

spruce trees and fir trees on aerial photos. The author would have been confident in the recommendation because it was based upon a scientific study of the facts and free from personal bias.

## LITERATURE CITED

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## PHOTOGRAMMETRY FOR PRACTICING FORESTERS AND WOODLAND MANAGERS

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## ABSTRACT

Most programs in photogrammetric education have been prepared to meet the specific needs of the engineer or professional map maker. However, the professional forester and forest land manager likewise need information on photogrammetric techniques applicable to their specific profession. Thoughtful consideration has been given to the organization and presentation of a short course in Forest Photogrammetry, and a basic program to satisfy this deficiency in photogrammetric education is proposed.

PHOTOGRAMMETRY in the field of forestry education has found considerable favor during the past decade, and most forestry schools are presently offering elective undergraduate and graduate courses of instruction in this relatively new science. However, this training has been somewhat ineffectual in the field of practical forestry for several reasons. The educational institutions have restricted registration in such courses or have included the topic as an adjunct to a course in surveying, because of limited equipment, available space, inadequate instructional staff, and curtailed budgets. Students who have secured more than an introduction to the theory and practice in the science of photogrammetry have been able to secure better compensation with engineering and mapping agencies than in forestry positions. Foresters and forest using industries have labored under the impression that the use of aerial photographs or photogrammetric techniques is much too expensive to show economic justification in average forest management problems.

Admittedly, few forest operators, particularly the smaller organizations, can economically justify the employment of a thoroughly trained photogrammetrist for his ability in this field alone, and are

equally dubious concerning the economic feasibility of negotiating contracts with aerial mapping concerns for photo coverage of scattered holdings. Some of these operators are aware that definite benefits are available through the efficient use of the aerial photograph, and encourage certain members of their present forestry personnel to acquaint themselves with the techniques involved in using this pictorial encyclopedia of information. Other forest land managers, realizing a potential value in the aerial photograph but being uninformed of its limitations, have become discouraged and even hostile, because the photograph was not a "cure all" for his forest management problems, or accuracies developed were far beyond his needs, thus rendering their use entirely uneconomical.

These foresters and woodland managers need guidance as they master the profitable techniques, realize potentials and limitations of using aerial photographs, and evaluate the data drawn from them. This seems to indicate that the establishment of short, practical courses of study, geared to the practicing forester and woodland manager, and presented by institutions for forestry education, is desirable.

A few forestry schools have already in-

stituted such programs, but generally speaking their effect has been rather local and limited. Additional programs of instruction should be organized at geographically scattered educational institutions possessing the necessary equipment and teaching personnel, in order to bring pertinent regional information and applicable techniques to the practicing profession of forestry in that area.

The proposal and organization of any course of study must carefully consider the student and his needs, if it is to be effective and beneficial to him. Assuming the student to be the practicing forester or woodland manager, and that his need for a short course in photogrammetry is very specialized, the following items must command prime consideration.

Scheduling, both from the standpoint of time of year and duration of the course, is of first importance. Most concerns are reluctant to relinquish the services of supervisory personnel, who would profit most by such photogrammetric training, during the busier operational periods or just prior to those periods when problems of organization and work plans are pressing. However, as the field season approaches an end, absence of personnel for a few days is deemed less serious, and there is adequate time before the next field season for the individual to profitably put into practice that which he has learned by attending the course.

Likewise, most firms are hesitant in granting leaves in excess of one work week without charging the time against the vacation period of the individual. Therefore, the ideal short course should not exceed five days in duration and should be correlated with the slack work periods of the forestry activities within the region to be served.

Also, the students for the course will probably be individuals whose formal education is several years behind and are not particularly interested in the topic from an academic point of view, but will be more likely to ask "How?" rather than "Why?" This attitude plus the fact that any short course must be rather intensive, precludes highly technical discussions of photogrammetric theory.

The type of training this type of student needs, and can best use, must be given major consideration. The great majority of these students will be sponsored by firms

who neither have, nor can afford, expensive photogrammetric equipment. Therefore, emphasis must be placed on instruments which, though simple and inexpensive, are capable of producing the desired accuracies. Techniques in the use of these instruments to produce usable information from the photograph must be a fundamental aim of the program. The basic instrument is of course the stereoscope, and emphasis should be placed on its use, coupled with a thorough grounding in interpretation of the detail portrayed in the photograph. Considerable valuable forest information may be obtained from the photograph by inference and by complete correlation of geological and ecological relationships. These relationships are well known to the forest land manager when seen on the ground, and he should be given the opportunity to acquire considerable experience in identifying them on the photograph.

