to placement changes

IX. Supervisory Development

Units of Instruction

1. Nature of supervisory development
2. Supervisory development program
3. Methods of developing supervisors
4. Administering the development program

X. Performance Development

Units of Instruction

1. Process of evaluation
2. Establishing an evaluation program
3. Utilization of performance evaluation data

XI. Motivation

Units of Instruction

1. Traditional and modern views
2. Human needs--Maslow's Theory
3. Satisfying human needs
4. Organizational environment and motivation

XII. Communications

Units of Instruction

1. Communications process
2. Communication and organizational structure
3. Communication media
4. Barriers to communications
5. Developing and maintaining effective communications

XIII. Supervision

Units of Instruction

1. Leadership in the organization
2. Supervisor's role
3. Characteristics of the effective supervisor
4. Improving supervisory leadership

XIV. The Working Group

Units of Instruction

1. Characteristics of work groups
2. Factors influencing behavior of work groups

XV. Employee Adjustment and Morale

Units of Instruction

1. Problems of employee adjustment
2. Symptoms of emotional problems
3. Employee counseling
4. Developing good morale

XVI. Discipline

Units of Instruction

1. Disciplinary actions
2. Employee grievances
3. Formal grievance procedures

XVII. Union and Its Role

Units of Instruction

1. Function of the union
2. Growth of organized labor
3. Union organization and leadership
4. Current problems and goals of unions

XVIII. Union-Management Relations

Units of Instruction

1. Developing bargaining relationship
2. Union security and recognition
3. Agreement negotiations
4. Government controls

XIX. Remuneration

Units of Instruction

1. Wage and Salary administration
2. Financial incentives

3. Job evaluation

XX. Employee Security

Units of Instruction

1. Health and safety
2. Fringe benefits
3. Retirement plans

Texts and References

----------. American Labor Movement.

Cruden and Sherman. Personnel Management.

__________ and __________. Readings in Personnel Management.

----------. Dictionary of Occupational Titles.

Ellis. The Transfer of Learning.

Gagne. The Conditions of Learning.

----------. Industrial Relations and Wage Terms.

Maier. Principles of Human Relations.

Maslow. Motivation and Personality.

Parkinson. Parkinson's Law.

Whyte. Men at Work.

Visual Aids

General Electric Company. (A local dealer may be contacted for procurement of this film.)

Inner Man Steps Out. 35 minutes. Illustrates individual differences in the motivation of employees.

McGraw-Hill Book Company, Text-Film Department, 330 West 42nd Street, New York, New York 10018.

Emotional Health. 20 minutes. Deals with common emotional problems, effects of prolonged emotional problems, and treatment required as any physical ailment.

Employment Interview. 11 minutes. Employment interview illustrated step by step. The function of supervisors in the interview is portrayed.

The Grievance. 30 minutes. Demonstrates how the rights of an employee are protected through the various stages of the grievance procedures.

Profession of Management Institute, 524 4th Avenue, Palo Alto, California.

Profession of Management Series. Films are available on the subjects of: the processes of management; planning; organizing; and controlling.

Roundtable Productions, Beverly Hills, California

Breaking the Delegation Barrier. The film treats the problem to help supervisors overcome fears that act as barriers to delegation.

Stuart Reynold Production, 195 South Beverly Drive, Beverly Hills, California

Eye of the Beholder. 25 minutes. Demonstrates the necessity of establishing two-way communication.

Stresses importance of perception in the communication process and how people pass judgment on other people.

ELEMENTS OF SOCIAL SCIENCE

Hours Required

Class, 3; Laboratory, 0

Course Description

This course is built on the assumptions that (1) the student will have had little or no prior exposure to the social sciences and (2) the orientation should be practical; that is, it should convey immediately useful concepts and information even at the expense of a scientific rigor and closure. Thus it may be seen in the format of the course that the student will be presented clusters of ideas intended to provide insight into the psychological growth process and the development of personality in the individual; structuring and functioning of social groups, communities and society; the antiquity, characteristics and content of human culture as it influences self in society; and an orderly presentation of some of the problems generated by accelerating social change, such as, technological unemployment, overpopulation, decline of rural society, the development of super-cities, and individual variances, such as crime, delinquency, mental illness, alcoholism, and the effects of inadequate or inappropriate environment.

There are no entirely suitable textbooks for a course of this nature. Listed in the Texts and Reference section of this outline are some suitable paperback readings, reprints from the Scientific American and other social science journals, and films apt for the subject matter. These may be used according to the competence and interests of the particular instructor. In smaller classes where discussion is possible, fewer topics may be explored at some gain to the student in terms of insight. In rather large classes, a broader variety of topics will be covered more superficially. Because the subject matter is presented in topical fashion and is not integrated over the whole course, it is recommended that frequent quizzes be administered to evaluate the students' grasp of the topic before proceeding. A final examination could fairly assess, at a relatively superficial level, the students' grasp of the entire subject area.

Major Divisions

		Class Hours
I.	Introduction to the Social Sciences	3
II.	Man	3
III.	Cultures of Man	3
IV.	The Individual	6

V.	Individuals in Groups	5
VI.	Societies	2
VII.	Social Organization	5
VIII.	Stratification of Society	4
IX.	Social Controls	3
X.	Communities	3
XI.	Problems of Individuals	3
XII.	Problems of Societies	5
XIII.	General Review	3
	TOTAL	48

I. Introduction to the Social Sciences

Units of Instruction

1. Definition of subject matter
    a. Anthropology
    b. Sociology
    c. Psychology
    d. Psychiatry
    e. Relationship to history, economics, and political science
2. Definition of ideas
    a. Culture
    b. Society
    c. Personality
3. Discussion of acquisition of information
    a. Statistical information

b. Human behavior

4. Meaning of new knowledge

   a. Consequences of recently formed concepts

   b. Film: Saga of Western Man: 1964

II. Man

Units of Instruction

1. Origins and descent

   a. Biological attributes of man

   b. Distinguishing characteristics

   c. Advantages

2. Races

   a. Distribution

   b. Interbreeding species

3. Social-cultural heritage

   a. Antiquity of societies and human culture

   b. Necessity of some social-cultural arrangements

III. Cultures of Man

Units of Instruction

1. Culture as a shared, learned behavior

   a. Common to all members of society

   b. Manner of transmission

   c. How culture is learned

   d. Culture is relatively changeless

2. Definition of ideas

   a. Artifacts

b. Language

c. Value

d. Belief

e. Sanction

f. Norms

g. Others

3. Culture change

a. Means

(1) Innovation

(2) Diffusion

(3) Invention

b. Cultural lag

c. Variations of culture over time and space

d. Films on alien cultures conveying the idea of the integrity of other cultures as a basis for discussing our own

4. Culture and the individual

IV. The Individual

Units of Instruction

1. Behavior of people

a. Why they behave as they do

b. Personality inadequacy

c. Film: <u>Feelings of Rejection</u>

2. Personality development

a. Maturation

b. Socialization

c. The unconscious

d. Relationship of self and society

e. Role and status

f. Learning and growth

(1) Physically

(2) Mentally

(3) Films: <u>Learning and Behavior</u>; <u>Learning and Growth</u>

3. Deviancy--failure of the maturation process

4. Self-fulfilling prophecy

V. Individuals in Groups

Units of Instruction

1. Groups

a. Characteristics and functions

b. Primary and secondary

c. Limits on size and organization

2. Definitions of human aggregates

a. Crowd

b. Mob

3. Primary group

a. Shaping and supporting the individual

b. Film: <u>Men at Work</u>

4. Organization of groups

a. Authoritarian and democratic

b. For work

c. For recreation

d. Film: <u>An Experimentally-Produced Social Problem in Rats</u>

VI. Societies

Units of Instruction

1. Definition of society

2. Distinctions between society and culture

3. Examples of societies

4. Film: <u>Berber Country</u>

VII. Social Organization

Units of Instruction

1. Structure of societies

2. Discussion of the functions of institutions

    a. Economic

    b. Educational

    c. Religious

    d. Political-military

    e. Recreational

    f. Scientific

    g. The family

3. A typical institution--kinds of social activity that are assignable to it

4. Function of the family in society

    a. Procreation and socialization of the young

b. Basic identification for members

c. Approved sexual association for partners

d. Nuclear and extended families

e. Deficiencies in modern society

f. Film: Angry Boy

B. Bureaucracy

a. Means of organizing industrial societies

b. Hierarchical structure

c. Characteristics and functions

VIII. Stratification of Society

Units of Instruction

1. Description of class structure

a. Social

b. Economic

2. Minority groups

a. Ethnic distinctions

b. Racial distinctions

3. Social mobility

a. Horizontal

b. Vertical

4. Power Structure

IX. Social Controls

Units of Instruction

1. Conformity

2. Formal and informal social controls

a. Folkways

b. Mores

3. Normative and sanctions systems

4. Methods of managing deviants

a. Courts

b. Hospitals

c. Prisons

d. Clinics

e. Supervision

5. Typical deviations

a. Characteristic behavior

b. Probable causes

X. Communities

Units of Instruction

1. Historic origins

2. Characteristics and tendencies in growth

3. Megalopolis

4. Changing rural-urban population balance

5. Obsolescence of cities and towns--causes and effects

a. Political

b. Economic

6. Films: <u>Changing City</u>; <u>The Uprooted Nation</u>

XI. Problems of Individuals

Units of Instruction

1. Effects of inadequate preparation for:
    a. Adult life
    b. Community life
    c. Unexpected experiences
        (1) Technological unemployment
        (2) Changes in life style
2. Addictions and alcoholism
3. Mental illness
    a. Kinds
    b. Implications
4. Crime and delinquency
    a. Antisocial and asocial behavior
    b. Evaluating normality and abnormality

XII. Problems of Societies

Units of Instruction

1. Modification and antiquity of culture
2. Technological unemployment
    a. Introductory film: <u>The Skilled Worker</u>
    b. Beyond the control of the individual
    c. Retraining for re-employment
        (1) Age
        (2) Sex
        (3) Location of residence
3. Chronic poverty and welfare
    a. The impoverished way of life

b. Intentions vs. achievement of welfare programs

c. Problem of changing the culture of poverty

4. Population

a. World population trends

b. Prospective food supply

c. Present problems in areas of major under-nourishment

d. Future prospects in terms of

(1) Land use

(2) Communications

(3) Transportation

e. Birth control

5. Wars

a. Implications of nuclear war for the future

b. Limited war--Viet Nam

6. The affluent society

XIII. General Review

Units of Instruction

1. Review of main concepts taught in the course

2. Review of terminology

a. Personality

b. Culture

c. Society

d. Anthropology

e. Psychology

f. Sociology

g. Behavior

h. Rewards and punishment

i. Groups

j. Institutions

k. Social classes

l. Ethnic and racial minorities

m. Social controls

3. Culture of man

a. A creation of man to facilitate his living in society

b. Most troubles of the world come from imperfect learning of it

c. Accelerating social changes today

Texts and References

Adams. "The Origin of Cities."

Bell. "The Racket-Ridden Longshoremen."

Bettelheim. "Individual and Mass Behavior in Extreme Situations."

Braidwood. "The Agricultural Revolution."

Butterfield. "The Scientific Revolution."

----------. Current Perspectives on Social Problems.

Deevey. "The Human Population."

Dobzhansky. "The Present Evolution of Man."

Gruenberg. "The Epidemiology of Mental Disease."

Harlow. "Social Deprivation in Monkeys."

Hawley. "Ecology and Human Ecology."

Levine. "Stimulation in Infancy."

Lewis. "The Culture of Poverty."

Mead. "The Social Self."

Meissner. Poverty in the Affluent Society.

----------. Minority Problems.

Palmer. Understanding Other People.

Sahlins. "The Origin of Society."

Sherif. "Experiments in Group Conflict."

Taeuber. "Residential Segregation."

Vidich and Bensman. Small Town in Mass Society.

Ward. The Rich Nations and the Poor Nations.

Warner. "What Social Class is in America."

Washburn and Devore. "The Social Life of Baboons."

Visual Aids

Carousel Films, 1501 Broadway, Suite 1503, New York, New York 10036

Learning and Behavior. 16 minutes, black and white, sound.

Churchill Films, 662 North Robertson Boulevard, Los Angeles, California 90069

Berber Country. 16 minutes, black and white, sound.

The Changing City. 16 minutes, black and white, sound.

The Uprooted Nation. 22 minutes, black and white, sound.

Coronet Films, Coronet Building, 65 East South Water Street, Chicago, Illinois 60601

The Human Body: The Nervous System.

Encyclopedia Britannica Films, 1150 Wilmette Avenue, Wilmette, Illinois 60091

Giant People (The Watussi). 11 minutes, black and white, sound.

Learning and Growth. 10 minutes, black and white, sound.

Indiana University, Audio-Visual Center, Bloomington, Indiana

Nervous System in Man. 18 minutes, color, sound.

International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60604

Angry Boy. 33 minutes, black and white, sound.

McGraw-Hill Book Company, Film-Textbook Division, 330 West 42nd Street, New York, New York

Men at Work. 27 minutes, black and white, sound.

Saga of Western Man: 1964. 54 minutes, color, sound.

The Skilled Worker. 27 minutes, black and white, sound.

Superfluous People. 54 minutes, black and white, silent.

National Film Board of Canada, 680 5th Avenue, New York, New York

Feelings of Rejection. 23 minutes, black and white, sound.

Psychological Cinema Register, Audio-Visual Aids Library, Pennsylvania State University, University Park, Pennsylvania 16802

An Experimentally-Produced Social Problem in Rats. 11 minutes, black and white, silent.

LIBRARY FACILITIES AND CONTENTS

Dynamic developments causing rapid changes in the technological sciences and practices make it imperative that the student of any technology learn to use the library.

In any evaluation of a technology teaching program, the qualifications of the librarian, the physical facilities, the quality, quantity, pertinency of content and organization of the library give a tangible indication of the strength of a program.

Instruction for forest technology students should be library-oriented so that they learn the importance of knowing where they can find the information relative to any of the various courses which they are studying. They should learn how to use the library and should form the habit of using it as a tool in the learning process. This knowledge helps develop a professional attitude in the student and further teaches him to depend on libraries as a means of keeping abreast of the new developments in the field of forest technology.

Instructors of all courses should constantly keep the student aware of the extent to which a library contains useful information which can be helpful as a part of the study in his curriculum. Planned assignments of library projects calling for the student to go to the library and prepare information on persons and subjects in his courses enable him to understand the resources available and how they relate to forest technology. Open book examinations requiring the use of the library provide excellent and objective experience for students as they work under the incentive of the examination and the limited time available. Their understanding of their own competency in library skills becomes realistically clear to all students.

The growth and success of the graduate forest technician will depend in large measure upon his ability to keep abreast of changes in his field. Libraries are information source agencies with trained personnel who classify resource data and assist those seeking it to find pertinent information quickly.

For these reasons, a central library under the direction of a professional librarian is important to the success of teaching technology curriculums. Most instructors have private libraries in their offices from which they may select books of special interest to discuss during personal conferences with students and thereby stimulate interest in related literature. However, a central library under the direction of a professional librarian insures the acquisition and cataloging of the library content according to accepted practice and provides the mechanics for location of reference materials by the use of systematic card files. The central library also provides the mechanics for lending books to students in a controlled and orderly manner typical of the libraries he will encounter in the course of solving problems in his employment after leaving school.

Study space with suitable lighting and freedom from outside distraction must be provided in the library for short-term study of reference data and provisions for the checking out of reference materials for out-of-library use should be systematic and efficient.

Library Staff and Budget

The head librarian usually reports to the dean or director of the school and has full faculty status.

The American Library Association standards state that, "Two professional librarians are the minimum number required for effective service in any junior college with an enrollment up to 500 students (full time equivalent). In addition there should be at least one non-professional staff member. The larger the more appropriate it will be to employ a higher proportion of non-professional staff members. Great care should be taken that professional staff members do not spend their time doing work that is essentially clerical because this is not only wasteful but also demoralizing."

According to the American Library Association, the library budget should be determined in relation to the total budget of the institution for educational and general purposes. The amount to be allocated to the library should be based on a program of optimum library service in support of the goals of the school. The execution of the library program, as it is outlined in these standards, normally requires a minimum of five per cent of the total educational and general budget. This minimum percentage is for a well-established library with an adequate collection. It would be augmented if there is a rapid increase in the student body or in the course offerings. It would again need to be increased if the library is responsible for an audio-visual program. The library budget for a newly organized institution should be considerably higher than five per cent.

Another criterion for the library budget approved by the American Library Association is that the funds for acquiring new library materials should be equal to or exceed the cost of the total library staff. This is for established libraries. The expenditure for acquisition of new library materials should be substantially greater for libraries which are just starting or when major additions of curriculums are being made.

Library Content

The content of the library must adequately provide the literature containing the knowledge encompassed by all subjects in the curriculum and extending somewhat beyond the degree of complexity or depth encountered in classroom activities. Literature dealing with unusually highly specialized aspects of a subject may be acquired as needed or may be borrowed by the librarian from more comprehensive libraries.

The library content should meet the needs of both full-time students, and part-time students pursuing supplemental courses designed to upgrade or update their occupational knowledge and skills. In addition, it should serve the day-to-day needs of the instructional staff as they keep their own technical knowledge abreast of new developments pertinent to their special field of applied science.

In view of the highly specialized nature of the library content for Forest Technology, it is recommended that the department head or chief instructor in the forest technology division be a part of a library committee and be responsible for providing or finally approving the reference materials for forest technology and related courses. The librarian, as chairman of such a committee, may be expected to take the initiative in assisting the head of the department by keeping him informed of new literature and library materials which become available. The librarian should also take the initiative in calling a meeting or informally consulting the department head in order to acquire appropriate library content for the forest technology program within the limitations of the budget and the overall consideration of total library needs.

The library content may be classified into basic encyclopedic and reference index material, reference books pertinent to the technology, periodicals and journals, and visual aids. Each will be discussed separately.

Encyclopedic and Reference Index Material

This portion of the library content is basic in that it contains the broadly classified and organized cataloging of all available knowledge pertinent to the objectives served by the library and the program which it supports.

The following is a typical list of general reference material which might be found in a publicly-controlled technical institute. Though many are general, all have some bearing on forest technology. It is suggested that some or all of these might appropriately be part of the library which supports a forest technology program. This list is not presented as being complete since there are other references and indices which appropriately might support a forest technology program. It is presented as an example. It is suggested that upon ordering any of these references for a library collection, the latest edition be specified.

Guides to Reference Books

Cook, M. G. The New Library Key. New York: H. W. Wilson.

