Commission VII on Photo Interpretation: Working Group on Forestry Applications

ANNUAL REPORT 1960

RUDOLF W. BECKING, *Chairman of Working Group**

EDITOR'S NOTE. The great delay in publishing this record for the year 1960 was caused by the combination of unavoidable difficulties and obstacles. See the 1961 YEARBOOK, p. 330 for reports of other working groups.

INTRODUCTION

THE year of 1960 has been characterized by numerous reports and summaries reviewing the present status of forest photo interpretation. Many new advances have been reported at the two important International Congresses held in the past year, the 5th World Forestry Congress, August 30–Sept. 9, 1960, at Seattle, Wash. (10, 11, 16, 42, 53, 56)† and the 9th International Congress of Photogrammetry, Sept. 6–16, 1960, at London, England. (7, 19, 28, 36, 40, 41, 44, 48, 50). Another major event in 1960 was the publication of the new MANUAL OF PHOTOGRAPHIC INTERPRETATION, an outstanding contribution to our present knowledge of forest photo interpretation.

This year, 24 reporters have generously contributed news and technical information to this annual report. Especially acknowledged is the qualified information received from abroad, from the Swedish Committee on Forest Photogrammetry and the German Arbeitskreis für forstliches Luftbildwesen, and the Arbeitsgemeinschaft für Forsteinrichtung.

For the first time, a selected bibliography of 1960 publications is incorporated in this annual report.

FOREST PHOTOGRAPHY AND PHOTO INTERPRETATION

Species identification studies conducted in Eastern Canada with Aero Plus X Panchromatic 1:15,840-scale photography has made the distinction possible of 23 important tree species. Each such species is characterized by its crown image and stand pattern, topographic site and species associations, and by comparison with species that appear similarly on the same photographs (Dixon). An illustrated forest type key of the South has recently been published (2) and the publication of 25 original stereograms of these forest types is in preparation (Avery). Extensive use in delineating soil and vegetation types is made of aerial photography in the current soil-vegetation survey in California (56).

Test photography in Eastern Canada (Dixon) indicates that a) Infrared photography taken in May with the Wild Infragon lens and a Minus-Blue filter during high overcast weather gave excellent results; b) Infrared summer photography under similar conditions would accentuate contrast between hardwoods and softwoods with a mininum loss of definition in shadow areas; and c) Panchromatic photography taken June 4 just before full foliage development gave a pronounced tonal distinction between Yellow birch (*Betula lutea*) and Sugar maple (*Acer saccharum*). However, difficulties in species distinction by tonal contrast have been noted in the tropics, and in mid-summer photography in England (28).

On the Ochoco National Forest in Eastern Oregon, the application of panchromatic photography at scales of 1:12,000, 1:8,000 and 1:5,000 was tested for its value in the unit area control management of Ponderosa pine (*Pinus ponderosa*). A highly useful map of forest condition classes could be made of any of these three photo scales showing overstory age and risk class, and understory height and stocking class of the Ponderosa pine forests. A field check verified the correct identification of the condition class components in 80 per cent of the stands checked. This aerial photography and its resulting map has already made a significant contribution to unit area control management, the laying-out of boundaries of cutting units and the planning of skid-road location (Pope).

* Humboldt State College, Arcata, California.

† The numbers refer to the selected Bibliography while an author's name in italics refers to information obtained personally from the reporter.

Photo Inventory Applications

Inventory techniques have recently been proposed in which aerial photography plays a leading role in forest type stratification, selection of sampling design, distribution of sample plots over each stratum, and the assessment of statistical precision of the inventory (13, 15, 20, 37, 44, 54). New is the further attempt by which diameter at breast-height of trees is directly determined from low-altitude Sonné photography taken in the leafless (autumn) season (33) or indirectly from tree crown-diameter measurements (12, 29).

The greatest interest, however, lies in the development of photo volume tables with a tendency towards the preparation of composite stand volume tables for broad species groups, like conifer versus hardwood stands. Generally, regression techniques have become more and more accepted using primarily double-ground/photo sampling for verification of local stand conditions. The statistically important variables to be measured in the field as well as on the photographs, are total tree height of a few dominant and codominant trees, crown closure per cent, and often visible crown-diameter. Recently, photo volume tables have been introduced: 1) composite stand volume tables for Lodgepole pine-deciduous stands in British Columbia (1), and 2) for Northern Minnesota (3), stand volume tables for pure stands of 3) second-growth Douglas fir and mature Ponderosa pine in Oregon (12), for 4) Ponderosa pine in the Rockies (31). New is the approach to develop specific local volume tables directly from local stand data by multiple regression analysis. It is concluded that this procedure is most successful because it allows best for peculiar local stand conditions and specific regression coefficients for each individual interpreter (21, 43).