It then follows that the ideal short course in photogrammetry will provide for a large measure of the laboratory type of instruction as opposed to the lecture method. After considerable detailed stereoscopic inspection of the photographs in the classroom, the student should be given the opportunity to verify his findings by field inspection trips to the areas portrayed in the photographs. This field inspection serves to check the classroom conclusions, builds self confidence within the student, and promotes a sharpened curiosity and more piercing inspection of the photographs.

In order to carry out this laboratory phase of the training, it is essential that local forest photography be available for course instruction. It is also desirable that photography of the same terrain at various scales, with a variety of film-filter combinations, and exhibiting seasonal differences, be available to give the student an opportunity to evaluate the numerous combinations in light of his individual and specific problems.

The availability of suitable photography in the region of the student's normal activity should be discussed rather thoroughly. A number of governmental agencies have, from time to time, conducted aerial surveys over wide areas throughout the country for a great variety of purposes. This photo coverage is, in the main, available to the private concern or individual, and he

needs only to be informed of these sources and the procedure of obtaining prints to utilize this economic source of forest information. Some areas are lacking in this coverage, or the existent photographs are unsatisfactory for forestry purposes by reason of scale, type, or date of photography; special contracts with aerial photographic firms may be negotiated to secure the desired coverage. In areas where the services of commercial aerial mapping concerns are considered necessary, it is desirable that the client be well informed as to the type of photography, scale and other specifications to be included in the contract terms, to secure maximum efficiency and return from the proposed investment. This topic should receive more than passing consideration in the proposed short course.

Keeping these several items in mind, the following general outline is proposed as a sound basis on which to build a short course in practical forest photogrammetry.

- I. *Basic Geometric Properties of Aerial Photographs.* This section should include the necessary definitions and standard nomenclature in the field of photogrammetry. The student, after completing the course may then read with understanding, articles dealing with the application of this science to his profession and which may come to his attention through technical journals. Discussions of tilt, scales, and relief displacement should be included in this section, pointing out the effect of each on the usability of the photograph for forestry purposes.
- II. *Development of Controlled and Uncontrolled Mosaics.* Included in this section should be a discussion of the frequency and accuracies needed in the field to develop adequately controlled mosaics; the extension of horizontal control by means of radial line plotting; and subsequent compilation of forest type maps and planimetry by sketch master or rectoplanograph methods, and area determinations.
- III. *Basic Principles of Stereoscopy and Parallax Measurements.* Practice in making parallax measurements for purposes of spot elevation determination, and tree height measurements for use in volume determination should be made available in this section. Considerable practice is necessary in making parallax measurements before the individual becomes consistent, and this point should be emphasized to the student. He should not expect to become proficient in this phase of the work during the period of the course, but should continue making parallax measurements and field checking them after returning to his home.
- IV. *Techniques of Photo Interpretation for Forestry.* These techniques will vary somewhat from region to region, depending upon the principal use of the forest. The use of photographs in problems of fire control, insect control, transportation, planting programs and recreational uses of the forest, employ the characteristics of size, shape, tone, and relative position of portrayed data in varying degrees, and the potentials and limitations must be made apparent to the student.
- V. *Photographic Specifications.* A section devoted to a discussion of film-filter combinations, scales, season of photography and other factors affecting the practical usability of the photograph by the forest manager.
- VI. *Sources of Photographic Coverage.* This section should furnish the student with information concerning the type, scale, data, cost and general excellence of the photographic coverage obtainable in his area of operations, from commercial, state or federal agencies. For areas where there is no existent photography or where coverage is unsuitable, discussion of contracts for special missions should be correlated with Section V.
- VII. *Photogrammetric Instruments.* This section should not be slighted in its coverage of sources, cost, general adaptability to forest problems, potentials and limitations of the more common and simpler instruments capable of providing the accuracies needed in forest operations.

The cost of the short course indicated above should probably be in the vicinity of \$50.00 per student, exclusive of board and room. This fee would make possible supplying him with the necessary photographic prints for laboratory work, a pocket type stereoscope, a note book and possibly a text book, all of which would

become property of the student. The fee would also include transportation for field trips. Salaries of the instructional staff and use of instruments other than pocket stereoscopes would be donated by the institution presenting the course.

This course is designed to be presented in ten (10) four-hour periods supplemented by two evening discussion periods. To the professional photogrammetrist, any one of the above subdivisions, if treated fully, might well consume a five day instructional period. However, basic information can

be presented in rather concise and condensed form without sacrificing practical usefulness to the practicing forest manager.

It must constantly be kept in mind by the instructional staff that this forest manager is not being trained to be a professional photogrammetrist but instead is to be acquainted only with those elements of the science that are applicable to his profession, and are economically consistent with the solution of his specific problems.

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