Gates, Jean Key. Guide to the Use of Books and Libraries. New York: McGraw-Hill Book Company, Inc.

Murphy, Robert W. How and Where to Look it Up: A Guide to Standard Sources of Information. New York: McGraw-Hill Book Company, Inc.

Russell, H. G., Shore, R. H., and Moen, B. E. The Use of Books and Libraries. Minneapolis: University of Minnesota Press.

Shores, Louis. Basic Reference Books. Chicago: American Library Association.

Winchell, G. M. Guide to Reference Books. Chicago: American Library Association.

General Encyclopedias

Columbia Encyclopedia. New York: Columbia University Press.

Encyclopedia Americana. New York: Americana Corporation.

Encyclopedia Britannica. Chicago: Encyclopedia Britannica, Inc.

Dictionaries

American College Dictionary. New York: Random House, Inc.

Roget's International Thesaurus. New York: Thomas Y. Cromwell.

Evans, Bergen and Cornelia. _A Dictionary of Contemporary American Usage_. New York: Random House, Inc.

Webster's Dictionary of Synonyms. Springfield, Massachusetts: G. and C. Merriam Company.

Webster's Third New International Dictionary. Unabridged. Springfield, Massachusetts: G. and C. Merriam Company.

Year Books

American Book of the Year, 1924 to date. New York: Americana Corporation.

Britannica Book of the Year, 1938 to date. Chicago: Encyclopedia Britannica, Inc.

Facts on File. New York: Person's Index, Inc., 1940 to date.

McGraw-Hill Yearbook of Science and Technology. New York: McGraw-Hill Book Company, Inc.

New International Year Book, 1907 to date. New York: McGraw-Hill Book Company, Inc.

The Forest Directory. Washington, D. C.: American Tree Association, 1924 to date.

Science and Technology

Biological Abstracts

Chamber's Technical Dictionary. New York: The MacMillan Company.

Henderson, Isabella F. and W. D. A Dictionary of Scientific Terms. New York: D. Van Nostrand Company.

Hutchinson's Technical and Scientific Encyclopedia. New York: The MacMillan Company.

McGraw-Hill Encyclopedia of Science and Technology. New York: McGraw-Hill Book Company, Inc.

Merrill, Anthony F. Our Eastern Playgrounds. New York: McGraw-Hill Book Company, Inc.

Van Nostrand's Scientific Encyclopedia. New York: D. Van Nostrand Company.

World Forest Products Statistics: 1946-1955. Rome, Italy: Food and Agriculture Organization of the United Nations, 1958.

General Indices

Reader's Guide to Periodical Literature, 1900 to date. New York: H. W. Wilson Company.

International Index to Periodicals, 1907 to date.

Special Indices

Applied Science and Technology Index, 1958 to date. (formerly Industrial Arts Index).

Book Review Digest. New York: H. W. Wilson Company, 1905 to date.

Essay and General Literature Index. New York: H. W. Wilson Company, 1934 to date.

New York Times Index. New York: New York Times, 1913 to date.

Ulrich's Periodical Directory. New York: R. R. Bowker Company.

Indices to Bulletins and Pamphlets

United States Government Publications: Monthly Catalog, 1895 to date. Washington, D. C.: Government Printing Office.

Technical Journals, Periodicals and Trade Magazines

The importance of this portion of the library content has previously been emphasized. These publications represent the most authoritative, most recent and most complete presentation of the knowledge and new application of principles to a specific area of applied science. It is essential that both instructors and students make frequent and systematic use of such literature to keep their technological information up to date. It is suggested that careful selectivity be exercised in retaining and binding or in microfilming these periodicals for permanent library use. Some represent important reference materials which may be used for many years. However, some, especially the trade journals, should not be bound for permanent reference material because the really important material which they contain will usually become a part of a handbook or a text book or will be presented in a more compact or useable manner within a year or two.

The following is a typical list of technical journals, periodicals and trade magazines which would be desirable in the library of a publicly-controlled technical institute. This list is given as an example which may suggest appropriate publications to those who are concerned with this type of content for a library supporting a forest technology teaching program.

GENERAL INTEREST

American Forests--American Forestry Association

American Nurseryman

American Tree Farmer and Forestry Digest

A.P.A. Quarterly--American Pulpwood Association

Audubon--National Audubon Society

Bio-Science--Institute of Biological Sciences

Canadian Forest Industries

Chain Saw Age

Christmas Tree Growers Council Bulletin--Ohio Forestry Association

Conservation News--National Wildlife Federation

Ecology--Ecological Society of America

Field and Stream

Fire Control Notes

Forest Chronicle

Forest Industries (formerly the Timberman)

Forest Pest Observer

Forest Practice Doings

Forest Products Journal--Forest Products Research Society

Forest Science--Society of American Foresters

Forestry Abstracts

Grist--National Park Service

Hardwood Plywood Manual--Hardwood Plywood Manufacturer's Association

Journal of Economic Entomology--Entomological Society of America

Journal of Forestry--Society of American Foresters

Journal of Soil and Water Conservation--Soil Conservation Society of America, Inc.

Journal of Wildlife Management

Logger's World

National Geographic

National Hardwood Magazine

National Parks Magazine--National Parks Association

National Wildlife--National Wildlife Federation

Natural History

Newsletter--American Pulpwood Association

Northern Logger (formerly Northeastern Logger)--
Northeastern Loggers Association, Inc.

Our Public Lands--Bureau of Land Management, U. S.
Department of Interior

Outdoor America--Izaak Walton League of America

Outdoor News Bulletin--Wildlife Management Institute

Parks and Recreation--American Institute of Park
Executives, Inc.

Phytopathology--American Phytopathological Institute

Progressive Fish Culturist

Pulp and Paper

Pulpwood Annual--American Pulpwood Association

Recreation

Soil Conservation

Southern Lumberman

Sports Afield

Surveying and Mapping--American Congress on Surveying
and Mapping

The Consultant--Association of Consulting Foresters

The Nature Conservancy News--The Nature Conservancy

Tree Planter's Notes--U. S. Forest Service

Trees Magazine

U.S. Government Publications Monthly Catalog

Wood Preserving News

Wood Research

Woodlands Review

Various state publications of a forestry and conservation nature

MISCELLANEOUS

Advance Reports--National Fire Protection Association

Appalachia--Appalachian Mountain Club

Greenthumb--Colorado Forestry and Horticulture Association

Journal of Mammology

Journal of Range Management--American Society of Range Management

Photogrammetric Engineering--American Society of Photogrammetry

Proceedings--Michigan Forestry and Park Association

Tappi--Technical Association of the Pulp and Paper Industry

The Abstract Bulletin of the Institute for Paper Chemistry--Institute of Paper Chemistry

Transactions--Wildlife Management Institute

The Book Collection

The American Library Association states that, "A two-year institution of up to 1,000 students (full-time equivalent) cannot discharge its mission without a carefully selected collection of at least 20,000 volumes exclusive of duplicates and text books. Institutions with broad curriculum offerings will tend to have larger collections; an institute with a multiplicity of programs may need a minimum collection of two or three times the basic figure of 20,000 volumes. The book holdings should be increased as enrollment grows and the complexity and depth of course offering expands. Consultation with many junior college librarians indicates that for most, a convenient yardstick would be the following: 'The book stock should be enlarged by 5,000 volumes for every 500 students (full-time equivalent) beyond 1,000.'"

At the initiation of a forest technology program, it is recommended that the head of the forest technology program and the librarian review the current pertinent reference books available and select the list of books to be placed in the library as regular reference material. The recommended policy is to place in the library only those reference books which are not a part of the regular text book material for the various courses.

It is suggested that at the beginning of a forest technology program, the library should contain at least

200 to 300 reference books on various aspects of forest technology and its related fields, particularly the field of professional forestry. Beyond the initial 200 to 300 books, there should be regular and systematic additions to the reference material in the library supporting the forest technology program from year to year, and eventually a weeding out of those references which have become obsolete.

A bibliography of textbooks on forestry, conservation and natural resource management is available from the Society of American Foresters, Washington, D. C.

Visual Aids

The same procedure is suggested for placing the visual aids content in the library as is outlined above for the acquisition of books pertinent to forest technology. Both the librarian and the head of the department should review and evaluate visual aid materials as they become available. Those which are deemed appropriate should be borrowed or rented for special use or purchased for regular use.

LABORATORY AND PHYSICAL FACILITIES

General Considerations

Building and equipping adequate forest technology laboratories for teaching forest technology is expensive. Institutions undertaking such programs may find it necessary or desirable to spread the initial building and acquisition expenses of such laboratories over more than one year. Ideally, such laboratories will be built and completely equipped before the first class of students is enrolled. Often there is a temptation to get part of a physical plant and then add to it later. This is fine in theory but seldom, if ever, works out satisfactorily. If at all possible, get the entire plant built and fully equipped right from the start to insure the greatest success of the program. Expansion may come later, but do not handicap a new program by giving it only half a start.

If the entire group of laboratories and equipment cannot be purchased at the beginning of the program, it is strongly recommended that there be no compromise in quality in the purchase of equipment and supplies, and that all of the laboratories be furnished with such equipment at one time. This plan provides good basic laboratories, usually at minimum cost, and allows them to be stocked with the necessary instruments, equipment, or apparatus as required or can be afforded.

Experience has shown that the department head or instructor should make the final decisions on the choice of laboratory equipment because of his knowledge of technical details. The instructor can avoid costly mistakes which often result if non-technical personnel attempt to equip a forestry laboratory.

Surplus equipment from either private or public organizations can be an important source of good materials and hardware for equipping forestry laboratories. Government surplus property may often be an especially attractive source of either standard or specialized components, units, assemblies, mechanisms, instruments and systems at a cost which is usually only a small fraction of their new cost. Educational institutions are high on the priority list of agencies to which government surplus property is made available.[1]

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[1] U. S. Dept. of Health, Education, and Welfare, Office of Field Administration, Division of Surplus Property Utilization. Directory: Directors of State Agencies for Surplus Property and Regional Representatives, Division of Surplus Property Utilization, Department of Health, Education, and Welfare. Washington, D. C., 1965.

How to Acquire Federal Surplus Personal Property for Health, Education, and Civil Defense Purposes and Federal Surplus Real Property for Health and Educational Purposes. Washington, D. C., 1965.

Surplus Material and Science Education. Washington: U. S. Government Printing Office, 1964.

Distribution of surplus property within the states must be made through the state agency for surplus property. Most state agencies maintain one or more distribution centers at which authorized representatives of eligible schools or school systems may select materials for educational use. Usually one or more officials of the school or school system are designated as authorized representatives. Technical educators should communicate with their authorized school system representative, if one exists, to arrange to visit their state agency's distribution center, or write to the director of the state agency for surplus property to obtain information regarding the procedures to be followed in acquiring equipment.

The state director of vocational and technical education in each state can provide specific information on the location of the government surplus property distributing agency in his state and the person in charge. Information on government surplus property may also be obtained by writing to: Chief, Surplus Property Utilization Division, Department of Health, Education and Welfare, Washington, D. C. 20201.

Experience has shown that it is most important to exercise the same elements of judgment and care in acquiring surplus equipment as is used in buying new equipment. Specific plans for the use and sound justification for the need should clearly be established for any piece of surplus equipment; a careful analysis made of its total effectiveness in the program; its cost including initial cost, transportation, space required, cost of installation, repair or tune-up (if incomplete) and maintenance; and its pertinence in terms of obsolescence.

Only technically competent, responsible and imaginative persons should select surplus equipment, and then only after a thorough on-site inspection. This practice avoids the temptation or tendency to acquire attractive but obsolete, irrevelant, bulky or excessive amounts of equipment.

Granted the foregoing approach, the resourceful department head or instructor can usually obtain quantities and components of materials (often by disassembling units or systems), instruments, apparatus or other essential up-to-date equipment for forestry laboratories at a very reasonable cost.

Suppliers of simulation and demonstration equipment may be found in scientific equipment suppliers' lists, purchasing directories (such as Thomas' Register), telephone directories and in advertisements in educational and trade journals. A budget for the purchase of such initial teaching equipment might well require from $75,000 to $100,000 in addition to the laboratory equipment specifically listed in this guide. A department head or instructor should select the specific demonstration unit considered the most suitable.

The cost of establishing, equipping and operating a department for teaching forest technicians will vary somewhat depending upon whether its location is near or far from major suppliers, on the size of the department, the quality of equipment or supplies purchased at any given time, and on the method of purchase. If the equipment can be bought as a part of a large purchase of scientific equipment through a central purchasing agency, the total price of equipment and supplies may be somewhat less than if the items are purchased separately. Small purchases of scientific supplies or equipment usually are not subject to the suppliers' discounts that are applied to purchases of larger quantities of the same supplies or equipment.

When plans to establish, enlarge or re-equip a forest technology department progress to a point which requires a detailed and precise estimate of cost, it is suggested that the services of major suppliers be obtained so that the cost estimates may be complete and sufficiently accurate for current budgetary purposes. <u>The purchase of</u>

up-to-date equipment of good quality is the best preparation for a successful program for forest technicians.

In initiating any forestry program, individuals planning the facilities and purchasing the laboratory equipment should consider what, if any, equipment is already available at the institution. Joint use of some of the forestry equipment may be feasible and prevent duplication of expensive equipment.

However, joint use of apparatus and equipment requires carefully coordinated planning with the other departments since it is essential that each department have sufficient equipment for its own needs at the time it is needed for each program.

Two types of suppliers probably will be involved in establishing or refurnishing a forestry technology department. One type is the manufacturer and supplier of the major units of permanently installed equipment for forest technology laboratories, such as unitized work tables and specialized storage cabinets. Generally these are supplied by the manufacturer and may best be purchased under a contract both to supply and install the equipment. Suppliers of such equipment provide engineering and consulting services free of charge, and will develop drawings, specifications and plans that may be used for soliciting competitive bids.

The second type of supplier sells specialized equipment, such as clinometers, compasses, logging supplies, etc.

General Planning of Facilities

In providing the facilities necessary to start a curriculum in forest technology, it is assumed that no facility or equipment is available. It is also assumed that this curriculum will be added to an already existing educational institution and, therefore, certain details have been omitted.

Laboratories and related classrooms, offices and storage facilities required for teaching forest technology do not present special or unusual conditions peculiar to the technology. Any well-constructed building with suitable utilities may be used. However, if the building is to be constructed to house a forest technology program, planning should include maximum use of moveable partitions and portable equipment to attain greater flexibility in the utility of space.

Consideration should be given to locating the forest technology plant somewhat away from other educational facilities. Some of the equipment used can cause noise interference such as chain saws, tractors, etc.

If possible, the forest technology laboratory should be on the ground floor where the dispatching of equipment and supplies for student use may be most efficiently accomplished. These considerations are purely for convenience and in no way mandatory.

Electricity is basic, not only for adequate lighting, but also for power. If possible, have lighting in abundance including night. Even though night classes are not anticipated; they may come later.

A classroom near the mensurational laboratory and drafting rooms is highly desirable. Classrooms and laboratories should be well-lighted with a recommended minimum of 50 foot-candles of light at the table or desk top. Fluorescent lighting is satisfactory. However, it is suggested that in the drafting room a minimum of 70 foot-candles of light be required at desk level.

Electrical services should provide 110V, single-phase electrical services for forest technology laboratories. Most equipment used in the laboratory requires only 110V. A 220V line should be extended to the repair shop.

In connecting electrical service to the laboratory benches or desks, it is suggested that each be connected to a separate circuit breaker on each ramp and the circuits be designed with ample capacity so that when a number of students in the laboratory are using computing machines, the lines will not become overloaded. Each laboratory should have a separate master distribution control panel for electrical circuits.

When planning space requirements for a forest technology department, many factors must be considered, some of which are: the number of students who are to be educated; facilities that are already available; the number of staff members to be involved; and the length of the program. These factors and many others come into play before suggestions for area allotment can be made. The following discussion has been developed on the assumption that a two-year program involving 60 beginning forest technology students, 30 advanced students, and three instructors in the technical specialty courses, plus a director are to be accommodated. This requires the use of multiple laboratories. Students in excess of the number assumed may be accommodated by the use of additional multiple laboratory sections or by assigning more than three students to each laboratory group. Figure I is an example of total floor space arrangement for a department to accommodate such a program. The access hall is centrally located to permit adequate classroom and laboratory areas on both sides. Through traffic is undesirable from both the security and the disturbance point of view; therefore, the hallway does not have a daily ingress-egress door at the far end. Compactness of course, is desirable for convenience to students and staff.

There are many ways in which a U-shaped internal area may be divided into classrooms, laboratory and staff facilities. For the sake of flexibility, it is suggested that internal walls be steel and glass movable partitions. Such construction permits changes to be made if they become necessary or desirable.

A floor plan should contain sufficient classroom space to conveniently accommodate the students within the department. Usually a single classroom is adequate. Normally the classroom will be equipped with student desks, chalk board and a screen to be used with projection equipment. The rooms should be well-lighted, at least 50 foot-candles at desk level, and be equipped to control the light to facilitate the use of visual aids. Electrical outlets for projection equipment must be provided.

Laboratory space is probably the most important area in a forest technology department. The laboratories must be planned for optimum convenience and utility for both students and instructors. Consequently, individual work benches equipped for single occupancy or teams of two students usually are to be preferred to long common benches for many students. Storage space for instruments and equipment should always be adjacent to the laboratory. Doorways should be located for easy traffic flow into and out of the laboratory. Storage areas in laboratories should be located so that the instructor can readily control the movement of stock, instruments and materials. Laboratories should be equipped with a chalk board and a screen for projection equipment. Certain laboratories will have multiple use and may even double as classrooms used for English, mathematics, etc.

Schematic Layout for a Forestry Department

The floor plan of a forestry teaching department's facilities suggested in Figure I has been considered from cost and practical teaching points of view.

It is a simple, one-floor arrangement isolated in a separate building or separate wing of a building. It is compact, functional and arranged so utility installation costs may be kept to a minimum, with a minimum of service lines hidden in partitions or located in inaccessible areas.

The reception room and offices for the staff, a classroom and a lecture-demonstration room are located in one end of the building, as much removed as possible from the two main forestry laboratories (drafting and mensurational). This tends to avoid student traffic through the laboratory area and is a convenient arrangement for the instructional staff.

A central storeroom is used primarily to provide materials to the mensurational and surveying laboratories;

hence, is located as centrally to them as possible. This makes it possible for students to obtain storeroom service only a few feet from the laboratory in which they are working and makes it easy for instructors to check with the storeroom supervisor without going far from their laboratory class.