Another interesting development is direct ocular volume estimation from photographs (30); the volume/acre for each stratum is estimated with regular checks by means of double-ground/photo sampling; appropriate corrections are continuously made following these checks. In British Columbia (22) helicopters are extensively used for so-called "air-calls". This inventory technique (22, 39) consists of ocular estimation of volume/acre at predetermined sampling points within each forest type, using tape recorders for storing information on forest type, species composition, volume, stocking density, age class and site quality. Recent experiments have been conducted for obtaining a large-scale (1:3,600) stereophotographic record of these air-calls from the helicopter. For this purpose two F-24 or Hulcher 70 mm. cameras were firmly mounted on a 15-foot boom which was suspended longitudinally beneath the helicopter. The difficult problem of accurate determination of the flying height above the ground was solved with acceptable precision by means of a regression analysis of 1/11 (flying height) on photo base (boom length). The photographic scale can be calculated from known focal-length, photo-base (boom length) and photo-measured air-base length (22). In addition, helicopters are extensively used for transportation, fire fighting, and aerial photo interpretation field checks (27).

Of special interest is the recent attempt (51, 52) to utilize aerial photography from 1951 and 1959 for height growth determination of the same forest stand. For the exacting precision, height measurements were made with a Zeiss Stereotop. Preliminary results are still inconclusive. In Germany, stand volume is exclusively determined by conventional groundcruising techniques (Von Laer, Hildebrandt).

A study of aerial determination of the site index of Douglas fir forests in Western Washington and Oregon has recently been concluded using 1:12,000 to 1:20,000 panchromatic photography. Used are chiefly geographic and physiographic features directly obtainable from maps and photos. The independent variables tested are: altitude and latitude obtained from maps, and slope aspect, topographic land form and soil depth estimations interpreted from the photos. A multiple regression analysis revealed that all these variables are significantly related to the dependent variable: site index of the Douglas fir (*Pseudotsuga menzisii*). However, only about 30 per cent of the total variation in the Douglas fir site index has been accounted for. Therefore, it is concluded that this photo estimation has only limited value at the present where rough site index estimates of large forest areas are quickly needed (Pope). Aerial site index estimate studies have also been recently concluded in British Columbia (JHG Smith).

In Canada (Dixon) as well as in the U. S. (Bradshaw) a program of regular rephotography of all forest land has been adopted where possible. Generally, the interval of 10 years is chosen. (13, 45). The most common forest photography is taken on Plus X Panchromatic film with a Minus-Blue filter at scales ranging from 1:15,000 to 1:20,000. In the State of Washington, a recent study has been completed to determine the value of aerial photography to supplement the current Forest Survey field estimates of total forest land, and its breakdown into stand size and stocking classes. It has been demonstrated that the addition of supplementary photo plots resulted in tremendous improvements in the accuracy of estimating total forest land area at a cost of only 5 to 40 per cent of the cost of a straight field survey of equal accuracy (Pope).

In Germany, the most common scale for forestry purposes is still 1:10,000, although recently the trend is towards 1:20,000. Most mapping work is done by the enlargement methods, generally with simple equipment (Zeiss, Luz, Leisegang Antiskop). Since 1960 more and more stereometric methods are applied in forest mapping for which especially the Zeiss-Stereotop seems to be most applicable. Apparently the gradual change from the monoscopic enlargement methods to stereometric mapping is the most remarkable fact of 1960 (Von Laer, Hildebrandt).

Forest Insect Damage Surveys

Test flights concerning the detective and inventory value of large-scale color photography have been continued the past year in projects near a) Ely, Minnesota, b) Bangor, Maine, c) Montpelier, Vermont, d) Mt. Mitchell, N.C. and e) Greenville, Tenn. The 70 mm. color photography is taken at scales ranging from 1:1,188 to 1:7,920 using a Skylight (1A) filter, Anscochrome, Super Anscochrome and Camouflage Detection films. This photography will serve as a photographic record of areas infested by Spruce Bud-worm (a), Balsam Woolly Aphid (b,c,d) and Oak Wilt (e). Its prime purpose is to test its detection value for early infestations, the real extent of the infection, the spread or trend of the outbreak and its subsequent control, and to provide for a quantitative estimate of defoliation and timber losses in these areas. (Aldrich, Heller).

Previous studies in the Coulter pine (*Pinus coulteri*) region of Southern California have indicated the great value of 1:5,000 color or camouflage-detection photography for the survey of the epidemic mortality in Coulter pines. However, still considerable interpretation errors resulted from this survey. Additional test flights have now been flown for 1:5,000 vertical color photography and 1:2,500 color photography taken both at the vertical and at 20° from the vertical. Preliminary interpretation indicates no significant improvement by the scale increase or the oblique viewpoint (Pope).