The reserve storeroom is located as close to the outside door as possible. The reserve storeroom is planned not only as a receiving area, but also as an area where quantity lots of material can be stored until needed. (A small ramp should be provided for wheel chair entry to the building.)

The lecture-demonstration room is located relatively near the central storeroom because most of the demonstrations will require apparatus and materials from the storeroom which can be delivered to the demonstration room as needed. Demonstration models, mock-ups and other materials can be stored in the central storeroom and thus be easily available for lecture room use.

While storage space is suggested here, more might well be planned and provided for because it seems to be impossible ever to have sufficient.

Safety

Planned safety for forestry teaching facilities costs very little. Some safety suggestions which should be considered in designing a forestry laboratory area follow:

Every laboratory should have at least two exits and two alternate routes for evacuation. If a work area should catch fire due to inflammable materials, it is possible that the fire can be shut off at one exit; thus, two exits are an absolute must for all forestry work areas.

Fire extinguishers should be installed and made easily available in all forestry laboratory areas.

Fire extinguisher types and locations should be planned when the building is designed, and extinguishers should be placed where, in case of fire, a man in any room can reach a fire extinguisher and fight his way out of the fire and room.

Safety glasses should be worn by everyone working in mechanical laboratories. It is an almost universal practice in most laboratories to require technicians and other personnel to wear safety glasses at all times. Safety regulations at a school laboratory should require all students who take a course in forestry or mechanics to purchase a set of safety glasses and to wear them at all times when they are in the laboratory.

Safety regulations should be posted in each laboratory and should be specifically called to the attention of all students and workers at the beginning of the work day. Most accidents, in both indoor and outdoor laboratories, are caused by lack of attention to safety precautions, "horseplay" or some other unnecessary act. Forestry personnel must constantly be aware of and practice safety precautions.

Field exercises in silviculture require all students to purchase and wear light steel leg guards and hard hats. Logging field work requires all students to purchase and wear hard hats and safety knee patches (fibre-glass). Hard hats should be required personal equipment in all field exercises and can be adorned with decals or other insignia representing the school. This practice will frequently increase the "espirit de corps" of the unit.

Telephone facilities are easily overlooked. Have ample extensions to save instructors' time. Consider a telephone in such areas as machine shops and storage areas where instructors may possibly spend periods of time.

Unfortunately, much forestry equipment and many supplies are subject to ready use by many people. Give a good deal of thought to adequate security.

Outside Facilities

Land area with a minimum of 2,000 acres is mandatory for maximum utilization of field exercises. The building of roads, boundary surveys, cruising techniques, harvesting techniques, and silvicultural consideration cannot be taught on a theoretical, simulated basis. They must actually be done by the students if a practical learning situation is to occur. Maximum timber types, age classes and topographic conditions must be included in this area.

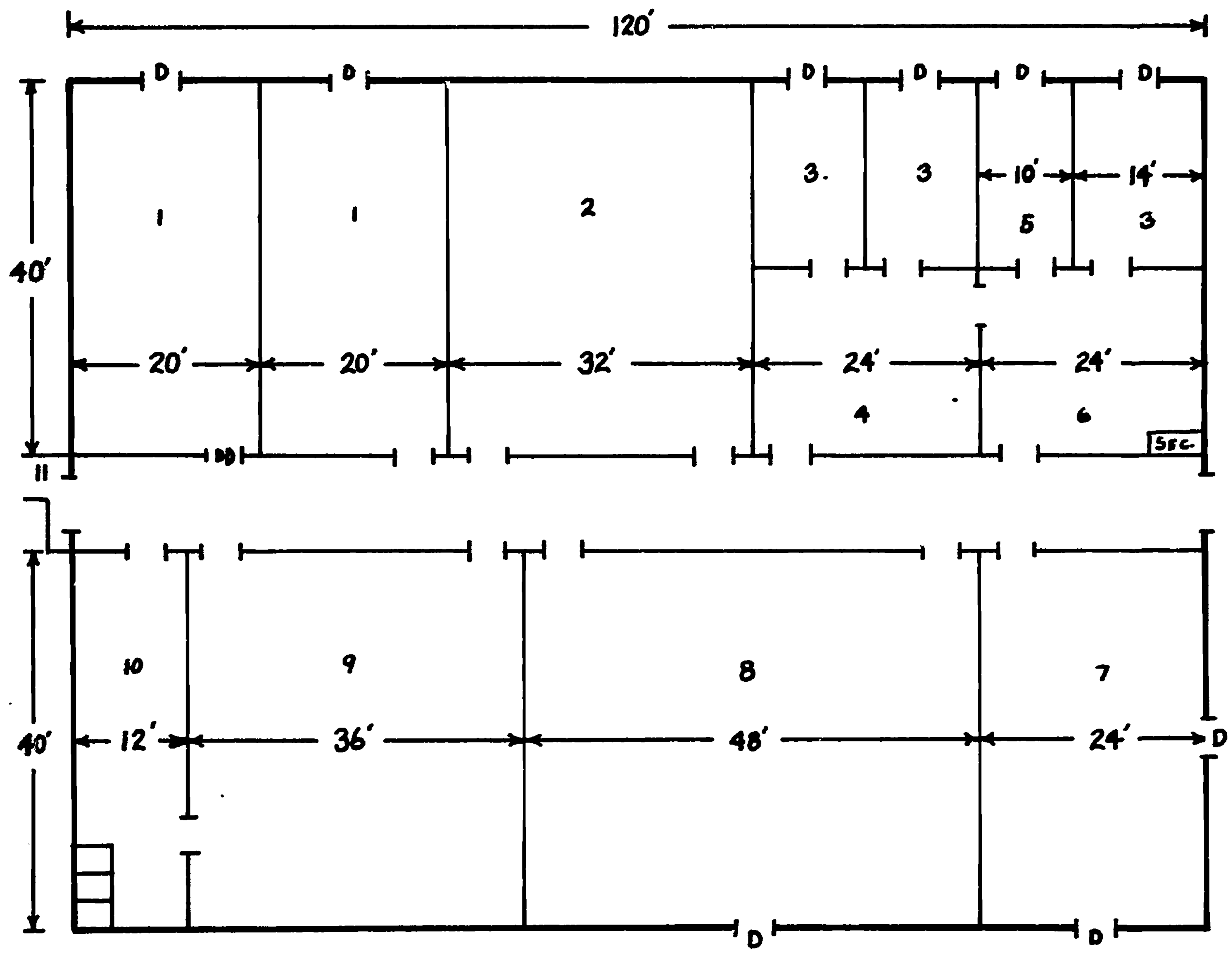
No program should be considered if insufficient land area is not readily obtainable. These forest areas cannot be over-emphasized as they are the single most vital element in the creation of a new forest technology program.

EQUIPPING THE LABORATORIES AND THEIR COST

In the following discussion, the diagrams are intended to show suggested equipment, arrangement of space for laboratories, storerooms and offices, and are not intended to be complete. Such items as janitors' closets and students' and staff toilet facilities, for example, are not shown, but must be provided in a complete plan of facilities for teaching forestry.

The forestry laboratory benches and other units shown in the diagrams and drawings are representative of those available from several forestry equipment suppliers. When a forestry program is being planned in detail, it is suggested that the engineering services of such suppliers be obtained. Suppliers will generally provide complete drawings and specifications for an entire laboratory layout in such form that they may be used to obtain competitive bids. Such engineering services generally are provided free of charge, and the suppliers' experienced engineers provide alternate plans and detailed suggestions which promote efficient arrangement and economical use of space and funds for the facility.

Most of the basic forestry work benches, cabinets and other units can be built on the spot. However, this is not generally recommended. It is not economical, and in most instances the standard unitized equipment available from forestry laboratory equipment suppliers are well-engineered, efficient in service, and are probably most economical if purchased and installed under contract.



1. Instrument and Central Storage
2. Mensurational Laboratory
3. Offices
4. Library and Conference Room
5. Files and Office Equipment
6. Reception Room
7. Class Room
8. Lecture and Demonstration Room
9. Drafting Room and Photo Interpretation Lab
10. Shower, Lavatory and Locker Room
11. Entrance Ramp

D. Emergency Door

DD. Dutch Doors

FIGURE I. SUGGESTED FLOOR PLAN FOR FORESTRY PROGRAM

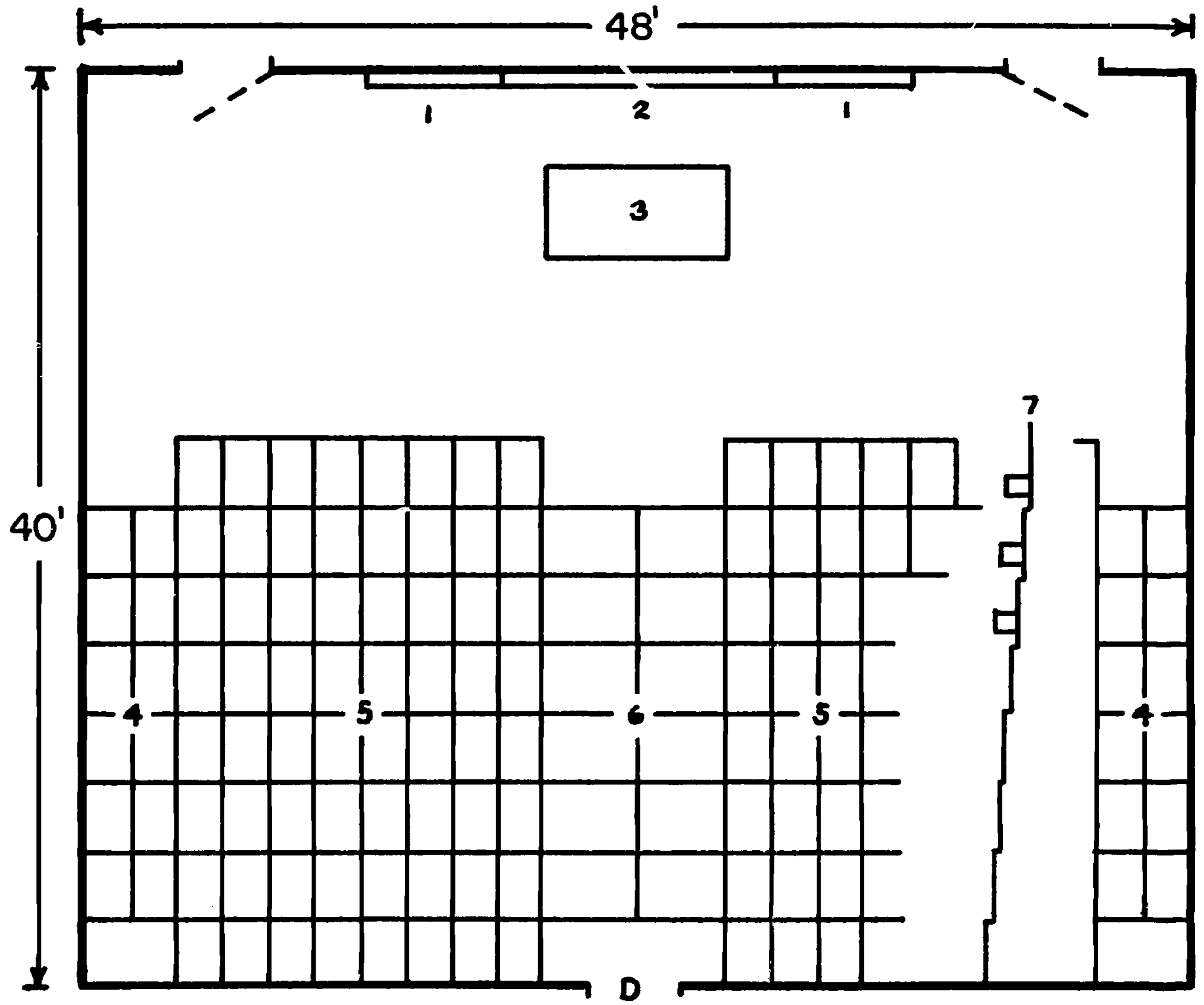
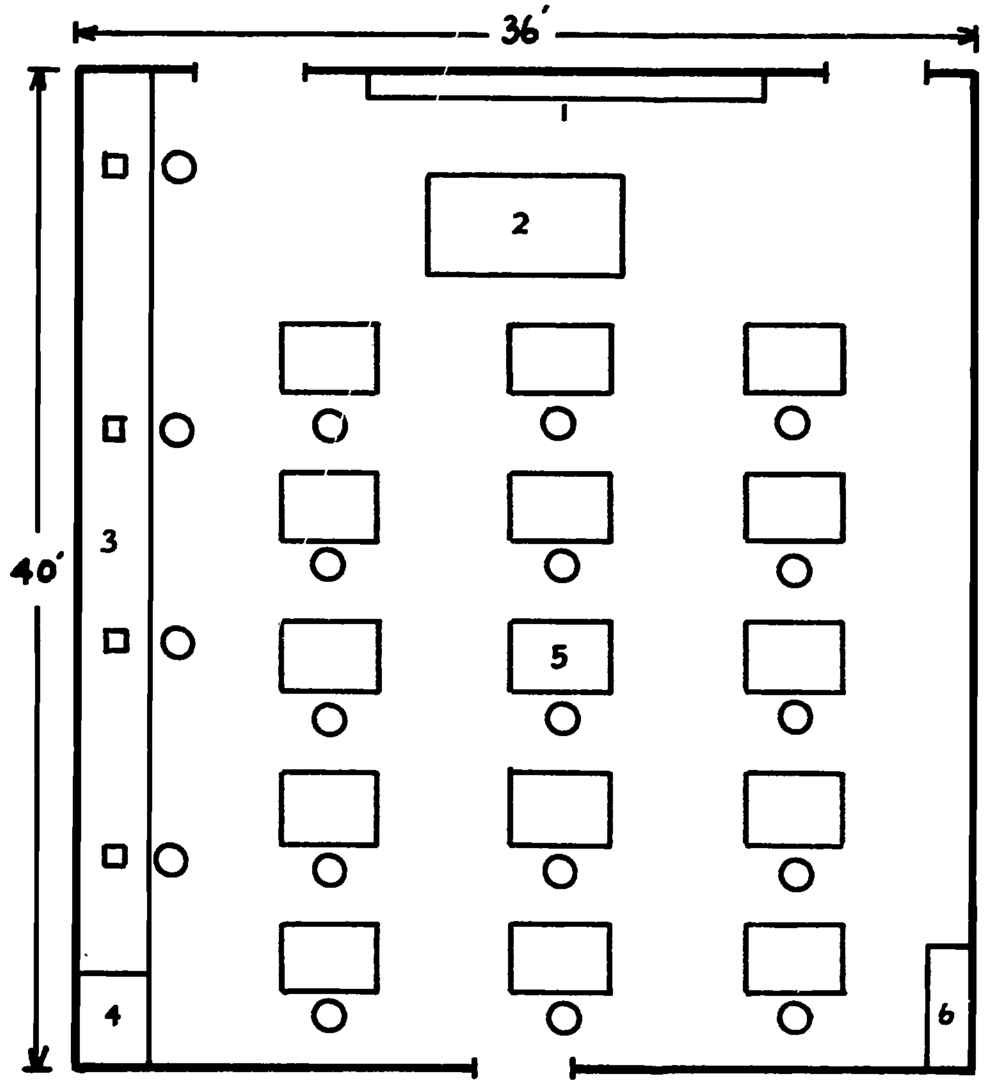


FIGURE II. LECTURE DEMONSTRATION ROOM

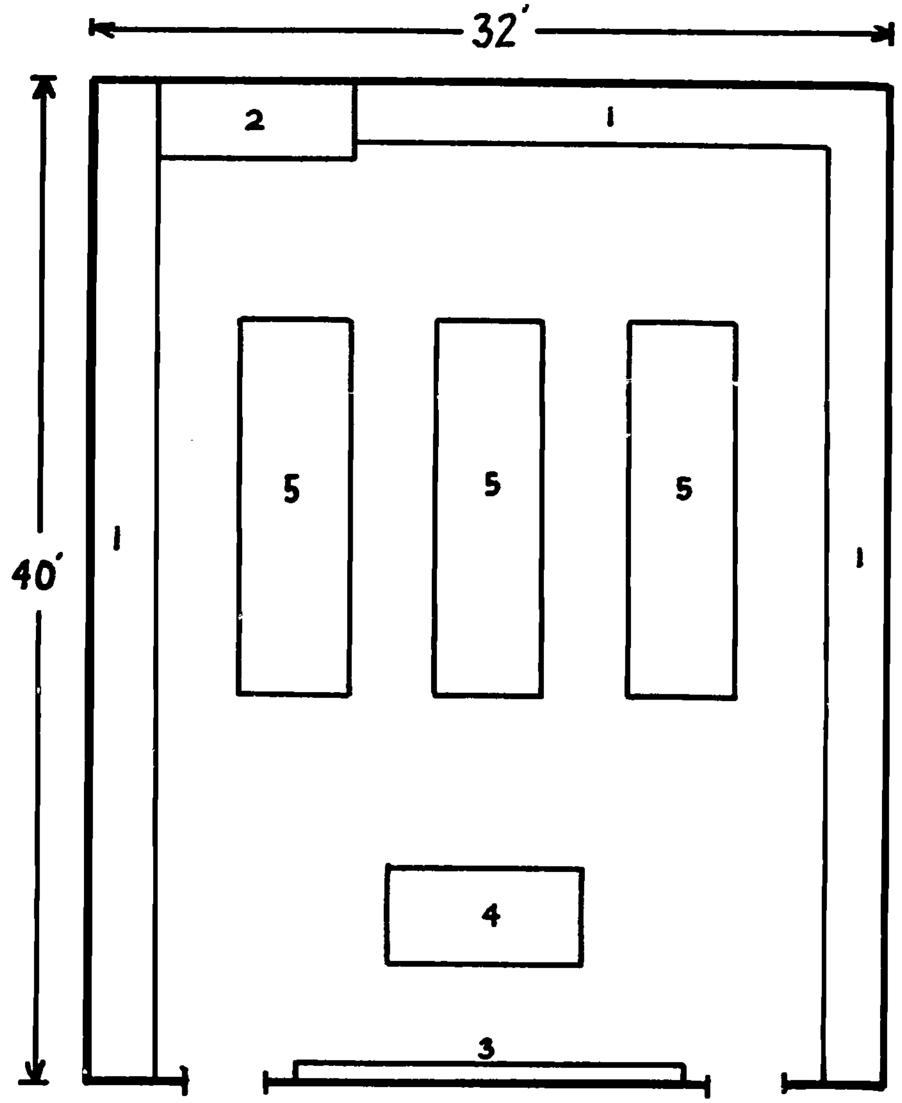
1. Cork board
2. Chalk board
3. 4' x 8' demonstration table
4. 4' aisle
5. Desks - 2' x 3'
6. 8' aisle
7. Cross section showing raised seats--3" rise per section



1. Blackboard & Corkboard
2. Demonstration Table 4' x 8'
3. Calculator Bench 36' x 3'
4. Storage Locker 3' x 4'
5. Tilting Drafting Table (3' x 4') with flexible arm fluorescent light
6. Instrument Cabinet

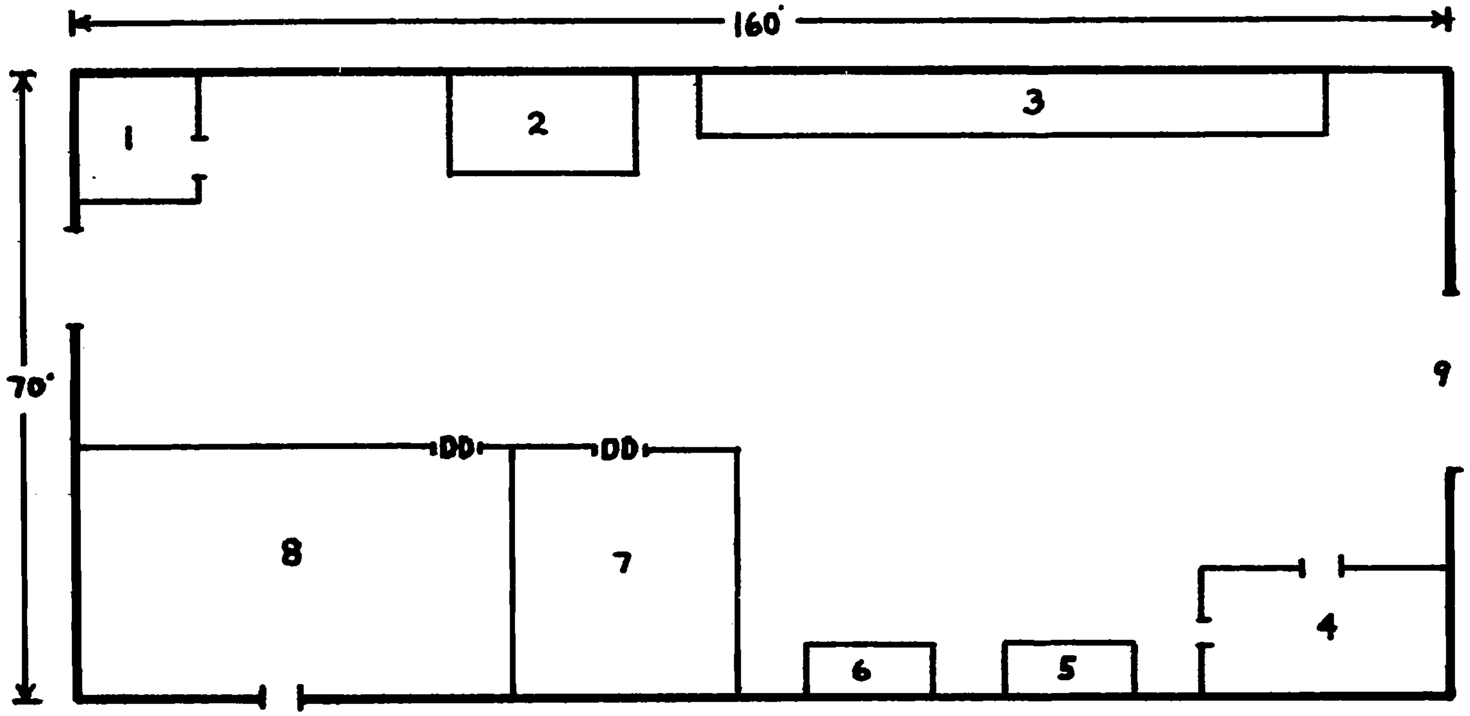
D. Emergency Door

Figure III. Drafting & Photo Interpretation Laboratory



1. 2.5' Electrified Wall Tables for desk calculators
2. Storage Cabinet 3' x 8'
3. Chalkboard
4. 4' x 8' Demonstration Table
5. Center Tables 4.6' x 15' with electrical hook-up

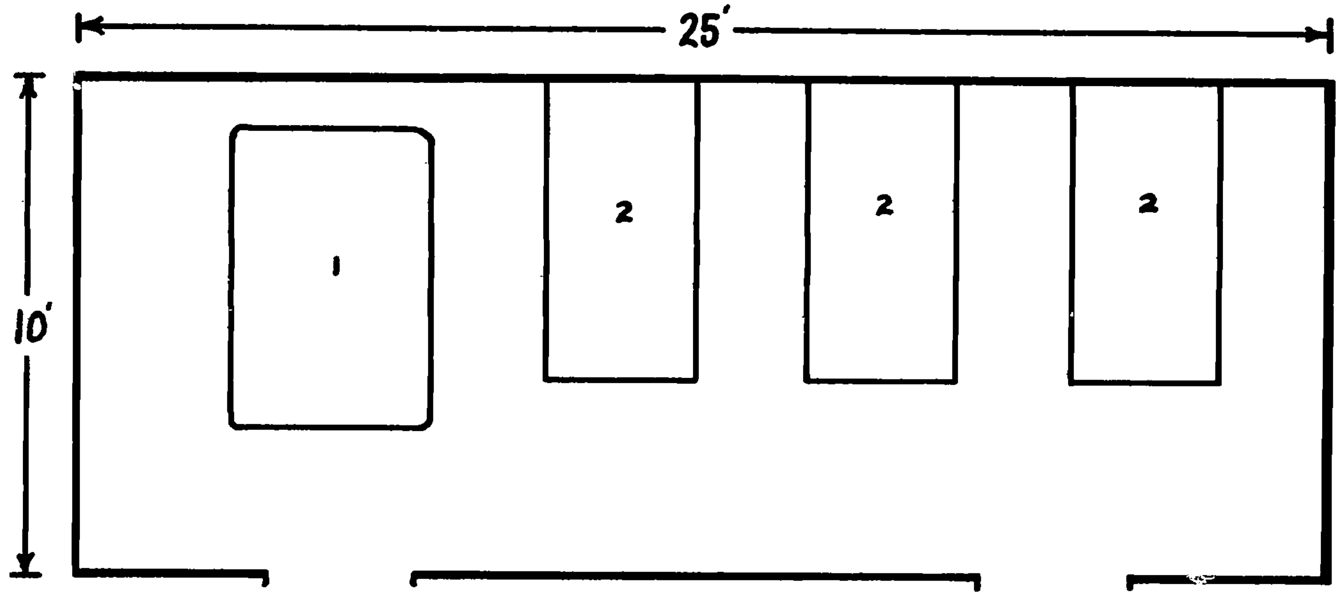
Figure IV. General Mensuration & Surveying Laboratory



1. Lavatory
2. Tire Rack
3. Tool Bench
4. Welding Tent
5. Oxy-Acetylene Bench
6. Compressor Bench
7. Equipment Storage
8. Hand Tool Storage Crib
9. Overhead Doors

DD. Dutch Doors

FIGURE V. SUGGESTED FLOOR PLAN FOR MACHINERY & EQUIPMENT REPAIR BUILDING



1. Gasoline storage tank 6' x 4' with extra length reel type hose for outside use
2. 3' x 6' adjustable storage shelves

Building is 15' high with a back sloping roof. A metal edge along the back of roof eliminates snow and ice build-up

FIGURE VI. SUGGESTED FLOOR PLAN FOR OUTSIDE CHEMICAL AND GASOLINE STORAGE

Assumptions Made in the Following Estimated Costs

The following estimates of the costs of completely supplying and equipping an ideal forest technology department for teaching technicians are as of the time of this publication.

The estimates are based upon the acquisition of modern equipment and supplies of good quality, but not the most expensive.

The estimates assume the availability of a building of suitable construction, equipped with normal services such as electricity, heat and water to and from the building, but otherwise unfurnished.

No provision is made in this estimate for office furniture, conventional classroom blackboards, student seats, filing cabinets, and the conventional staff or instructors' office equipment.

The estimates are for well-equipped laboratories having the furnishings and equipment described in the diagrams and listed hereunder for each facility. These facilities may be considered typical of those required for a good forest technician education program. Facilities for any given institution may be expected to vary in detail, but should include most of the facilities and equipment herein described to provide an adequately furnished and equipped department for teaching forest technology students.

If possible, a completely equipped laboratory for a two-year program should be provided at the beginning of the program. However, a minimum of laboratory equipment and apparatus required for starting the first-year forestry classes may be acquired at the beginning of the program and additional instruments, items of equipment and apparatus added as necessary and feasible.

The specifications for laboratory equipment listed in this section are typical of equipment to be used in teaching forest technicians and are offered as assistance to the instructor or department head who may have the responsibility for purchasing equipment. Quantities suggested are intended for a class of 10-15 students per section for technical specialty courses under optimum instructional conditions and will provide the necessary items for student instruction and practice. Non-technical courses could handle 24 students per section or more.

When a program gets under way and all the recommended equipment has been purchased, it will still be necessary to have an annual equipment and supply budget. These funds are required to replace or repair equipment, to re-stock expendable items and to purchase new equipment to meet regional modifications of the program. At least $3,000.00 to $4,000.00 per year should be planned to meet such needs and substantially more may be required if special new types of equipment are developed and needed to keep the program up-to-date.

The following costs and laboratories assume that the school has an adequate forest area of at least 2,000 acres in various age classes, species groups and topographic conditions within a twenty to forty mile radius of the campus. Experience has shown that this acreage is necessary in order to teach all of the courses in a logical comprehensive manner. This land may be either privately or university owned, national forest land which has free utilization based upon accepted standards of forestry practices, or private pulp and paper company lands. Land will frequently be available from the state park or state lands system. It is more desirable to have this land in university ownership due to the long-term investment and action of forestry practices and to insure the continuity of the program.

Central and Reserve Storerooms

It is desirable to have the central storeroom located as near to all laboratories as possible to reduce to a practical minimum the distance and time required for students to go to the storeroom (Figure I). In addition, a reserve storeroom is recommended in which to store extra material. This allows material to be moved to the central storeroom for distribution to various laboratories as needed. The reserve storeroom should be located near the unloading ramp or outside door.

Machinery and Equipment Repair

Attached to the main building should be a repair facility for the care and minor repair of trucks, tractors and other machinery. This building should be equipped with a floor jack, air compressor, welder, oxy-acetylene unit, and various mechanics' hand tools (Figure V).

Gasoline and Chemical Storage

A gasoline and chemical storage facility must be made available in a small (10' x 25') cinder or cement block building near to but not attached to the main building. This storage shed should contain a 250 gallon gasoline tank with pump and hose, and shelves for the storage of chemicals (Figure VI).

Transportation Equipment Storage

A pole-type shed should be erected in order to protect those trucks having canopys, and other rolling stock which would deteriorate under adverse weather conditions. This shed may easily be topped with aluminum roof sheathing which is relatively inexpensive but quite serviceable. The style of the shed should complement the quality of the main building and should in no way detract from the overall esthetic value of the campus.

Wood Utilization Laboratory (Sawmill)

The combined facilities of building and lumber yard will serve as an outdoor laboratory where instruction may be given in several different subject areas. The building itself will be utilized as a manufacturing plant to reduce logs to lumber. Logs can be stored on the log deck for log grading.

Cutting logs for a specific product and grade requires an intimate knowledge of log and lumber grade specifications. It is this particular job which industry is so greatly concerned about because many dollars may be lost by incorrect bucking thereby creating a lower quality log.

The best way to teach a student the principles of tree defect, cull factors, gross and net scale and other factors is to "open up" logs exhibiting these effects. The student then also begins to realize what to look for in bucking logs.

Office Space for Staff

Suggested office space for staff is indicated on the schematic diagram (Figure I) for the forestry department.

Office space should be provided for each instructor and it is recommended that no more than two staff members be located in any one office. More than two staff members occupying an office tends to discourage students from approaching instructors for assistance. It is desirable to have a waiting room adjacent to staff offices where students can study comfortably while waiting for the instructor's assistance. Usually, the waiting room will house the departmental secretary who can arrange conference appointments for students if necessary.

The conference room shown in Figure I may also be used for student and staff conferences. No specialized equipment is needed for forestry department staff offices.

A small room should be made available for the storage of alumni files and the operation of office machines.

Demonstration and Lecture Room

Seats in the demonstration-lecture room should be so arranged that the view of the demonstration tables is good from both the rear and the front of the room. The suggested plan with seats elevated as they approach the rear, has been found to be a good arrangement (Figure II). The room should be equipped with a lecture-demonstration table and should have electrical outlets. The diagram indicates a seating capacity of 100 students in the lecture-demonstration room. However, if the forestry department offers forestry service courses to other departments, a lecture-demonstration room seating up to 200 students should be considered. This permits the combining of groups for lecture and demonstration purposes.

The demonstration room should be located near the stock room. This allows the technical person who operates the stock room to prepare visual aids and demonstration materials and to deliver them expediently to the teacher in the demonstration room. No attempt should be made to stock demonstration apparatus and supplies in the lecture room. They should be delivered from the stock room whenever needed.

Approximate cost estimates on lecture-demonstration room equipment follow:

ITEM	QUANTITY
Demonstration Table	1
Projection Equipment	
16 mm. Projector with Screen	1
Opaque Projector	1
Overhead Projector	1
Slide Projector (Carousel type)	1
Tape Recorder	1
35 mm. Camera and attachments	1
Polaroid Land Camera	1
Ditto Machine	1

TOTAL ESTIMATED COST $3,000 - $4,000.00

General Equipment Required to Operate the Program

Most of the following equipment can be used year around if a crew of two to three men are hired to do woods work including road building, logging and grounds maintenance.

The sawmill is included here since it is utilized as both a production and teaching unit in Mensuration, Logging, and Wood Utilization.

ITEM	QUANTITY	APPROXIMATE COST $
4-wheel drive, 3/4 ton Pickup with long body (Personnel)	1	3,500
Canopy truck (Personnel) 1-1/2 Ton	1	4,000
6 Cu. Yard Dump Truck (Used)	1	5,000
Road Rake	1	800
JD 2010 Crawler or equivalent with 4-angle dozer blade, integral arch, winch and canopy	1	8,000
Farm Tractor with bucket	1	4,500
3-Ton Stake Body, Dump Truck (Government surplus)	1	5,000
Bus (44 passenger, heavy duty - Government Surplus)	1	8,000
6-Ton High-Wheeled Pneumatic Tired Fork Lift, high-centered, 9-foot mast (Used)	1	5,000 - 9,000
Stationary electric circular (52") Sawmill with edger, cut off and double end trimmer. A durable building is included to house the saw and equipment	1	15,000
Desk Calculators	10	6,500 - 8,000

Equipment which could be obtained from surplus supplies--
No attempt will be made to quote a price since the prices are highly variable within regions

	QUANTITY
Passenger bus, heavy duty	1
Dump Truck, stake body, 3-Ton	1
Small Crawler Tractor with dozer blade	1
Dump Truck, 6 cu. yards	1
Canopy Truck, 1-1/2 Ton (Personnel)	1
Pickup, 3/4 Ton, 4-wheel drive	1
TOTAL ESTIMATED COST	$65,000 - $71,000

General Drafting Laboratory

The suggested plan for the general drafting laboratory is shown in Figures I and III, which diagram the arrangement of student work spaces and desks. A representative list of apparatus for the general drafting laboratory along with a cost estimate of the contents follows.

This laboratory can be utilized for courses in Surveying and Photo-Interpretation; therefore, if at all possible, courses should be scheduled to take advantage of this arrangement.

Equipment and Supplies - Drafting Laboratory

EQUIPMENT

ITEM	QUANTITY
Drafting tables, 3' x 4', metal base, dust cover (tilting top)	15
Drafting tables, 3' x 5', metal base, dust cover (tilting top)	15
Drafting stools	30
Reproduction machine	1
Filing cabinets for instructors	2
Map file cabinets, five drawers with base and cap, 30" x 42"	2
Drawing instruments	15 sets
Limited number of auxiliary items such as beam compasses	
Demonstration slide rule, 7'	1
Assorted slide rules to demonstrate types used in industry	10
Flat scales, assorted	30
Triangles	30 sets
Assorted curves and templates	2 sets
Cutting board	1
Lettering guide sets	4
12" trimming shears	5

SUPPLIES

ITEM

Tracing paper, drawing paper, tracing cloth, reproduction paper and supplies, assorted graph paper, orthographic, isometric and oblique sketching paper and pads.

Coordinate sheets, lettering guide sheets, etc.

Pencils, erasers, erasing shields, thumb tacks, masking tape, ink, etc.

Estimated cost of drafting laboratory equipment and supplies---------------$10,000 - $12,000

Student Equipment for Drafting

	QUANTITY
Triangular Engineers Scale	1
Bench brush	1

Student equipment for Drafting is the same as that required for Elementary Surveying

Elementary Surveying Laboratory
(See Figure III)

ITEM	QUANTITY
Steel Tapes, 100' Surveyor's	15
Plumb Bobs, 8-ounce	15
Steel Tapes, 2-Chain Topographic	15
Compasses, Staff with Tripods	12
Chaining Pins	12 sets
Abney Levels	12
Clinometers	12
Range Poles	20

Polar Planimeters	10
Grids	15

Total estimated cost of supplies and equipment for Elementary Forest Surveying--------$3,500 - $5,000

Student Supplies and Equipment

	QUANTITY
Compass, Hand	1
Field Book with Forms	1
Drawing Board	1
Set Curves and Angles	1
Miscellaneous Erasers, Pencils, Books	

Student equipment is the same as that required for Applied Drafting for Forestry

Total Cost: $24.00

Advanced Forest Surveying Equipment Cost

Equipment for 12 students or 1 Section - 4 Crews

ITEM	QUANTITY
*Transits	6
Levels	6
Plane Tables & Alidades	6
Level Rods	6
Stadia Rods	6
Engineer's Tapes	6
Chaining Pins	6 sets

TOTAL ESTIMATED COST - $7,000 - $11,000

*Note: There is one extra piece of equipment in each set so that course work is not interrupted by equipment breakdown.