The original 70 mm. continuous strip viewer has been completely redesigned incorporating many new improvements like more working space, variable illumination intensity, a spring release on the glass pressure plate to reduce film scratching, and increased portability. Also a 6-watt fluorescent tube is used as its light source connected with two 45-Volt "B" batteries, good for 16 hours of continuous service (Aldrich, Heller).

Special Applications

Interesting is the use of ground stereophotography in studying the defect development in infected tree boles of sample trees (55).

Education and Training

The only forestry textbook in photogrammetry has been completely revised in its second edition (46). A very practical Training Handbook and Training Kit (33), primarily designed for self study and forestry applications has been distributed in more than 1,000 copies throughout the U. S., Canada and also abroad. At least 27 universities and colleges have ordered training kits for their instruction (Moessner).

The International Training Center for Aerial Survey, Delft, Netherlands has initiated a new series of ITC Publications in the fields of Photogrammetry and Photo interpretation which are distinctive for their quality and instructive information (Boon).

A new 35-minute sound and color motion picture entitled "Photo Interpretation for the Discovery and Evaluation of Forest Resources" has been completed the past year with either English or Spanish sound track (Colwell).

Reporters

For addresses of the reporters, reference is made to the membership list of the American Society of Photogrammetry.

CANADA: Geo. W. Allison, R. M. Dixon, S. T. B. Losee, E. H. Lyons, H. E. Seely, J. H. G. Smith.

EUROPE: H. Axelsson (Stockholm, Sweden), D. A. Boon (ITC, Delft, Netherlands), G. Hildebrandt (Freiburg i.Br, West Germany), W. Von Laer (Koblenz, West Germany), E. Welander (Stockholm, Sweden).

U.S.A.: R. C. Aldrich, T. Eugene Avery, K. E. Bradshaw, J. Carow, C. D. Chase, R. N. Colwell, J. R. Dilworth, R. C. Heller, Wm. P. MacConell, K. E. Moessner, C. E. Olson, J. W. Willingham, H. E. Young.

FOREST PHOTO INTERPRETATION

Selected Bibliography for 1960

(1) Allison, G. W. and R. E. Breadon, (1960), Timber volume estimates from aerial photographs: *For. Survey Note*, B.C. Forest Serv. no: 5, 1960: 25 pp.

In the Babina Public Working Circle, 10,000 acres of mature spruce-lodgepole pine stands have been inventoried by double ground/photo sampling. Photo volume is obtained by regression analysis with tree-height of 4 D&CD trees and crown-closure %. Local volume tables have been prepared for a) mature conifers b) immature conifers and c) lodgepole pine-deciduous stands.

(2) Avery, Gene, (1960), Identifying Southern forest types on aerial photographs: *Southeast. For. Exp. Sta., Station Paper* no: 112 1960: 12 pp.

Eight single photographs organized in pairs on panchromatic and infrared film are selected to represent forest types of the Coastal Plain, Piedmont, and the mountains of North Carolina & Georgia. Photos are annotated and at a scale of 1:15,840.

(3) Avery, Gene and M. P. Meyer, (1960), Volume tables for aerial timber estimating in Northern Minnesota: *Lake States For. Exp. Sta., Station Paper* no: 78, 1959: 21 pp.

Photo-volume is estimated from 1:15,840 photography using existing photo-volume tables of the Rockies (conifers), Kentucky (hardwoods) and Mississippi (conifers & hardwoods). A preliminary local volume for Carlton County, Minn. is prepared using average tree-height and crown-closure per cent.

(4) Bajzak, D., (1960), An evaluation of site quality from aerial photographs of the University of British Columbia Research Forest, Haney, B.C.: *For. Chron.* 36(2) 1960: (171) M.F. Thesis Univ. British Columbia, Vancouver B.C. 1960.

Site Quality Classification from aerial photography is studied by PI of topographic & physiographic features, forest cover-types and their combination. Collected 238 sample plots in 30-yr or stands, and 26 plots in old-growth stands. Significant correlations exist of site index with local and general topography, % slope, elevation, soil depth, moisture regime (best single variable), soil permeability & texture. However, only 31% of total variation in site indices is accounted for.

(5) Berezin, A. M. and N. G. Kharin, (1960), Krupnomasshtabnuiu serofotos! emku-v proizvodstvo. (Large-scale aerial photography in production): *Lesn. Khoziaistvo* 1960 (5): (15–8).

On 1:15000–25000 photography 25–30% of the total number of trees can be individually counted, on 1:10,000 65% of the trees, on 1:1,500–5,000 72–80% of trees. Field check of 1:2,000 photography amounted only to about 5–7% loss in total volume from not-counted trees. On 1:3,000 SN-2 spectrazonal film the average stand-height could be measured within 6% accuracy. A linear regression between visible crown-diameter and dbh of individual trees is given for Pinus, Abies, Betula & Alnus.