PHOTO-INTERPRETATION LABORATORY

The suggested plan for the photo-interpretation laboratory is shown in Figures I and III which diagram the arrangement of student work space and desks. This laboratory can be scheduled in the drafting laboratory. A representative list of apparatus for the photo-interpretation laboratory along with a cost estimate of the contents follows. A list of other major equipment items which are normally required in this laboratory are shown.

Photo-Interpretation Laboratory Equipment and Supplies

ITEM	QUANTITY
Carousel-type Projector - Remote-controlled with Screen	1
Tape Recorder	1
Stereo Plotters	4
Mirror Stereoscopes (Government Surplus Suggested)	10
Parallax Bars (Government Surplus Suggested)	15
Lens-type Stereoscopes (Pocket, Folding)	20
Height Finders (Parallax Bars to fit Stereoscopes)	20
Stereocomparagraphs	4
100' Surveyor's Steel Tapes	10
USGS Topographic Maps of 1:24000 Scale (Local Area)	30

Sets of 3 Photos, 9" x 9" with 60% Forward Overlap (Expendable - will require new photos for each class)	30
Shadow Scale Guides, Crown Density Guides, Protractors	20 sets
Drawing Tables with Stools (See Drafting Equipment)	15 sets
Flexible Arm Fluorescent Lights (Individual)	15

Total estimated cost of photo-interpretation equipment and supplies-------------------$2,000 - $3,500

An additional initial cost of $2,500 - $3,000 will be necessary if government surplus stereoscopes and parallax bars are unobtainable.

GENERAL MENSURATIONAL LABORATORY

The suggested plan for the general mensurational laboratory is shown in Figures I and IV. This diagrams the arrangement of student work space and desks. 110 volt electrical outlets are necessary for the use of desk calculators. A representative list of apparatus for the general mensurational laboratory along with a cost estimate of the contents is shown. A list of other major equipment items which are normally required in this laboratory are also shown.

Elementary Forest Measurements Equipment and Supply List

ITEM	QUANTITY
Tree Calipers 1/	15
Bark Gauges 1/	15
Diameter Tapes 1/	15
Abney Levels, 1/, 2/	10
Increment Borers with Case 1/	15
Loggers Tapes 1/	10
Polar Planimeters 1/, 2/	10
Topographic Trailer Tapes 1/, 2/	15
100' Steel Tapes 1/, 2/	15
Biltmore Sticks 1/	15
Log Rules	30
Haga Altimeters 1/	5
Relaskops 1/	4
Syracuse Tree Markers	10
Tree Marking Paint	
Tree Marking Chalk	
Assorted Flagging	
Aluminum Tags	
Felt Tip Markers	

The estimated total cost of supplies and equipment for Elementary Forest Measurements:

$4,000 - $5,000

Student Supplies

Tally Book and Forms

Tree Scale Stick

Axe

Safety Hat

Total Costs: $20.00 - $30.00

1/ Also used in Advanced Forest Mensuration. No need to duplicate, unless both courses offered at the same time.

2/ Also used in Elementary Forest Surveying. No need to duplicate, unless both courses offered at the same time.

Advanced Forest Measurements Equipment and Supplies

ITEM	QUANTITY
Surveying Compasses Complete 2/	5
Tree Marking Guns	5
Tally Meters	15
Tree Calipers 2/	15
Diameter Tapes 2/	15
Abney Levels 2/	10
Topographic Trailer Tapes 1/, 2/	15
100' Steel Tapes 1/, 2/	15
Aluminum Tags	

The total Estimated Cost of Supplies and Equipment for Advanced Forest Measurements is-------$2,000 - $3,500

Student Purchased Supplies
(Other Than Those Already Purchased)

Wedge Prism

Hand Compass

Tally Sheets

Total	$25.00 - $35.00

1/ Also used in Elementary Forest Measurements

2/ Also used in Elementary Forest Surveying

Applied Silviculture Field Equipment and Supplies

ITEM	QUANTITY
Mistblower	1
Pruning saws with blades	15
Pruning saws, hand	15
Paint (Marking) Guns	9
Tree Markers	15
Tree Injectors	2
Pressure Spray Cans (3 gal. cap.)	2
Brush Saw	1
Woodsmans Saws	8
Brush Axes	8
Direct Seeders	8
Planting Bars	15
Planting Mattocks	15

Miscellaneous Supplies

Paint, flagging tape, herbicides,

planting bags, oil cans (pump)

Approximate total cost of Applied Silviculture Laboratory equipment and supplies---------$1,500 - $2,500

Student Locker Requirement

	QUANTITY
Hard Hat	1
Light metal leg guards	1 pr.
1-lb. Hand Axe	1

Approximate Student Cost------------$15.00 - $17.00

General Logging Supplies and Equipment Cost

EQUIPMENT

ITEM	QUANTITY
Chain Saws	6
Filing guides, clamp-type	2
Peavys, short-handled	6
Peavys, long-handled	4
Logging boom	1
Rubber-tired Skidder	1
Scoots	2
5-ton Log truck with hydraulic loader	1

TOTAL ESTIMATED COST - $25,000 - $30,000

SUPPLIES

ITEM	QUANTITY
Gasoline cans, 2-1/2 gal., red	5
Oil cans, 1 gal.	5
Felling wedges, Magnesium	10
Filing guides, hand, with file	6
Cable chokers, 1/8" wire rope, 6 ft. length	6
Cable chokers, 3/8", 2 slip hooks, 6 ft. length	6
Logging tongs	2 pr.
Flat bastard files	6
Tool kits, small	6
Markal Paint Sticks	3 doz.
Log rules, 1/2" Int.	6
Polyhooks	6
Load binders, heavy duty	4
Log chain	150 ft.

TOTAL ESTIMATED COST - $500 - $800

Student Equipment

ITEM	QUANTITY
Aluminum Safety Hat, Hi-Viz Orange	1
Axe, limbing, 2-1/2 lb., 30" handle, wood	1
Safety knee patches (fibre-glass)	1 pr.

TOTAL ESTIMATED COST - $12.00 - $14.00

SUMMARY OF COSTS

The equipment listed is basic and does not include items for specialized programs. The cost estimates assume the purchase of new equipment of good quality in the quantities indicated. Especially advantageous buying and the acquisition of suitable government or private surplus equipment may make it possible to equip forest technology field laboratories for less cost. For the purposes of estimating the probable costs of equipping a forest technology program, these cost reduction potentials <u>should not be counted on</u>.

Therefore, the total cost of equipping a forest technology program based on 1966 prices may be estimated as follows:

Item	Estimated Cost $
Suggested allowance for demonstration and special teaching equipment	3,000 - 4,000
Drafting tables, work benches, storage cabinets and fixtures	10,000 - 12,000
Equipment used primarily in the first year	
Minimum required equipment	24,000 - 30,000
* Additional to fully equip laboratories	3,500 - 5,000
Supporting tools and supplies for first year courses	1,900 - 3,700

Equipment used primarily for second year courses	
Minimum required equipment	33,500 - 43,500
* Additional to fully equip laboratories	5,000 - 7,500
Supporting tools and supplies for second year courses	1,500 - 2,600
*General field equipment required to operate a full program	27,000 - 47,500
Total Estimated Cost to Fully Equip the Program	$123,000 -155,500

The total estimated cost of $123,000 to $155,500 to fully equip a forest technology program may, if necessary, be reduced to the total cost of the minimum recommended equipment by deferring the purchase of the items marked with an asterisk (totally $35,500 to $60,000) until their purchase is financially feasible. Thus the estimated cost of the minimum recommended equipment and facilities to undertake a program is from $87,500 to $95,500. It is recommended however, that the full budget allocation be authorized in order to make available to the students an effective learning situation.

The foregoing estimates do not provide for the cost of the building which, if constructed for the program, may be calculated at $13 to $15 per square foot of unfurnished laboratory space. Such space with special utilities and built-in furnishing, without portable equipment, may be estimated at $30 to $35 per square foot.

BIBLIOGRAPHY

*Adams, L. J. Intermediate Algebra. New York: John Wiley and Sons, Inc., 1954.

Adams, Robert M. "The Origin of Cities." No. 607. San Francisco: Scientific American Offprints, current edition.

*Allen, Durwood L. Our Wildlife Legacy. New York: Funk and Wagnall Co., 1962.

Allis-Chalmers Company. "Fundamentals of Logging." 5th edition. New York: the Company, 1963.

Allison, Richard C. and Roger Leighton. "Evaluating Forest Campground Sites." Extension Folder No. 64. Durham, N. H.: Cooperative Extension Service, University of New Hampshire, 1966.

American Pulpwood Association. "Pulpwood Truck Driving." Training Guide No. 7. New York: the Association, current edition.

__________. "Small Crawler Operator's Manual." New York: the Association, current edition.

__________. Various technical releases on Timber Harvesting. New York: the Association.

Anderson, Roger F. Forest and Shade Tree Entomology. New York: John Wiley and Sons, Inc., 1960.

Andres, P. G. and others. Basic Mathematics for Science and Engineering. New York: John Wiley and Sons, Inc., 1944.

Applefield, Milton and Paul J. Bois. "Thickness Variation of Hardwood Lumber in 1963 by Circular Sawmills in North Carolina." Asheville, No. Carolina: Southeast Forest Experiment Station, Forest Service, U. S. Department of Agriculture, May 1966.

Arnold, Joseph N. and others. Introductory Graphics. New York: McGraw-Hill Book Co., Inc., 1958.

*Avery, Eugene. Interpretation of Aerial Photographs. Minneapolis: Burgess Publishing Co., 1962.

__________ and Allyn M. Herrick. Field Projects and Classroom Exercises in Basic Forest Measurements. Athens, Georgia: University of Georgia Press, 1963.

Avery, G. S. and Elizabeth B. Johnson. "Hormones and Horticulture." New York: McGraw-Hill Book Co., Inc., 1947.

*Babb, Hugh W. and Charles Martin. Business Law. New York: Barnes and Noble, Inc., 1964.

Bailey, L. H. The Cultivated Conifers of North America. New York: The Macmillan Co., 1934.

*Baird, A. Craig and Franklin H. Knower. Essentials of General Speech. 3rd edition. New York: McGraw-Hill Book Co., Inc., 1963.

__________ and __________. General Speech: An Introduction. 2nd edition. New York: McGraw-Hill Book Co., Inc., 1957.

Baker, Wilfred H. Elements of Photogrammetry. New York: Ronald Press, 1960.

*Barrett, John W. Regional Silviculture of the United States. New York: Ronald Press, 1962.

*Bauer, Royal D. M. and P. H. Darby. Elementary Accounting. 3rd edition. New York: Barnes and Noble, Inc., 1965.

Bear, F. E. Soils in Relationship to Crop Growth. New York: Reinhold Publishing Co., 1965.

Beardsley, Monroe C. Thinking Straight: Principles of Reasoning for Readers and Writers. 3rd edition. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1960.

Bell, Daniel. "The Racket-Ridden Longshoremen." No. S-12. Indianapolis, Indiana: Bobbs Merrill Reprint Series, current edition.

*Berger, K. C. Introductory Soils. New York: The Macmillan Co., 1965.

Bettelheim, Bruno. "Individual and Mass Behavior in Extreme Situations." No. S-23. Indianapolis, Indiana: Bobbs Merrill Reprint Series, current edition.

*Billings, W. D. Plants and the Ecosystem. Belmont, Calif.: Wadsworth, 1965.

Black, C. A. Soil-Plant Relationships. New York: John Wiley and Sons, Inc., 1957.

Blenis, Henry W. The Indispensable Forest Technician. Washington, D. C.: Society of American Foresters, 1962.

__________. "The Maritime Forest Ranger School and its Place in Canadian Forestry Education." Boston: Regional Meeting of the Society of American Foresters, 1965.

*Bordeaux, Jean. How to Talk More Effectively. 2nd edition. Chicago: American Technical Society, 1952.

Boucher, Harry and Francis H. Moffit. Surveying. 5th edition. Scranton, Pa.: International Textbook Co., 1965.

*Boyce, John S. Forest Pathology. 3rd edition. New York: McGraw-Hill Book Co., Inc., 1961.

Braidwood, Robert J. "The Agricultural Revolution." No. 605. San Francisco: Scientific American Offprints, current edition.

Breed, Charles B. Surveying. 2nd edition, revised. New York: John Wiley and Sons, Inc., 1957.

Breed, Charles B. and G. L. Hosmer. Surveying. New York: John Wiley and Sons, Inc., 1920.

*Brinker, Russell C. and Warren C. Taylor. Elementary Surveying. Scranton, Pa.: International Textbook Co., 1961.

Britton, N. L. North American Trees. New York: Henry Holt and Co., 1908.

*Brock, C. Frank. Recreational Use of Wild Land. New York: McGraw-Hill Book Co., Inc. 1959.

*Broom, H. J. and J. G. Longenecker. Small Business Management. Cincinnati: South-Western Publishing Co., 1964.

Brown, Curtis M. Boundary Control and Legal Principles. New York: John Wiley and Sons, Inc., 1957.

*__________ and Winfield M. Eldridge. Evidence and Procedure for Boundary Location. New York: John Wiley and Sons, Inc., 1963.

*Brown, Nelson C. Logging: The Principles and Methods of Harvesting Timber in the United States and Canada. New York: John Wiley and Sons, Inc., 1949.

*__________ and James S. Bethel. Lumber. 2nd edition. New York: John Wiley and Sons, Inc., 1958.

*Bruce, Donald. Prism Cruising in the Western United States and Volume Tables for Use Therewith. Portland, Oregon: Mason, Bruce and Girard, 1961.

*__________ and Felix Schumacher. Forest Mensuration. New York: McGraw-Hill Book Co., Inc., 1950.

Buckley, William E. and William C. McAvory. American College Handbook of English Fundamentals. New York: American Book Co., 1960.

*Buckman and Brady. Nature and Properties of Soils. 6th edition. New York: The Macmillan Co., 1960.

Bunting, B. J. The Geography of Soil. Chicago: Aldine Publishing Co., 1965.

Burt, William H. and Richard P. Grossenheider. A Field Guide to the Mammals. 2nd edition. New York: Houghton-Mifflin, Inc., 1964.

Butler, W. E. "Chip Markets: Potentials and Problems for Sawmills and Plywood Plants." Forest Products Journal, April 1965.

Butterfield, Herbert. "The Scientific Revolution." No. 607. San Francisco: Scientific American Offprints, current edition.

*Cahalane, Victor. Mammals of North America. New York: The Macmillan Co., 1961.

*Chapman, H. H. and Walter H. Meyer. Forest Mensuration. New York: McGraw-Hill Book Co., 1949.

*Cheyney, Edward G. What Tree is That? New York: D. Appleton and Co., 1927.

----------. "Christmas Trees--A Technical Manual for Farmers." Harvey J. Stangel, editor. New York: Allied Chemical Corp., 1966.

Church, Thomas W., Sr. "Railroad Crossties--Opportunities for Improving the Manufacture and Serviceability." Southern Lumberman, December 1965.

*Clawson, Marion. Land and Water for Recreation. Chicago: Rand McNally and Co., 1963.

Cobb, B. C. "Skidding with Rubber-Tired Tractors in the Tennessee Valley." Technical Note No. 26. Norris, Tenn.: Tennessee Valley Forestry Commission, January 1957.

Combellack, Wilfred. Introduction to Elementary Functions. New York: John Wiley and Sons, Inc., 1962.

Cook, R. L. Soil Management for Conservation and Production. New York: John Wiley and Sons, Inc., 1962.

Cook, Stanton A. Reproduction, Heredity and Sexuality. San Francisco: Wadsworth, 1965.

Corrington, Murlan S. Applied Mathematics for Technical Students. Revised edition. New York: Harper and Brothers, 1952.

Crafts, Alden S. and W. F. Robbins. "Weed Control." New York: McGraw-Hill Book Co., Inc., 1962.

*Craighead, F. C. Insect Enemies of Eastern Forests. U. S. Department of Agriculture Publication No. 657. Washington, D. C.: U. S. Government Printing Office, 1950.

*Crouch, William G. and Robert Zetler. A Guide to Technical Writing. 3rd edition. New York: Ronald Press, 1964.

*Cruden, Herbert J. and Arthur S. Sherman Jr. Personnel Management. 2nd edition. Chicago: South-Western Publishing Co., 1963.

*__________ and __________. Readings in Personnel Management. 2nd edition. Chicago: South-Western Publishing Co., 1966.

Cuppett, Donald C. "Air-Drying Practices in the Central Appalachians." Research Paper NE-56. Upper Darby, Pa.: Northeast Forest Experiment Station, 1966.

__________. "How to Determine Seasoning Degrade Losses in Sawmill Lumberyards." Research Note NE-32. Upper Darby, Pa.: Northeast Forest Experiment Station, 1965.

*----------. Current Perspectives on Social Problems. Judson R. Landis, editor. Belmont, Calif.: Wadsworth, 1966.

Dame, L. L. Handbook of Trees of New England. Boston: Ginn and Company, 1904.

Dana, S. T. and E. W. Johnson. Forestry Education in America Today and Tomorrow. Washington, D. C.: Society of American Foresters, 1963.

Darwin, W. N. "Logging Facts for Sawmill Operators." Norris, Tenn.: Tennessee Valley Authority, 1953.

Dasmann, Raymond E. Environmental Conservation. New York: John Wiley and Sons, Inc. 1959.

*__________. Wildlife Biology. New York: John Wiley and Sons, Inc., 1964.

*Davis, Kenneth P. Forest Fire: Control and Use. New York: McGraw-Hill Book Co., Inc., 1959.

*Davis, Raymond E. Elementary Plane Surveying. 3rd edition. New York: McGraw-Hill Book Co., Inc., 1955.

*Dean, Howard H. and Kenneth D. Bryson. Effective Communication. 2nd edition. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1961.

Deevey, Edward S. Jr. "The Human Population." No. 608. San Francisco: Scientific American Offprints, current edition.

Delphendahl, Johannes. "Outdoor Recreation in Maine." Orono, Maine: Agricultural Experiment Station, University of Maine, 1965.

DeVitis, A. A. and J. R. Warner. Words in Context: A Vocabulary Builder. New York: Appleton-Century-Crofts, Inc., 1961.

*Dilworth, J. R. Log Scaling and Timber Cruising. Corvallis, Oregon: Oregon State University, 1962.

*__________ and T. F. Bell. Variable Plot Cruising. Corvallis, Oregon: Oregon State University, 1963.

Doane, R. W. and others. Forest Insects. New York: McGraw-Hill Book Co., Inc., 1936.

Dobzhansky, Theodosius. "The Present Evolution of Man." No. 609. San Francisco: Scientific American Offprints, current edition.