(6) Bickford, C. A., (1960), A test of continuous inventory for National Forest Management based upon aerial photographs, double sampling and remeasured plots: *Proceed. Soc. American For.* 1959/1960, 1960: (143–8).

Aerial photography is intensively used in the continuous inventory of the Alleghany Natl. Forest for stratification in forest types, area determination and exact relocation of sample plots for remeasurement. The initial inventory has to represent the present volume of the stands accurately, since no correlation of the growth with the initial stand-volume has been observed. A flexible random sampling design has been developed using the most recent photography.

(7) Boon, D. A., (1960), Report of Working Group 4 (Vegetation), Commission VII, International Society of Photogrammetry. International Training Center, Delft, Neth. Photogram. Eng. 26 (2), 1960: (283–302).

Forestry uses of aerial photography are reported from 30 countries. An extensive bibliography is included.

(8) Borman, P. S., (1960), Razumno ispol' zovat' fotoplanshety. (Rational use of photo maps): *Lesn. Khoziaistvo* 1960 (1): (22–4).

The different kinds of maps available to the forester are discussed and the difficulty in making a photo-mosaic map because of ratioed and rectified photography, its limited usefulness for surveying because of lack of visible triangulation stations, and other important survey information. On large timber tracts there are still no maps at all available.

(9) Catinot, R. & G. de Saint-Aubin, (1960), Utilisation des photographies aériennes sans point au sol en cartographie forestière: *Bois For. Trop.* 69 (1) 1960: (17–25).

A study of transforming aerial photographs into sketch-maps without any ground control points, but by means of photo triangulation of pass-points and astronomic reference points. Approx. costs of map production for scales 1:50,000 or 1:25,000 are given.

(10) Cromer, D. A. N., (1960), Surveys applicable to extensive forest areas in the Asia-Pacific Region: Communication 5th World Forestry Congress, Seattle, Wash. 1960: GA/7/I/A-Australia, abstract 1 pp.

New Zealand forest inventory is now completed from aerial photography using variable sampling intensity according to the productive potential of the forest itself as strata. The use of photo-volume tables has met with little success owing to the presence of defect and variable species cull in Eucalyptus stands. Considerable progress has been made in PI techniques (elimination of shadow point) but difficulty is encountered in stratifying the tropical rain forest.

(11) De Rosayro, R. A., (1960), Surveys particularly applicable to extensive forest areas (Asia): Communication 5th World Forestry

Congress, Seattle, Wash. 1960: GA/157/I /A-Ceylon, abstract 2 pp.

In rain forest types an ecological stratification from 1:15,840 aerial photography proves to be the best for stand inventory. Tropical dry evergreen and moist deciduous forest is inventoried from 1:9,000–7,200 photos with the aid of 1:20,000–40,000 photography. Montane forest types are best stratified along ecological lines. Sampling intensity varies from ¼–3% for the individual strata.

(12) Dilworth, J. R., (1959), Aerial photo-mensuration tables: *Oregon State College Agric. Exp. Sta., Forest Research Division, Research Note no: 2, 1959: 8 pp.*

Included are tables for a) the relation of dbh to visible crown-diameter (VCD) and tree-height (TH) for second growth Douglas fir in medium and well-stocked stands, b) board-foot photo-volume, c) cubic-foot photo-volume tables, d) the same tables for McDonald Forest, Corvallis, Ore, e) the same tables for well-stocked DF Stands, f) a regression solution of dbh on VCD and TH for Ponderosa pine in well to medium-stocked stands of site IV, and g) standard tree photo-volume table for mature Ponderosa pine in similar stands and site.

(13) Dixon, R. M., (1960), Inventory maintenance procedure for Ontario: *Ontario Dept. Lands & Forests, Timber Branch, Silvicultural Series, Bull.* no: 1, 1960: 24 pp.

Outlined is the detailed inventory procedure, aerial photography specifications and uses, map revision procedures, PI work for forest typing, stocking-density, area classification and the data compilation by IBM cards for statistical and management reports. The inventory is applicable up to a 20-year period of interval, and stratifies the forest into 20-yr. age classes.

(14) Ericsson, H., (1960), Concerning accuracy in measuring trees and stand heights: *Svensk Lantmäteri Tidskrift* 3, 1960:

Errors in stereo-parallax height determinations are caused by difficulties in identifying the ground level and the tree tips, attributed to different kinds of photography, local height differences and the shape of the tree-crown. Measurements from photographs at different scales, paper print qualities and negatives, by different simple or precision instruments have indicated distinct tendencies to underestimate tree-heights, particularly from prints without shadows.

(15) Francis, D. A., (1960), Interim report to the Government of the Sudan on forest inventory: Expanded technical assistance program, FAO, Rome. 1959: 56 pp.

Described are the progress made and methods employed in the National Forest inventory with particular reference to aerial photography.

(16) Glerum, B. B., (1960), Report to the Government of Brazil on a forestry inventory in the Amazon Valley (Part V) (Region between Rio Caete and Rio Marocassume): Expanded Technical Assistance Program, FAO, Rome. *FAO Report* no: 1250, 1960: 67 pp.

It covers a very inaccessible region E. of the Amazon estuary. Once the planned Belem-Sao Luis road is constructed, small sawmills, relying mainly on Carapa guianensis, are thought to be an economical possibility, but not veneer or paper mills. Extensive use of aerial photography has been made in planning the economic development of the forest resources.

(17) Heinsdijk, D., (1960), Surveys particularly applicable to extensive forest areas (South America): Communication 5th World Forestry Congress, Seattle, Wash. 1960: GA/124/I/A-Brazil (FAO) Abstract, 1 pp.

Completed now is photography of 17 million hectares in the Amazon Basin survey and 550,000 ha in the Parana pine region. Aerial photography is intensively used for topographic mapping, forest type-mapping and in the Parana pine region also for crown-density stratification. Tree species in tropical rain forest seem to be nondomly distributed but group sizes of 2–5 ha can be detected. However, when volume classes within forest types are used as strata, a random (Poisson) distribution is evident on 1:25,000 photography. Stand volume estimates are possible with reasonable accuracy in the Parana pine region.

(18) Hildebrandt, G., (1960), Literatur über forstlichen Luftbild- und Kartenwesen (1958–1960): Univ. Freiburg i. Br. West Germany. Instit. Forsteinrichtung, 1960: 15 pp. (mimeogr.)

A listing (not annotated) of 1958–1960 publications according to the following subject division: a) manuals, textbooks, reports, b) map preparation, area determination, c) photo interpretation: general, technical problems, forest-type distinction & management, d) forest-inventory, e) new photo interpretation equipment, f) aerial timber estimation, and g) forest cartography.

(19) ———, (1960), Ein Zeitvergleich von Waldtaxationen mit und ohne Luftbildern: Paper 9th Internat. Congress Photogram., London, Engl. 1960: 4 pp. (Typescript).

The use of aerial photography for stand description, division into subcompartments, and site quality assessment in preparing management plans has resulted in a 40% reduction of time and expenses when compared with conventional field procedures.

(20) Kuusela, K., (1960), Koeala-arvioinnin tilastollisen tarkkuuden laskonta (Calculation of statistical precision in plot inventory): *Metsät. Aikak.* (6/7) 1960: (233–4).

Outlined is the inventory technique using aerial photography for forest stratification and area determination. Total timber volume is estimated by stratified sampling. Optimum sample plot allocation and accurate area calculation of the strata reduce the number of plots needed for the required accuracy of volume estimation.

(21) Lee, Yam., (1959), A comparison of some 12-inch and 6-inch focal length photographs for photo mensuration and forest typing: Univ. Br. Columbia, Vancouver B.C. M.F. Thesis, 1959: 124 pp.

Conclusions are 1) crown-closure % is overestimated by photo estimate when compared to densimeter readings, 2) treecounts are not effectively usable, 3) f:12″ at 15,600 ft. altitude photography proves to be best in PI work, 4) among photo-volume table variables tested, tree-height, crown-diameter, crown-closure prove to be the only effective ones, 5) no significant differences among paper qualities and their finishes are detected for photo-volume estimation, 6) RF 1:15,840 is best for stand typing, 7) greatest source of variation in volume exists between interpreters, 8) volume estimation is improved by regression analyses adapted to the individual interpreter.

(22) LYONS, E. H., (1960), 70 mm. helicopter stereo photography: Paper at Dec. 6, 1960 meeting of the Puget Sound Region, Amer. Soc. Photogram. 6 pp. (Typescript).

Stereo photography at a scale of 1:700 to 1:1,200 is obtained by mounting 2 cameras on a 15 ft. boom. F-24 cameras with focal-plane shutters were impractical in turbulent air. Hulcher 70 mm. movie cameras were only fair in their precision. The system of air calls from helicopters provide inventory information at a cost of 2.8 cts/acre. 3 test areas were photographed in the Yellow pine Region near Lytton, B.C.

(23) MARK, E., (1960), Zur gegenwärtigen Situation der forstlichen Photogrammetrie in Oesterreich: *Allgem. Forstztg*, Vienna 71 (13/14) 1960: (153–6)

Forestry applications of aerial photography in Austria are discussed with notes on PI equipment. Now available is photography at 1:25,000 (Vorarlberg), 1:28,000 for the remainder of Austria.

(24) ———, (1960), Die Passpunktbeschaffung für forstlich-photogrammetrische Kartierungsaufgaben: *Allgem. Forstztg*, Vienna 71 (13/14) 1960: Informationsdienst appendix: 2 pp.