Donnelly, Robert. "A Technique for Relating Logging Costs to Logging Chances." Northeastern Logger, September, 1962.

Dowdle, Barney and Robert Bain. "Lumber or Chips?" Station Paper No. 150. Upper Darby, Pa.: Northeast Forest Experiment Station, 1961.

*Dressler, Isidore. Review Text in Preliminary Mathematics. New York: AMSCO School Publications, Inc., 1962.

__________ and Rich. Reviewing Trigonometry. New York: AMSCO School Publications, Inc., 1948.

*Duerr, William A. Fundamentals of Forestry Economics. New York: McGraw-Hill Book Co., Inc., 1960.

Eells, R. The Meaning of Modern Business. New York: Columbia University Press, 1960.

Eichler, A. C. and J. L. Tubis. Photogrammetry Laboratory Kit. New York: Cooper Union School of Engineering, current edition.

Ellis, Henry. The Transfer of Learning. New York: The Macmillan Co., 1965.

*Emerson, Fred W. Basic Botany. New York: Blakiston Co., 1949.

* __________ and L. M. Shields. Laboratory and Field Exercises in Botany. New York: Blakiston Co., 1949.

*Falk, Harry W., Jr. Timber and Forest Products Law. Berkeley, Calif.: Howell-North, Inc., 1958.

Field, Lawrence. "Types and Arrangement of Equipment and its Affect on Grade Recovery." Northeastern Logger, August 1962.

Fletcher, Peter W., J. L. George and R. E. McDermott. "Training Technicians and Professionals for Natural Resources Management." Resource Publication No. 30. Washington, D. C.: U. S. Government Printing Office, 1966.

Fogel, Charles M. Introduction to Engineering Computations. Scranton, Pa.: International Textbook Co., 1960.

Forbes, R. D. Forestry Handbook. New York: Ronald Press, 1956.

Forest Products Research Society. Forest Products Journal. Selected articles. New York: the Society.

----------. "Forest-Soil Relationships in North America." C. T. Youngberg, editor. Corvallis, Oregon: Oregon State University, 1965.

Foster, A. B. Approved Practices in Soil Conservation. 3rd edition. Danville, Illinois: Interstate Printers and Publishers, Inc., 1964.

*French, T. E. and C. J. Vierck. Fundamentals of Engineering Drawing. Princeton, N. J.: D. Van Nostrand Co., Inc., 1960.

*Fryer, H. C. Elements of Statistics. New York: John Wiley and Sons, Inc., 1954.

Fuller, Harry J. General Botany. New York: Barnes and Noble, Inc., 1955.

Gagne, Robert M. The Conditions of Learning. New York: Holt, Rinehart and Winston, Inc., 1965.

Gerber, John. The Writer's Resource Book. New York: Scott Foresman Co., 1957.

Giesecke, Frederick E., A. Mitchell, and Henry C. Spencer. Technical Drawing. 4th edition revised. New York: Ronald Press, 1960.

Gillies, C. B. "Comments on Some Factors Affecting the Grade and Quality of Lumber Production." Northeastern Logger, August 1962.

*Glos, R. E. and Harold A. Baker. Introduction to Business. 6th edition. New Rochelle, New York: South-Western Publishing Co., 1967.

*__________ and __________. Teacher's Manual for Introduction to Business. New Rochelle, New York: South-Western Publishing Co., 1967.

*__________ and __________. Workbook for Introduction to Business. New Rochelle, New York: South-Western Publishing Co., 1967.

Graham, Edward H. Natural Principles of Land Use. Oxford: Oxford University Press, 1944.

*Graham, Samual A. and Fred B. Knight. Principles of Forest Entomology. New York: McGraw-Hill Book Co., Inc., 1965.

Gruenberg, Ernest M. "The Epidemiology of Mental Disease." No. 441. San Francisco: Scientific American Offprint, current edition.

----------. Guidelines to Planning, Developing and Managing a Rural Recreation Enterprise. George W. Cornwell and Carl J. Holcomb, editors. Bulletin #301. Blaksburg, Va.: Virginia Polytechnic Institute, September 1966.

Hall, D. W. and Louis O. Kattsoff. Unified Algebra and Trigonometry. New York: John Wiley and Sons, Inc., 1962.

Hamlin, Mark E. and others. "The Pulp Chipping Program in the Northeast." Northeastern Logger, April 1963.

----------. Handbook of Public and Private Agencies and Services for Income-Producing Outdoor Recreation Enterprises. Ithaca, New York: Cooperative Extension Service, Cornell University, 1963.

*Hardin, James W. Workbook for Woody Plants. Minneapolis: Burgess Publishing Co., 1960.

Harlow, Harry F. and Margaret K. "Social Deprivation in Monkeys." No. 473. San Francisco: Scientific American Offprints, current edition.

*Harlow, William M. Fruit Key and Twig Key to Trees and Shrubs. New York: Dover Publications, Inc., 1946.

__________. Trees of the Eastern United States and Canada. New York: Dover Publications, Inc., 1957.

*__________ and Ellwood S. Harrar. Textbook of Dendrology. 4th edition. New York: McGraw-Hill Book Co., Inc., 1960.

Hart, Donald J. Business in a Dynamic Society. New York: The Macmillan Co., 1963.

Harwell, George C. Technical Communications. New York: The Macmillan Co., 1960.

Hawley, Amos H. "Ecology and Human Ecology." No. S-115. Indianapolis, Indiana: Bobbs Merrill Reprint Series, current edition.

Hawley, R. C. and D. M. Smith. The Practice of Silviculture. 6th edition. New York: John Wiley and Sons, Inc., 1954.

Hedlund, Arnold and Joe Christopher. "Southern Forest Survey Field Instructions." New Orleans, Louisiana: Southern Forest Experiment Station, 1966.

Heebink, Thomas B. "Suitability of Seven West Coast Species for Pallets." Research Paper FPL 22. Madison, Wisc.: Forest Products Laboratory, U. S. Forest Service, 1965.

__________ and Eugene W. Fobes. "Hardwood Pallet Manufacturing." Report No. 2132. Madison, Wisc.: Forest Products Laboratory, U. S. Forest Service, 1958.

Hicks, Tyler G. Successful Technical Writing. New York: McGraw-Hill Book Co., Inc., 1959.

Hoelscher, Randolph P. and Clifford H. Springer. Engineering Drawing and Geometry. 2nd edition. New York: John Wiley and Sons, Inc., 1961.

__________, __________, and S. J. Dobrovolny. Basic Drawing for Engineering Technology. New York: John Wiley and Sons, Inc., 1964.

Hooker, Leland. "Techniques of Sawing for Grade Recovery." Northeastern Logger, August 1962.

Hovind, H. and C. Rieck. "Basal Area and Point Sampling." Technical Bulletin No. 23. Madison, Wisc.: Wisconsin Conservation Department, 1961.

----------. "How to Develop a Campground." Brieflet No. 1095. Burlington, Vermont: Vermont Extension Service, University of Vermont, 1965.

*Huey, Ben M. Introductory Drafting and Mapping Workbook for Students in Business and Science. Dubuque, Iowa: William C. Brown Co., 1965.

Huntsberger, David. Elements of Statistical Inference. Boston: Allyn and Bacon, Inc., 1961.

Husch, Bertram. Forest Mensuration and Statistics. New York: Ronald Press, 1963.

Industrial Forestry Association. Forest Industries. Selected articles. Portland, Oregon: the Association.

Jackson, A. M. and F. Raw. Life in the Soil. New York: St. Martin's Press, 1966.

James, Clifford L. Principles of Economics. 9th edition. New York: Barnes and Noble, 1962.

Jensen, William A. The Plant Cell. San Francisco: Wadsworth, 1965.

Jiles, Robert A., Jr. "Hardwood Logging Methods and Costs in the Tennessee Valley." TVA Report 232-60. Norris, Tenn.: Tennessee Valley Authority, 1960.

*Juszli, Frank and Charles A. Rogers. Elementary Technical Mathematics. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

Kains, M. G. and McQuesten. Propagation of Plants. New York: Orange Judd, Inc., 1958.

*Kegal, Charles H. and Martin Stevens. Communication: Principles and Practices. San Francisco: Wadsworth, 1959.

Kelley, P. and K. Lawyer. How to Organize and Operate a Small Business. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1961.

King, Lawrence J. Weeds of the World: Biology and Control. New York: Interscience Publishers, Inc., 1966.

Kissam, Philip. Surveying. 2nd edition. New York: McGraw-Hill Book Co., Inc., 1956.

*Kramer, Paul J. and T. T. Kosolowski. Physiology of Trees. New York: McGraw-Hill Book Co., Inc., 1960.

*Kulow, D. L. Elementary Point Sampling. Circular No. 116. Morgantown, West Virginia: West Virginia University, 1965.

*Lehman, John W. The Changing Sawmill Industry. Norris, Tenn.: Tennessee Valley Authority, Division of Forestry Relations, July 1961.

_________. "Utilizing Pine Sawmill Residue for Pulp Chips." TVA Report No. 223-58. Norris, Tenn.: Tennessee Valley Authority, Division of Forestry Relations, December 1958.

Lennhardy, Adele. College Algebra. New York: John Wiley and Sons, Inc., 1961.

*Leopold, Aldo. Game Management. New York: Charles Scribners, 1933.

*_________. A Sand Country Almanac. Oxford: Oxford University Press, 1949.

Levine, Seymore. "Stimulation in Infancy." No. 436. San Francisco: Scientific American Offprints, current edition.

Lewis, Oscar. "The Culture of Poverty." No. 631. San Francisco: Scientific American Offprints, current edition.

Lewis, Wayne C. "Wood Residue Utilization." Forest Products Journal, August 1965.

Lockard, C. R. and others. "Grade Defects in Hardwood Timber and Logs." Agricultural Handbook No. 244. Forest Service, U. S. Department of Agriculture, Washington, D.C.: U. S. Government Printing Office, August 1963.

*Low, Julian W. Plane Table Mapping. New York: Harper and Brothers, 1952.

*Lutz and Chandler. Forest Soils. New York: John Wiley and Sons, Inc., 1946.

Luzadder, Warren J. Basic Graphics. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

Mahlstede, John P. and E. S. Haber. Plant Propagation. New York: John Wiley and Sons, Inc., 1957.

*Maier, Norman R. F. Principles of Human Relations. New York: John Wiley and Sons, Inc., 1952.

Makin, F. K. Identification of Trees and Shrubs. (Out-of-print.)

Malcolm, Fredrick B. "What Has Research Done for the Sawmill." Madison, Wisc.: Forest Products Laboratory, U. S. Forest Service, 1965.

Marder, Daniel. The Craft of Technical Writing. New York: The Macmillan Co., 1960.

Markworth, Gordon. "Statistics for Schools of Forestry." Journal of Forestry, 1966.

*Marsh, Joel W. and A. E. Brower. Insect Primer. 3rd edition. Circular No. 9. Augusta, Maine: Maine Forest Service, June 1961.

Maslow, A. H. Motivation and Personality. 2nd edition. New York: Houghton-Mifflin Co., 1955.

Matson, Robert C. Elements of Mapping. Houghton, Mich.: Michigan College of Mining and Technology, 1943.

McCauley, Orris D. "Cause and Cost of Production Delay at Hardwood Circular Sawmills in Kentucky and Ohio." Research Note 43. Columbus, Ohio: Central States Forest Experiment Station, 1965.

McCraw, W. E. "Relative Skidding Production of Track and Wheel Skidders." Canadian Forest Industries, March 1964.

McCrorie, Ken. The Perceptive Writer, Reader, and Speaker. New York: Harcourt, Brace and Co., 1959.

McDaniel, J. W. Essential Student Personnel Practices for Junior Colleges. Washington, D. C.: U. S. Government Printing Office, 1962.

Mead, George H. "The Social Self." No. S-187. Indianapolis, Indiana: Bobbs Merrill Reprints, current edition.

*Meissner, Hannah H. Poverty in the Affluent Society. New York: Harper and Row, 1966.

*----------. Minority Problems. Arnold M. and Caroline Rose, editors. New York: Harper and Row, 1965.

Merz, Robert W. and others. "Estimating Log-Making Costs in the Central States." Columbus, Ohio: Central States Forest Experiment Station, May 1965.

Meyer, Arthur. Forest Mensuration. State College, Pa.: Penns Valley Publishers, Inc., 1953.

Meyer, Carl F. Route Surveying. 2nd edition. Scranton, Pa.: International Textbook Co., 1956.

Millar, Turk, and Foth. Forest Soils. New York: John Wiley and Sons, Inc., 1965.

*Mossner, Karl E. Basic Techniques in Forest Photo-Interpretation. Ogden, Utah: U. S. Forest Service, February 1960.

Moffit, Francis. Photogrammetry. Scranton, Pa.: International Textbook Co., 1959.

Mohs, Milton C. Service Through Placement in the Junior College. Washington, D. C.: U. S. Government Printing Office, 1962.

Montville, Francis E. "How to Plan the Recreation Enterprise." Circular No. 396. Orono, Maine: Cooperative Extension Service, University of Maine, 1963.

Morgan, H. L. "Wood Chips from Sawmill Residues." Chillicothe, Ohio: The Mead Corporation, 1962.

----------. "Motor Vehicle Laws." State Department of Safety.

Muller, Walter H. Botany: A Functional Approach. New York: The Macmillan Co., 1963.

Murie, Olaus J. A Field Guide to the Mammals. New York: Houghton-Mifflin, 1958.

National Conference on State Parks. "The Park Practice Program--Grist, Guideline, Design, Trends." Washington, D. C.: the Conference.

----------. "New Jersey Private Campground Code." Trenton, N. J.: New Jersey State Department of Conservation and Economic Development, 1964.

National Hardwood Lumber Association. "An Introduction to the Grading and Measurement of Hardwood Lumber." Chicago: the Association, 1962.

__________. "Rules." Chicago: the Association, 1963.

National Safety Council. "Chain Saw Safety." Farm Safety Review, 1964.

National Wooden Pallet Manufacturers Association. "Specifications and Grades for Warehouse, Permanent or Returnable Pallets." Washington, D. C.: the Association, 1960.

__________. "Specifications and Grades for Warehouse, Permanent or Returnable Pallets of West Coast Woods." Washington, D. C.: the Association, 1962.

New England Family Campers Association. "Campfire Chatter." Newburyport, Mass.: the Association.

----------. "New Hampshire Forest Market Report." Extension Circular No. 387. Durham, N. H.: Cooperative Extension Service, University of New Hampshire, 1967.

Newman, W. and C. Summer. The Process of Management. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962.

Niskala, George R. and Thomas W. Church, Jr. "Cutting Hardwood Cants Can Boost Sawmill Profits." Research Note NE-46. Upper Darby, Pa.: Northeast Forest Experiment Station, 1966.

Northeastern Loggers Association. Northern Logger. Selected articles. Old Forge, N. Y.: the Association.

Northeastern Lumber Manufacturers Association. "Northeastern White Pine--Its Grades and Uses." New York: the Association, 1950.

__________. "Standard Grading Rules for Northern White Pine." New York: the Association, September 1962.

Northern, Henry T. Introductory Plant Science. New York: Ronald Press, 1958.

Odum, E. P. Ecology. New York: Holt, Rinehart and Winston, 1963.

*Oosting, H. J. Study of Plant Communities. San Francisco: W. H. Freeman and Co., 1948.

----------. "Opportunities for Private Campgrounds as an Alternative Use of Land." Circular No. 792. Blacksburg, Virginia: Agricultural Extension Service, Virginia Polytechnic Institute, 1963.

----------. Our Crowded Planet. Fairfield Osborne, editor. New York: Doubleday, Inc., 1962.

----------. "Outdoor Recreation Phenomenon." Ithaca, N. Y.: State College of Agriculture, Cornell University, 1964.

Pafford, F. William. "Handbook of Survey Notekeeping." New York: John Wiley and Sons, Inc., 1965.

*Palmer, Stuart. Understanding Other People. New York: Fawcett World Library, 1965.

*Panshin, A. J. and others. Forest Products. 2nd edition. New York: McGraw-Hill Book Co., Inc., 1962.

Paré, Eugene G. Engineering Drawing. New York: Holt, Rinehart, and Winston, 1959.

*Parkinson, C. N. Parkinson's Law. New York: Houghton-Mifflin, 1957.

Peck, Edward C. "Air-Drying Lumber." Revised edition. Report No. 1657. Madison, Wisc.: Forest Products Laboratory, U. S. Forest Service, 1961.

*Perrin, Porter G. and George Smith. Handbook of Current English. Revised edition. Chicago: Scott, Foresman and Co., 1962.

Peterson, Roger Troy. A Field Guide to the Birds. Revised edition. New York: Houghton-Mifflin, 1939.

*Petrides, George A. A Field Guide to Trees and Shrubs. Boston: Houghton-Mifflin, 1958.

Preston, John F. Developing Farm Woodlands. New York: McGraw-Hill Book Co., Inc., 1954.

__________. North American Trees. Ames, Iowa: Iowa State College Press, 1948.

----------. "Quality Control in Circular Sawmill Operation." Report No. 226-59. Norris, Tenn.: Tennessee Valley Authority, Division of Forestry Relations, June 1959.

Ragan, Robert. Financial Recordkeeping for Small Stores. Small Business Administration. Washington, D. C.: U. S. Government Printing Office, 1966.

*Randall, Charles E. "So You Want to be a Forester." Washington, D. C.: The American Forestry Association, 1964.

Rhodes, Fred H. Technical Report Writing. 2nd edition. New York: McGraw-Hill Book Co., Inc., 1961.

Roget, Peter Mark. New Roget's Thesaurus of the English Language. Revised edition by Norman Lewis. New York: G. P. Putnam's Sons, 1965.

*Rossweiler, Merrill and J. Merle Harris. Mathematics and Measurements. Evanston, Illinois: Row Peterson Co., 1954.

Row, Clark and others. "Improving Sawmill Profits Through Operations Research." Research Paper SO-20. New Orleans; Southern Forest Experiment Station, 1965.

Rubey, Harry and others. Engineering Surveys: Elementary. 3rd edition. New York: The Macmillan Co., 1958.

Russell, E. B. Soil Conditions and Plant Growth. 9th edition. New York: John Wiley and Sons, Inc., 1961.

Sahlins, Marshall D. "The Origin of Society." No. 602. San Francisco: Scientific American Offprints, current edition.

Sampson, N. T. "Films and Filmstrips on Forestry." Bulletin No. 7. Nacogdoches, Texas: Stephen F. Austin State College, April 1965.