Use of aerial photography in property delineation, forest survey and road design. Needed are independent pass-points (4 for Zeiss Aerotopograph, 3 for Wild A6 & A8) selected for their reliability in triangulation and elevation. Since large forest complexes lack visible triangulation stations, there is suggested obtaining additional pass-points by means of the Radialsecator of Zeiss, and calculating exact coordinates of these pass-points for forest mapping.

(25) MATÉRN, B., (1960), Forest surveys and the statistical theory of sampling. Some recent developments: Communication 5th World Forestry Congress, Seattle, Wash. 1960: GA/74/I/B/-Sweden, 12 pp.

The best efficiency of various sampling designs is provided by "multi-phase" sampling which provides for intensive use of aerial photography. Sampling units are stratified on the photos, ocular estimates of photo plots are obtained and calibrated against field checks, and a cluster arrangement for field plots is adopted to avoid high cost of travel. Cluster plots should be arranged in an optimum structure over the area. Advocated also is use of an independently performed parallel survey for evaluation of subjective errors, and the idea of sampling on successive occasions is mentioned.

(26) MAYER, E. R., (1960), Neue Wege der Herstellung von Forstkarten: *Allg. Forstztg.* 71 (17/18) 1960: Suppl. (informationsdienst no. 36). 2 pp.

Discussed are inscribing techniques on various papers and plastic foils of great dimensional stability, including techniques of special coatings on such foils, cutting tools and reproduction possibilities.

(27) MILBURN, J. A., (1960), Helicopter uses in forest protection: *Canad. Pulp & Paper Industry* 13 (2) 1960: (72–78).

Described are the uses of helicopters for visibility mapping and site location of fire lookout towers, transportation of personnel and building materials to lookout towers, pre-fire season inspections, dropping smoke jumpers and supplies, emergency evacuation, aerial detection and bombing of fires, directing fire fighting crews, laying of fire hoses, emergency back firing.

(28) MILLER, R. G., (1960), The interpretation of tropical vegetation and crops on aerial photographs: *Photogrammetria* 16 (3) 1959–1960: (232–40).

Forest typing can be best accomplished on 1:30,000 photography in the tropics because of the confusing species mixtures at larger scale photography. No tonal contrast is observed between conifers (Agathis, Podocarpus, Juniperus) in the tropics against hardwoods, probably caused by the maturity of foliage. In England, larch is difficult to distinguish in mid summer from hardwoods; in the Carribean areas the same effects are observed with *Pinus caribea.* Other uses in the tropics include PI for fire history, cyclonic storm pattern, shifting agriculture pattern, savanna structure and patterns.

(29) MINOR, C. O., (1960), Estimating tree diameters of Arizona Ponderosa pine from aerial photographs: *Rocky Mountain For. Range Exp. Sta. Research Note* no: 46, 1960: 2 pp.

A regression analysis of visible crown-diameter (X1) and total height (X2) on dbh (Y) of Ponderosa pine, stratified into different age-classes and 10-ft total height-classes ranging from 40 to 110 ft, is: y(inches) $= 12.0 + 0.0076$ X1 X2 (ft.) $r = 0.84$ and $sy = \pm 2.6$ inches.

(30) MOESSNER, K. E., (1960), Estimating timber volume by direct photogrammetric methods: *Proceed. Soc. Amer. For., San Francisco Meeting,* 1959: (148–51).

Direct ocular photo estimation by dot sampling on 1:20,000 photography is efficient, time-saving and rather accurate if estimates are continuously checked by double ground/photo sample plots. Each dot is classified by species composition, forest type, stand size class, broad volume class, and topographic site. Six estimators without previous experience estimated generally timber volume within 5–10% accuracy. Use is advocated where overall volume estimates are quickly needed and the timber value is low.

(31) ———, (1960), Aerial volume tables for Ponderosa pine type in the Rocky Mountains: *Intermountain For. Range Exp. Sta., Research Note* no: 76, 1960: 6 pp.

Photo-stand volume tables are presented

for Ponderosa pine stands using 10% crown-closure classes, 5-ft height classes and 3 crown-diameter classes. Volume is expressed in cubic feet (Internat. ¼", Scribner rules).

(32) ———, (1960), Estimating the area in logging roads by dot sampling on aerial photos: *Intermountain For. Range Exp. Sta., Research Note* no: 77, 1960: 4 pp.

The jammer logging road patterns are readily discernible immediately after the end of logging operations; the area in roads and logging disturbance can be estimated by dot sampling using a 256 dots/sq. inch grid. Tests by photo versus ground sampling is slightly less than photo estimate, but subject to considerable sampling errors. Photo sampling results in 1.5x faster operation at only 10% of the cost of ground survey.

(33) ———, (1960), Training handbook. Basic techniques in forest photo interpretation: *Intermountain For. Range Exp. Sta.*, unnumbered publication 1960: 73 pp., plus training kit.

A series of practical problems with their solutions is used to demonstrate the basic PI techniques used in forestry. The method is particularly adapted for self study by foresters interested in acquiring basic knowledge of forest PI.

(34) Pallin, D. A., (1960), Direct measurement of tree diameter from low altitude continuous strip photograph: Univ. Michigan, School Natural Resources, M. For. Thesis 1960: 22 pp.

A sample of dbh's ranging from 7 to 28 inches of 70 hardwood trees has been measured directly from low altitude (250 ft. above ground) Sonné photography taken in the autumn (leafless) season. Photo measurements were consistently too high when compared to ground checks. The linear regression equation relating actual dbh with photo-measured dbh has a standard error of 2.2" and r: 0.909. It is concluded that the great image displacement permits tree-diameter measurement to a satisfactory accuracy.

(35) Pope, R. B., (1960), Ocular estimation of crown-density on aerial photos: For. Chron. 36 (1) 1960: (89–90).

Two ocular methods for crown-density estimating are described: 1) "tree cramming" method which divides mentally the plot into quarters, and crams the available tree-crowns into canopy openings of the individual quarters, 2) "tree counting" method which will count individual tree-crown in terms of the average tree crown-size. The ratio of the actually counted "average crowns" to the total number of "average crowns" to be fitted into the plot area establishes the crown-cover percentage.

(36) Reinhold, A., (1960), Arbeiten auf dem Gebiete der Luftbild-interpretation: *Ztschr. f. Vermessungstechnik* 8, 1960:

In the D.D.R. (Easy Germany) 1:10,000 panchromatic photographs are exclusively used to interpret 40,000 hectares of forest land of which 20,000 ha for site quality interpretation. Reduction of 30% in stand typing and 15% in volume inventory work have been obtained by PI.

(37) Rogers, E. J., (1960), Forest survey design applying aerial photographs and regression technique for the Caspian forest of Iran: Photogram. Eng. 26 (3) 1960: (441–3).

A forest survey design of hardwood forests surrounding the Caspian Sea is described using photo-stand measurements with ground checking. Basically are combined Chapman's triple sampling design, Meyer & Worley's methods of estimation of photo volumes, Chapman & Schumacher's regression sampling technique. The survey uses average total tree-height and average crown-closure percent as photo variables.

(38) Sanktjohanser, L., (1960), Forstliche Luftbildmessung in Hochgebirge: *Mitt. a. d. Staatsforstverwaltung Bayerns* Heft 31, 1960: (208–15).

The Zeiss-stereotop is used in map preparation of forest land in mountainous regions. A simplified technique is outlined for orienting the stereo-models with use of pass-points of known elevation.

(39) Savenkov, P. F., (1960), Aerotaksatsiia lesa s vertoleta MI-1. (Aerial forest estimation with the aid of the helicopter MI-1): *Lesn. Khoziaistvo* 1960(7): (11–3).

Comparisons are made between ocular estimation from helicopters with a ground line cruise of a 4×4 km forest tract. Two methods of the helicopter cruise are used: 1) flying height at 250 m above ground, air speed 60 km/hr, 2) at 100 m above ground, air speed of 40 km/hr, both in combination with a photo-mosaic of 1:15,000 photography for orientation and annotation. Species identification and stocking density estimates are obtained during flight 1, while site quality identification is done during flight 2, necessitating two flight missions over the tract for ocular estimation by the same cruiser. In spite of considerable cost increases when compared with ground line surveys, it is believed that the added information and accuracy is most valuable for planning the mechanization in harvesting the forest tract.

(40) Schmiedt, G., (1960), Report from Italy: Internat. Soc. Photogram., London, Engl. Suppl. Commission VII Report, 1960: (7–13).

Forestry applications include the use of 1:25,000 photography for stand typing, area determination; volume determinations are strictly made by ground cruising.

(41) Schneider, S., (1960), Report from Germany; The status of regional geographic air-photo evaluation in Germany: Internat. Soc. Photogram., London, Engl. 1960, Suppl. Commission VII Report, (1–6).

Discussed is the past history of the two most important aerial photography collections in Germany, and some of the research work on vegetation interpretation during 1943–44.

(42) Seely, H. E., (1960), Aerial photogrammetry in forest surveys: Communication 5th World Forestry Congress, Seattle, Wash. 1960: GP/12/I/B-Canada: 11 pp.

General summary of aerial photography applications in the practice of forestry in Canada. Discussed are tree-height, crown-density, species-type distinctions, stratification, sampling from aerial photography and aerial volume inventory. Included are the Forestry tri-camera, large-scale photography, infrared, color and camouflage detection fiilms.

(43) SMITH, J. H. G., YAM LEE, AND J. DOBIE, (1960), Intensive assessment of factors influencing photocruising shows that local expressions of photo volume are best: PHOTOGRAM. ENG., 26 (3) 1960: (463–9).