Schmedemann, Ivan W. and others. "Outdoor Recreation... Potential in East Texas." College Station, Texas: Agricultural Experiment Station, Texas A & M University, 1964.

Schmidt, Orvel A. "Lumber--Quality? Grade?" Part I. Northeastern Logger, November 1963.

_________. "Lumber--Quality? Grade?" Part II. Northeastern Logger, December 1963.

Schutte, William N. and Erwin R. Steinberg. Communication in Business and Industry. New York: Holt, Rinehardt and Winston, 1960.

Schwab, G. O. and others. Elementary Soil and Water Engineering. 1st edition. New York: John Wiley and Sons, Inc., 1957.

*Semenow, Robert W. Questions and Answers on Real Estate. 4th edition. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1965.

Shain, W. A. and V. Rudolph. "Continuous Forest Inventory." Article 47-37. East Lansing, Mich.: Agricultural Experiment Station, Michigan State University, 1965.

Shenefelt, Roy D. and Daniel M. Benjamin. Insects of Wisconsin Forests. Madison, Wisc.: Agricultural Experiment Station, University of Wisconsin, current edition.

Sherif, Muzafer. "Experiments in Group Conflict." No. 454. San Francisco: Scientific American Offprints, current edition.

*Shilt, Bernard A. and W. Harmon Wilson. Business Principles and Management. 4th edition. New Rochelle, N. Y.: South-Western Publishing Co., 1961.

*__________ and __________. Teacher's Manual for Business Principles and Management. New Rochelle, N. Y.: South-Western Publishing Co., 1961.

*__________ and __________. Workbook for Business Principles and Management. New Rochelle, N. Y.: South-Western Publishing Co., 1961.

*Shirley, Hardy L. Forestry and its Career Opportunities. New York: McGraw-Hill Book Co., Inc., 1964.

Silverborg, Savel B. "Northern Hardwoods Cull Manual." Bulletin No. 31. Syracuse, N. Y.: College of Forestry, State University of New York, 1954.

__________. "Tree Diseases of New York State Plantations." Bulletin No. 44. Syracuse, N. Y.: College of Forestry, State University of New York, 1962.

Simmons, Fred C. "Logging Farm Wood Crops." Farmers Bulletin No. 2090. Revised. Washington, D. C.: U. S. Government Printing Office, 1962.

________. "Northeastern Logger's Handbook." Handbook No. 6. Washington, D. C.: U. S. Government Printing Office, 1951.

Sinnott, E. W. and Katherine S. Wilson. Botany: Principles and Problems. New York: McGraw-Hill Book Co., Inc., 1963.

Sloan, Roger P., John Sargent, and Leslie B. Sargent. "Christmas Trees--A Cash Crop." Extension Bulletin No. 157. Durham, N. H.: Cooperative Extension Service, University of New Hampshire, 1965.

Smith, Charles R. and others. Rural Recreation for Profit. Danville, Illinois: Interstate Printers and Publishers, Inc., 1966.

*Smith, David M. The Practice of Silviculture. 7th edition. New York: John Wiley and Sons, Inc., 1962.

*Society of American Foresters. "Forest Cover Types of North America." Washington, D. C.: the Society, 1954.

________. "Society of American Foresters Check List of Forestry Items in a Working Library." Washington, D. C.: the Society, 1962.

*Souther, James W. Technical Report Writing. New York: John Wiley and Sons, Inc., 1957.

*Sowder, Arthur M. "Christmas Trees: The Tradition and the Trade." U. S. Department of Agriculture Information Bulletin No. 94. Washington, D. C.: U. S. Government Printing Office, 1965.

*Spencer, Henry C. Basic Technical Drawing. New York: The Macmillan Co., 1956.

*Springer, Richard D. and others. Basic Graphics: Drawing and Descriptive Geometry. Boston: Allyn and Bacon, Inc., 1963.

Spurr, Stephen H. Aerial Photographs in Forestry. New York: Ronald Press, 1948.

*__________. Forest Ecology. New York: Ronald Press, 1964.

*__________. Forest Inventory. New York: Ronald Press, 1952.

*__________. Photogrammetry and Photo-Interpretation. 2nd edition. New York: Ronald Press, 1960.

----------. "State Regulations Governing the Sanitation of Juvenile Recreational Camps."

----------. "State Regulations Pertaining to Public Swimming in Pools and Bathing Places."

Stevens, N. E. and R. E. Disease in Plants. Waltham, Mass.: Chronica Botanica Co., 1952.

*Stewart, Marie M. and others. Business English and Communication. 2nd edition. New York: McGraw-Hill Book Co., Inc., 1963.

*Strunk, William Jr. and E. B. White. The Elements of Style. New York: The Macmillan Co., 1963.

Taeuber, Karl E. "Residual Segregation." No. 626. San Francisco: Scientific American Offprints, current edition.

----------. Technical Education Yearbook. Ann Arbor, Michigan: Prakken Publications, Inc., 1966.

Telford, C. J. "Small Sawmill Operator's Manual." Washington, D. C.: U. S. Government Printing Office, 1952.

Thompson, Wayne N. Fundamentals of Communication. New York: McGraw-Hill Book Co., Inc., 1957.

Tisdale, S. L. and W. L. Nelson. Soil Fertility and Fertilizers. 2nd edition. New York: The Macmillan Co., 1966.

*Tracey, John C. Plane Surveying. New York: John Wiley and Sons, Inc., 1934.

Tracy, Calvin R. and Harold L. Jennings. Handbook for Technical Writers. Chicago: The American Technical Society, 1961.

Trefethen, James B. Wildlife Management and Conservation. Boston: D. C. Heath and Co., 1964.

Trippensee, Reuben E. Wildlife Management. Volume I. New York: McGraw-Hill Book Co., Inc., 1948.

__________. Wildlife Management. Volume II. New York: McGraw-Hill Book Co., Inc., 1953.

U. S. Department of Agriculture. "Converting Factors and Tables of Equivalents Used in Forestry." Miscellaneous Publication No. 225. Washington, D. C.: U. S. Government Printing Office, June 1949.

__________. "Forest Fire Fighting Fundamentals." Washington, D.C.: U. S. Government Printing Office, current edition.

__________. "Insect Manual (4-H Club)." Agricultural Handbook No. 65. Washington, D. C.: U. S. Government Printing Office, February 1964.

__________. Plant Diseases, The Yearbook of Agriculture. Washington, D. C.: U. S. Government Printing Office, 1953.

__________. "Rural Recreation--A New Family-Farm Business." Washington, D. C.: U. S. Government Printing Office, 1962.

__________. "Rural Recreation Enterprises for Profit." Agricultural Information Bulletin No. 277. Washington, D. C.: U. S. Government Printing Office, 1963.

__________. "Rural Recreation--New Opportunities on Private Land." Miscellaneous Publication No. 930. Washington, D.C.: U. S. Government Printing Office, 1963.

__________. "Rural Recreation Report of Task Force on Income-Producing Recreation Enterprises on Farm Land." Washington, D. C.: U. S. Government Printing Office, 1962.

__________. Soils and Men: The Yearbook of Agriculture. Washington, D. C.: U. S. Government Printing Office, 1938.

__________. Soil Survey Manual. Handbook No. 18. Revised. Washington, D. C.: U. S. Government Printing Office, 1963.

__________. Soil: The Yearbook of Agriculture. Washington, D. C.: U. S. Government Printing Office, 1950.

__________. "Summaries of Selected Publications on Rural Outdoor Recreation." Economic Research Service Publication No. 190. Washington, D. C.: U. S. Government Printing Office, 1964.

__________. Bureau of Outdoor Recreation. "Federal Assistance in Outdoor Recreation." Washington, D. C.: U. S. Government Printing Office, 1964.

__________. Federal Extension Service. "Bibliography of Selected Publications in Rural Recreation as a Business." No. RDPA (11-62). Washington, D. C.: U. S. Government Printing Office, 1963.

__________. Federal Extension Service. "Budgeting Farm and Ranch Recreation Enterprises." Extension Service Circular No. 559. Washington, D. C.: U. S. Government Printing Office, 1964.

__________. Forest Service. "Campgrounds for Many Tastes." Research Paper No. INT-6. Ogden, Utah: Intermountain Forest and Range Experiment Station, 1963.

__________. Forest Service. "Forest Insect Conditions in the United States--1962." Washington, D. C.: U. S. Government Printing Office, July 1963.

__________. Forest Service. "Forest Recreation for Profit." Agricultural Information Bulletin No. 265. Washington, D. C.: U. S. Government Printing Office, August 1962.

__________. Forest Service. "Grade Defects in Hardwood Timber and Logs." Handbook No. 244. Washington, D. C.: U. S. Government Printing Office, August 1963.

*__________. Forest Service. "A Guide to Hardwood Log Grading." Upper Darby, Pa.: Northeast Forest Experiment Station, 1965.

________. Forest Service. "A Guide to Log Diagramming for Eastern Softwoods." Upper Darby, Pa.: Northeast Forest Experiment Station, 1964.

*________. Forest Service. Manual for Forest Fire Control. Washington, D. C.: U. S. Government Printing Office, 1958.

*________. Forest Service. National Forest Log Scaling Handbook. No. FSH 2443.71. Washington, D. C.: U. S. Government Printing Office, 1964.

________. Forest Service. "Outdoor Recreation in the National Forest." Agricultural Information Bulletin No. 301. Washington, D. C.: U. S. Government Printing Office, 1965.

________. Forest Service. "Permanent Logging Roads for Better Woodlot Management." Upper Darby, Pa." Northeast Forest Experiment Station, 1960.

________. Forest Service. "Recreation Opportunities and Problems in the National Forests of the Northern and Intermountain Regions." Research Paper No. 66. Ogden, Utah: Intermountain Forest and Range Experiment Station, 1962.

________. Forest Service. "Silvics of Forest Trees of the United States." Agricultural Handbook No. 271. Washington, D. C.: U. S. Government Printing Office, 1965.

________. Forest Service. "Tree Diseases of Eastern Forests and Farm Woodlands." Agricultural Information Bulletin No. 254. Washington, D. C.: U. S. Government Printing Office, April 1962.

________. Forest Service. "Wood . . . Colors and Kinds." Agricultural Handbook No. 101. Washington, D. C.: U. S. Government Printing Office, 1956.

*________. Forest Service. Woody-Plant Seed Manual. Miscellaneous Publication 654. Washington, D. C.: U. S. Government Printing Office, June 1948.

________. Forest Service. "Working Drawings of Basic Facilities for Campground Development." Agricultural Information Bulletin No. 264. Washington, D. C.: U. S. Government Printing Office, August 1962.

*__________. Forest Service, Forest Products Laboratory. Wood Handbook. Handbook No. 72. Washington, D. C.: U. S. Government Printing Office, 1955.

__________. Soil Conservation Service. Soil Classification: A Comprehensive System, Seventh Approximation. Washington, D. C.: U. S. Government Printing Office, 1960.

U. S. Department of the Army. "Elements of Surveying." Technical Manual TM 5-232. Washington, D. C.: U. S. Government Printing Office, 1953.

U. S. Departments of the Army and Air Force. General Drafting. Technical Manual TM 5-230. Washington, D. C.: U. S. Government Printing Office, October 1962.

U. S. Department of Health, Education, and Welfare, Office of Education. Occupational Criteria and Preparatory Curriculum Patterns in Technical Education Programs. Washington, D. C.: U. S. Government Printing Office, 1962.

__________. Office of Education. Scientific and Technical Societies Pertinent to the Education of Technicians. Washington, D. C.: U. S. Government Printing Office, 1965.

__________. Office of Field Administration. Surplus Property Utilization Division. Directory: Directors of State Agencies for Surplus Property and Regional Representatives Division of Surplus Property Utilization Department of Health, Education, and Welfare. Washington, D. C.: U. S. Government Printing Office, 1965.

__________. Office of Field Administration. Surplus Property Utilization Division. How to Acquire Federal Surplus Personal Property for Health, Education, and Civil Defense Purposes and Federal Surplus Real Property for Health and Educational Purposes. Washington, D. C.: U. S. Government Printing Office, 1965.

__________. Office of Field Administration. Surplus Property Utilization Division. Surplus Material and Science Education. Washington, D. C.: U. S. Government Printing Office, 1964.

__________. Public Health Service. "Environmental Health Practices in Recreational Areas." Publication No. 1195. Washington, D. C.: U. S. Government Printing Office, 1965.

__________. Public Health Service. "Manual of Individual Water Supply Systems." Washington, D. C.: U. S. Government Printing Office, 1962.

__________. Public Health Service. "Manual of Septic Tank Practice." Washington, D. C.: U. S. Government Printing Office, 1957.

U. S. Department of the Interior. "A Primer on Ground Water." Washington, D. C.: U. S. Government Printing Office, 1963.

__________. Bureau of Sport Fisheries. "National Survey of Fishing and Hunting, 1960." Washington, D. C.: U. S. Government Printing Office, 1960.

__________. Farmers' Home Administration. "Handbook of Outdoor Recreation Enterprises in Rural Areas." Washington, D. C.: U. S. Government Printing Office, 1966.

*__________. Outdoor Resources Review Commission. Outdoor Recreation for America. Washington, D. C.: U. S. Government Printing Office, 1962.

U. S. Department of Labor. "American Labor Movement." Bulletin No. 1000. Washington, D. C.: U. S. Government Printing Office, 1957.

__________. "Industrial Relations and Wage Terms." Bulletin No. 1438. Washington, D. C.: U. S. Government Printing Office, 1965.

__________. Small Business Administration. The Why and What of Bookkeeping. Administrative Management Course Program, Topic 4. Washington, D. C.: U. S. Government Printing Office, 1965.

U. S. Department of the Navy. "Surveyor 1 and C." NAVPERS 10632-A. Washington, D. C.: U. S. Government Printing Office, 1955.

__________. "Surveyor 3 and 2." NAVPERS 10632-B. Washington, D. C.: U. S. Government Printing Office, 1955.

U. S. Employment Service. Dictionary of Occupational Titles. 2nd edition. Washington, D. C.: U. S. Government Printing Office, 1955.

Vardamen, James M. Tree Farm Business Management. New York: Ronald Press, 1965.

Vaughan, C. L. and others. "Hardwood Log Grades for Standard Lumber." Madison, Wisconsin: Forest Products Laboratory, 1966.

Verrall, Arthur F. "Building Decay Associated with Rain Seepage." Technical Bulletin No. 1356. Washington, D. C.: U. S. Government Printing Office, 1966.

__________. "Preserving Wood by Brush, Dip and Short-Soak Method." Technical Bulletin No. 1334. Washington, D. C.: U. S. Government Printing Office, 1965.

Vidich, Arthur J. and Joseph Bensman. Small Town in Mass Society. Garden City, N. Y.: Doubleday ANCHOR, 1960.

*Wackerman, A. E. Harvesting Timber Crops. 2nd edition. New York: McGraw-Hill Book Co., Inc., 1966.

*Wangaard, Frederick F. The Mechanical Properties of Wood. New York: John Wiley and Sons, Inc., 1950.

*Ward, Barbara. The Rich Nations and the Poor Nations. New York: Norton and Co., 1962.

Warner, W. Lloyd. "What Social Class is in America." No. S-302. Indianapolis, Indiana: Bobbs Merrill Reprints, current edition.

Warriner, John E. and others. English Grammar and Composition: A Complete Handbook. 10th edition, revised. New York: Harcourt, Brace and Co., Inc., 1965.

Washburn, S. L. and Irven Devore. "The Social Life of Baboons." No. 614. San Francisco: Scientific American Offprints, current edition.

Wheeland, Hoyt A. Bibliography of Timber Products Harvesting in Eastern United States and Canada. Washington, D. C.: U. S. Government Printing Office, October 1964.

Whittaker, James C. "A Cost-Accounting System for Small Sawmills." Columbus, Ohio: Central States Forest Experiment Station, 1965.

__________ and Orris D. McCauley. "Costs and Returns for Hardwood Lumber Production in the Appalachian Region of Kentucky and Ohio." Research Paper NE-55. Upper Darby, Pa.: Northeast Forest Experiment Station, 1966.

Whyte, William F. Men at Work. Homewood, Illinois, Richard D. Irwin, Inc., 1961.

Wilde, S. A. Forest Soils. New York: Ronald Press, 1958.

----------. The Wildlife Society: Manual of Game Investigational Techniques. 2nd edition. Blacksburg, Va.: Virginia Cooperative Wildlife Research Unit, 1963.

Wilson, George T. "Family Camping Manual." Bulletin No. 16. New York: American Institute of Park Executives, Inc., 1962.

Winer, Herbert I. "Multi-Product Logging Opportunities and Problems." Northeastern Logger, July 1961.

Wing, L. W. Practices of Wildlife Conservation. New York: John Wiley and Sons, Inc., 1961.

Witty, Paul. How to Become a Better Reader. Revised edition. Chicago: Science Research Associates, 1962.

Woodford, E. K. and S. A. Evans. Weed Control Handbook. Oxford: Blackwell Scientific Publications, 1965.

Yoder, Dale. Personnel Management and Industrial Relations. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1965.

Young, Charles E. and Emil F. Symonik. Practical English: Introduction to Composition. New York: McGraw-Hill Book Co., Inc., 1958.

Zetler, Robert L. and George W. Crouch. Successful Communication in Science and Industry. New York: McGraw-Hill Book Co., Inc., 1961.

*Zozzora, Frank. Engineering Drawing. 2nd edition. New York: McGraw-Hill Book Co., Inc., 1958.

* Indicates pertinent and appropriate text.

A P P E N D I C E S

APPENDIX A

Selected List of Scientific and Technical Societies Pertinent to the Education of Forest Technicians

A list of some of the professional, scientific, and technical societies concerned with forest technology and its applications may be a useful source of instructional information and reference data.

The selected list which follows is not a complete listing of all such organizations; and inclusion does not imply special approval of an organization, nor does omission imply disapproval of an organization. Details regarding local chapters or sections of societies have been omitted.

It is suggested that teachers and others desiring information from the organizations listed below should address their inquiry to "The Executive Secretary" of the organization. A request for information about the organization and its services, or for specific information usually can be answered promptly by them.

AMERICAN CONGRESS ON SURVEYING AND MAPPING, 733 15th Street, N., Washington, D. C. 20005.

History: Organized June 1941.

Purpose: To advance the science of surveying and mapping in their several branches; to further the interests of both those who use maps and surveys and those who make them; to contribute to public education in the use of maps and surveys, and to encourage the prosecution of basic mapping and surveying programs which are paid in whole or in part with public funds; to provide means or channels for the exchange of information, advancement of techniques, and establishment of standards in the professional and public interest.

Total Membership: 6,000

Publications: Surveying and Mapping, quarterly; ACSM Bulletin, periodically.

AMERICAN CONSERVATION ASSOCIATION, INC., 30 Rockefeller Plaza, New York, New York 10020.

Purpose: A non-membership, non-profit educational and scientific organization formed to advance knowledge and understanding of conservation and to preserve and develop natural resources for public use.

AMERICAN FISHERIES SOCIETY, 1404 New York Avenue, N.W., Washington, D. C. 20005.

History: Organized 1870; incorporated in the District of Columbia, 1910.

Purpose: To promote conservation, development, and wise utilization of fisheries, both recreational and commercial.

Total Membership: 2,100

Publications: Transactions, quarterly.

AMERICAN FORESTRY ASSOCIATION, 919 17th Street, N.W., Washington, D. C. 20006.

History: Organized April 1882, in Cincinnati, as the American Forestry Congress; joined at the Montreal meeting August 1882, by an earlier American Forestry Association organized in Chicago in 1875; name changed to present title 1889; incorporated, January 1920, in the District of Columbia.

Purpose: To promote the advancement of intelligent management and use of the country's forests and related resources of soil, water, wildlife, and outdoor recreation.

Total Membership: 40,000

Publications: American Forests, annually.

AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES, 3900 Wisconsin Avenue, N.W., Washington, D. D. 20016.

History: Organized February 1948; incorporated January 1955.

Purpose: To advance the biological, medical, and agricultural sciences and their applications to human welfare; to give assistance to societies, organizations, and individual biologists in matters of common concern which can be most effectively dealt with by united action.

Total Membership: 15,000 (43 adherent societies and 17 industrial members)

Publications: Bio-Science, monthly; Quarterly Review of Biology.

AMERICAN INSTITUTE OF PARK EXECUTIVES, INC., Ogleybay Park, Wheeling, West Virginia 26003.

History: Organized 1898, as New England Association of Park Superintendents; name changed to American Association of Park Superintendents 1904; re-organized and name changed to present title 1921; incorporated 1925.

Purpose: To promote the gathering and dissemination of information concerning public parks, gardens and other recreation grounds, facilities, and programs; to promote the increase of such facilities and their greater utilization.

Total Membership: 3,872

Publications: Parks and Recreation, monthly; Management Aids Bulletin, monthly.

AMERICAN PULPWOOD ASSOCIATION, 605 Third Avenue, New York, New York 10016.

History: Organized January 30, 1934.

Purpose: To guide and help the pulpwood industry grow and harvest pulpwood of the highest quality, in sufficient amounts now, and for future generations, at a reasonable cost; to serve the entire industry in technical safety and training, statistics, forest management, and legislative programs; to encourage all members to prepare now for the predicted increase in pulpwood consumption.

Publications: APA Quarterly; Newsletter, weekly; Pulpwood Annual.

AMERICAN SOCIETY OF PHOTOGRAMMETRY, 644 Leesburg Pike, Falls Church, Virginia 22044.

History: Organized August 1934; incorporated October 1934.

Purpose: To advance knowledge in the science and art of photogrammetry; to provide means for the dissemination of new knowledge and information, and thus to encourage the free exchange of ideas and intercourse among those contributing to the advancement of the art; to stimulate student interest in the field of photogrammetry by advocating a strengthening of college curriculums; to hold meetings for the presentation of symposia, panels, papers, and discussions; and to exert its efforts toward the improvement of standards.

Total Membership: 4,000

Publications: Photogrammetric Engineering, semi-monthly. Manual of Photogrammetry (textbook); Manual of Photographic Interpretation (textbook).

AMERICAN SOCIETY OF RANGE MANAGEMENT, P. O. Box 5041, Portland, Oregon 97213.

History: Organized 1947; incorporated in State of Wyoming, June 1949.

Purpose: To foster advancement in the science and art of grazing land management; to promote progress in the conservation and greatest sustained use of forage and soil resources; to stimulate discussion and understanding of scientific and practical range management problems; to provide a medium of exchange for ideas and facts among Society members and with allied technicians; and to encourage professional improvement of members.

Total Membership: 4,585

Publications: Journal of Range Management, bimonthly.

ASSOCIATION OF CONSULTING FORESTERS, Box 6, Wake, Virginia 23176.

History: Organized and incorporated 1948.

Purpose: To assure forest owners of competent professional service through maintenance of high standards of performance by consulting foresters; to promote the most economical and most scientific management of forest resources.

Total Membership: 150

Publications: The Consultant, quarterly.

ECOLOGICAL SOCIETY OF AMERICA, Oak Ridge National Laboratory, Radiation Ecology Division, Oak Ridge, Tennessee 37831.

History: Founded 1951; incorporated 1957; a member of American Institute of Biological Sciences since 1947.

Purpose: To promote the scientific study of organisms in relation to their environment, both as individuals and as members of populations and communities; and to facilitate the exchange of ideas among those interested in this area of study.

Total Membership: 2,850

Publications: Bulletin, quarterly; Ecology, quarterly; Ecological Monographs, quarterly.

ENTOMOLOGICAL SOCIETY OF AMERICA, 4603 Calver Road, College Park, Maryland 20740.

History: Founded 1953, by a merger of the American Association of Economic Entomologists, organized

1889, and the former Entomological Society of America, organized 1906.

Purpose: To promote the science of entomology in all its branches; to assure cooperation in all measures tending to that end; and to publish the Annals of the Society, the Journal of Economic Entomology and other entomological publications.

Total Membership: 4,950

Publications: Journal of Economic Entomology, six times a year; Annals, six times a year; Bulletin, quarterly.

FOREST FARMERS ASSOCIATION COOPERATIVE, 1100 Crescent Avenue, N.E., Box 7284, Station C, Atlanta, Georgia.

History: Organized 1941.

Purpose: A non-profit forestry organization of timber land owners--primarily small owners--in 15 southern states, organized in 1941 to give private timber owners and related interests a greater voice in matters affecting their business.

FOREST PRODUCTS RESEARCH SOCIETY, 417 North Walnut Street, Madison, Wisconsin 53705.

History: Organized January 3, 1947.

Purpose: To promote the interchange of information among individuals and organizations interested in forest products research development, productions, distribution, and utilization.

Total Membership: 4,200

Publications: Forest Products Journal, monthly.

INSTITUTE OF ENVIRONMENTAL SCIENCES, 34 South Main Street, Mt. Prospect, Illinois 60057.

History: Merger of Institute of Environmental Engineers and Society of Environmental Engineers in April 1959, resulted in Institute of Environmental Sciences.

Purpose: To provide means whereby environmental sciences can be explained, discussed, and debated, and thus aid the technological advances of this hemisphere.

Total Membership: 1,900

Publications: Journal of Environmental Sciences, bi-monthly; Proceedings, annually.

INDUSTRIAL FORESTRY ASSOCIATION, 1410 S.W. Morrison Street, Portland, Oregon 97205.

History: Organized 1934.

Purpose: To promote forestry on both private and public lands throughout Douglas fir region of western Oregon and western Washington. Founded Tree Farm movement in United States in 1941 and sponsors it throughout region.

NATIONAL FIRE PROTECTION ASSOCIATION, 60 Batterymarch Street, Boston, Massachusetts 02110.

History: Organized 1896; Electrical Committee took over in 1911 work of National Conference on Standard Electrical Rules, dating from 1897; Safety to Life Committee organized 1912; Marine Committee, 1922; Fire Marshals Protective Association of North America, dating from 1909; became section of this Association, 1927; Aviation Committee organized 1928; Society of Fire Protection Engineers organized as section of this Association, 1950; Railroad section reestablished 1963.

Purpose: To promote science and improve methods of fire protection and prevention, to obtain and circulate information on these subjects; and to secure cooperation of members in establishing proper safeguards against loss of life and property by fire.

Total Membership: 21,000

Publications: Advance Reports, annual; Proceedings, annual; National Fire Codes, annual; Annual Fire Protection Handbook; 600 other publications (catalog on request).

NATIONAL PARKS ASSOCIATION, 1300 New Hampshire Avenue, N.W., Washington, D. C. 20036.

History: Organized 1919.

Publications: National Parks Magazine.

NATIONAL SHADE TREE CONFERENCE, 1827 Neil Avenue, Columbus, Ohio 43210.

History: Founded 1924.

Purpose: To promote and improve the practice of arboriculture and to promote public education to develop a greater appreciation for the value of arboricultural practices.

Total Membership: 1,850

Publications: Arborists News, monthly; Proceedings; annually; various irregular publications.

NATIONAL WILDLIFE FEDERATION, 1412 16th Street, N.W., Washington, D. C. 20036.

History: Organized 1936; formally chartered 1937; incorporated in District of Columbia.

Purpose: To federate on a national scale state-level organizations expressing an interest in the conservation of wildlife and other natural resources and representing a cross-section of conservation interests with the states.

Total Membership: 2,000,000

Publications: Conservation News, bi-weekly; Conservation Report, Weekly.

NATURAL RESOURCES COUNCIL OF AMERICA, 320 Bond Building, Washington, D. C. 20005.

History: Organized October 26, 1946.

Purpose: To advance attainment of sound natural resource management through an organization of major national and regional conservation and scientific societies by effecting cooperation among them to serve common needs in resource management.

Total Membership: 40 regional and scientific societies

Publications: Legislative News Service, semi-monthly.

(THE) NATURE CONSERVANCY, 2039 K Street, N.W., Washington, D. C. 20006.

History: Organized in 1917 as Committee for the Preservation of Natural Conditions, under the Ecological Society of America; as Ecologists Union in 1946; as present title in 1950. Incorporated 1951 in the District of Columbia.

Purpose: To preserve wild nature, particularly to establish and protect nature preserves which will include an adequate series of natural areas of all types; to promote scientific, educational, and inspirational use of such areas.

Total Membership: 7,000

Publications: The Nature Conservancy News, quarterly.

NORTH AMERICAN WILDLIFE FOUNDATION, INC., 709 Wire Building, Washington 5, D. C.

History: Organized under a charter granted by the District of Columbia, July 22, 1935, as American Wildlife Institute; renamed American Wildlife Foundation, Inc., 1946; present name adopted February 1951.

Purpose: To attain better management of natural resources; to encourage and perpetuate training of technicians and administrators; to advance public education and knowledge, promote necessary research and its applications, and effect better use of funds in fields of restoration and conservation.

Total Membership: Voting and non-voting members, members of the board

NORTHEASTERN LOGGERS ASSOCIATION, INC., Old Forge, New York 13420.

History: Organized 1952; board of directors includes representatives of paper and lumber industries, United States Forest Service, state forestry departments, forestry colleges, and loggers.

Purpose: To promote profitable utilization of low grade wood and wood wastes in the interest of forestry.

Total Membership: 700

Publications: Northern Logger, special wood utilization issues, semi-annually.

RESOURCES FOR THE FUTURE, INC., 1755 Massachusetts Avenue, N.W., Washington, D. C. 20036.

History: Organized 1952.

Purpose: To advance the development, conservation and use of natural resources through programs of research and education.

SOCIETY OF AMERICAN FORESTERS, Suite 300, 1010 16th Street, N.W., Washington, D. C. 20036.

History: Organized November, 1900.

Purpose: To represent, advance, and protect the interests and standards of the profession of forestry; to provide a medium for exchange of professional thought; and to promote the science, practice, and standards of forestry at an accredited college or university.

Total Membership: 15,500

Publications: Journal, monthly; Forest Science, quarterly.

SOCIETY OF WOOD SCIENCE AND TECHNOLOGY, Colorado State University, College of Forestry, Fort Collins, Colorado 80521.

History: Organized as American Institute of Wood Engineering, June 1958, at Madison, Wisconsin; name changed to present title, 1959.

Purpose: To establish a professional basis for the pursuit of wood science and technology; to foster improvements in education in wood science and technology; to promote research in this field; and to provide a medium for exchange of ideas and technical information relating to wood science and technology.

Total Membership: 200

Publications: Intermittent.

SOIL SCIENCE SOCIETY OF AMERICA, 677 South Segoe Road, Madison, Wisconsin 53711.

History: Organized 1936; incorporated in Wisconsin 1952; member, American Society of Agronomy.

Purpose: To foster all phases of fundamental and applied soil science.

Total Membership: 2,900

Publications: Proceedings, bi-monthly.

SOIL CONSERVATION SOCIETY OF AMERICA, INC., 7515 N.E. Ankeny Road, Ankeny, Iowa 50021.

History: Founded 1941; incorporated 1949.

Purpose: To advance the science and art of good land use.

Total Membership: 11,141

Publications: Journal of Soil and Water Conservation, bi-monthly.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, 360 Lexington Avenue, New York, New York 10017.

History: Founded 1915.

Purpose: To promote research, education, and application of the sciences in the pulp and paper industry, and the collection and dissemination of technical data fundamental to pulp and paper manufacture and use.

Total Membership: 11,210

Publications: Tappi, monthly; Yearbook; Bibliography of Paper Making, annually.

WILDLIFE MANAGEMENT INSTITUTE, 700 Wire Building, Washington, D.C. 20005.

History: Incorporated in the State of New York, May 8, 1946.

Purpose: To promote research and scientific activities in wildlife restoration, conservation and management, including maintenance of research projects; to develop new and improved techniques, and demonstrate their use for the guidance of others; to gather basic technology and disseminate it by publications and publicity of all kinds and by personal contacts, through its field representatives; to provide contacts and maintain advisory consulting services; to promote and encourage education.

Total Membership: 674

Publications: Transactions, annual; Outdoor News Bulletin, bi-weekly.

APPENDIX B

Suggested Procedure for Laboratory Report Writing

GENERAL CONSIDERATIONS

Observations of equipment and analysis of inventory techniques are usually summarized in the form of reports. In most cases, these reports are submitted to individuals who have not been actively engaged in the tests; therefore, the reports must be clear and concise enough to leave no doubt concerning the method of operation and the interpretation of the result. Data should be summarized and shown graphically whenever diagrams, charts or graphs simplify its comprehension or interpretation.

The report should be written in the past tense and in the third person. It should be impersonal throughout. The report must be complete in itself so that it can be followed by a reader without extensive knowledge of the equipment or technique under consideration. A good report is thorough, orderly, neat and grammatically correct.

SPECIFICATIONS

1. Write in ink or use a typewriter.
2. Use $8\frac{1}{2}$ x 11 inch paper. (Ruled paper for handwriting.)

4. Draw all illustrations, diagrams and curves neatly and carefully.
5. Letter or type all information on drawings, diagrams, and curves. Do not mix lettering styles.
6. Assemble the sheets in the order given in the following report outline. Submit the material in a standard report folder with the brads inserted through the back cover only, with the heads on the outside.

REPORT OUTLINE

The material should be arranged in the following order:

I. Title Page

II. Introduction

III. Methods of Investigation

- A. Procedure
- B. Diagrams

IV. Results

- A. Data
  - 1. Type of equipment observed
  - 2. Observed and calculated data
- B. Sample calculations
- C. Curves, charts or graphs

V. Analysis of results

VI. Questions

(Not more than one of the above six divisions should be included on a single page. Omit Roman numerals.)

DISCUSSION OF REPORT OUTLINE

I. Title Page

On this page should appear the name of the school, the course number and title, the date performed, the date submitted, the name of the student reporting, and the name of co-worker or co-workers. This page may be omitted if the form printed on the report folder includes these items.

II. Introduction

The introduction should be a concise statement setting forth the aim and scope of the investigation

III. Method of Investigation

A. Procedure. In this section a general description of the procedure should be given. It should be comprehensive but brief. The enumeration and detailed description of routine operations and their sequence should, in general, be avoided. However, when a specific method of operation is necessary to assure the validity or accuracy of the test data, it is important that the essential details be included in the description.

B. Diagrams. Each diagram should have a figure number. It should be referred to in the text material by that number. Each figure should have a descriptive title. Small diagrams may be included in the body of the description, or several may be drawn on one separate sheet if the result is not crowded. Standard symbols should be used.

IV. Results

A. Data. The first item under results should be the identification of the apparatus observed. The original observed data and the calculated data should be presented in tabular form. If the observed data require corrections, these should be made before tabulation.

B. Sample Calculations. This section should consist of a sample of a complete calculation of each type involved in the determination of calculated data and the solution of problems. When a succession of calculations is required in order to reach a final result, the same set of observed data should be used in carrying through the successive sample calculations, i.e.: the same sample figures that are selected from a data column should be used in all calculations involving that set of data.

C. Curves. All curve sheets should conform to the following specifications:

1. Use "twenty to the inch" coordinate paper, $8\frac{1}{2}$ x 11 inch for rectangular plots.
2. Plot the first quadrant where only one quadrant is needed.
3. In general, make the axes intersect within a sectioned part of the paper. Leave the curve sheet margins blank.
4. Plot the independent variable as the abscissa and the dependent variable as the ordinate.
5. In general, start the scale of the dependent variable but not necessarily the scale of the independent variable, at zero.
6. Choose scales that are easy to use and do not allow points to be plotted to a

greater accuracy than justified by the accuracy of the data.

7. Indicate points plotted from data by visible dots or small circles.
8. Draw a smooth, average curve through the plotted points. Use a French curve in drawing the curves.
9. Place a title containing all pertinent information on each sheet. The title should be lettered or typed. Label the axes and show the units in which they are marked.
10. Draw only related curves on the same sheet.
11. Insert curve sheets in the report so that they can be read from the bottom or the right side.
12. Use ink for everything on the sheet except the curves themselves; these should be drawn with a colored pencil.

V. Analysis of results

The analysis of results is the most important section of the report. As the name implies, it should be a complete discussion of the results obtained. Part of the discussion should deal with the accuracy or reliability of the results.

It is suggested, where applicable, that this section consist of a careful treatment of the effect on the results of the following:

(1) Errors resulting from the necessity of neglecting certain factors because of physical limitations in the performance of the test

(2) Errors in manipulation

(3) Errors in observation

(4) Errors in instrumentation

An important part of the discussion should be a comparison of the results obtained with those which would reasonably have been expected from a consideration of the theory involved in the original problem. Whenever the theory is apparently contradicted, the probable reasons should be discussed.

When results are given in graphical form such as curves, the shape of each curve should be carefully explained. Such an explanation should state the causes for the particular shape the curve may have.

Any original conclusions drawn as a consequence of the laboratory procedure should be included in this section.

VI. Questions

In this section should be included answers to any questions which are given as a part of the test.