Stand volumes are estimated by means of 41 multiple regression equations based upon ground/photo measured variables of tree-height, crown-diameter, crown-closure percent and their combinations. Analysis was done on 15 plots using the Alwac IIIE computer testing 5 variables, 19 interpreters, 5 stands, 4 photofinishes, 2 kinds and 3 scales of photography. Best results were obtained using localized volume-tables adapted to the individual interpreters.

(44) SPARTAN AIR SERVICES LTD., (1960), Recent applications of aerial survey to forest inventory: Spartan Air Services Ltd., Ottawa, Canada, 1960:

Experimental work using mechanically located stereo-pairs of large-scale (1:2,000) photography taken periodically along the center lines, has limited field work to 0.10 of that normally required for map preparation from aerial photography.

(45) SPECIFICATIONS FOR AERIAL PHOTOGRAPHY. Amended February 1960. (1960) Province of Ontario, Dept. Lands and Forests, Toronto, Ont. 1960: 25 pp. (mimeogr.)

Specifications, methods and equipment uses are described to insure good results of aerial photography flown for forestry purposes.

(46) SPURR, S. H., (1960), Photogrammetry and photo-interpretation. With a section on applications to forestry: *Ronald Press Co.* N.Y. 1960: 472 pp.

A completely reorganized second edition of this text book in 5 parts: aerial photographs, photogrammetry, mapping, photo interpretation and forestry applications.

(47) STEWARD, B. E., (1960), A bibliography of forest photogrammetry and allied subjects from PHOTOGRAMMETRIC ENGINEERING 1939–1959 (Except 1941 and 1942). Univ. Maine, School Forestry, 1960: 20 pp. (unnumbered, mimeographed).

Unannotated compilation of relevant publications by year and author. Articles were selected for their importance to forestry, their background information and instruments.

(48) TOTEL, R. (1960), Einige Ergebnisse des Luftbildeinsatzes in der forstliche Standortserkundigung der D.D.R.: Paper 9th Internat. Congress Photogram., London, Engl. 1960:

Site quality can be interpreted from aerial photographs using crown-diameter sizes of even-aged stands as criterion. PI can be improved by proper choice of film-filter combinations.

(49) VON LAER, W., (1960), Der Wald im Luftbilde. Einige Gesichtspunkte für die forstliche Luftbildinterpretation: *Landeskundliche Luftbildauswertung in mitteleuropäischen Raum,* Heft 3, 1960: Das Luftbild in seiner landschaftlichen Aussage, (39–40).

Presented are two photographs illustrating differences in stand management and conditions of small ownership farm woodlots. However, on 1:30,000 photography the parcellation pattern of the woodlots is quite different because of the cooperative management agreement of one forest area. The photograph is the best historic record.

(50) ———, (1960), Stereophotogrammetrische Ausmessungen von Kleimmasstablichen Luftbildern für forstliche Zwecke: *Bildmessung u. Luftbildwesen* 1960 (2): (101–4).

Periodic revisions of maps can be made on the base map from episcopic projection of the aerial photograph over the map. If the photo image cannot be properly fitted, a complete remapping program should be initiated from the aerial photography.

(51) ———, (1960), Vorläufiger Bericht über die Entwickelung eines Verfahrens zur aerophotogrammetrischen Hohenzuwachsmessung von Waldbeständen: Paper 9th Internat. Congress Photogram., London, Engl. 1960: 9 pp. (Typescript).

The first attempt to determine height growth of a 70-yr. old beech forest mixed with younger oaks and a 50-yr. old spruce forest from aerial photography at 1:15,000 taken in 1951 and 1959. Precise height measurements are made with a Zeiss Stereotop. Results were field-checked and a correction factor was calculated.

(52) ———, (1960), Bericht über die Kommission VII (Luftbildinterpretation): *Bildmessung u. Luftbildwesen,* manuscript 1960: 3 pp. (typescript).

Impression of the London meetings are given with the modern trend of using statistical analyses and improved forest stratification, small-scale photography in conjunction with precision instruments, growth studies directly from aerial photography taken at periodic intervals.

(53) WILSON, R. C., (1960), Surveys particularly applicable to extensive forest areas (North America): Communication 5th World Forestry Congress, Seattle Wash. 1960: GA/83/I/A-USA, 11 pp.

Outlined are five general sampling designs using statistics of areas of forest classes (cover-type, stand-size, age, site & other conditions) and volumes, growth, mortality and cut of timber. Random or systematic sampling is superior; double or triple sampling designs using aerial photography are considered the most flexible and efficient sampling methods. Current forest inventory of Alaska uses 1:250,000 topographic maps, 1:6–70,000 photography, strip photography IRMB 1:5,000 at 30 miles interval, a one-acre square photo plot, visual aerial check of PI information, and 100 ground sample plots.

(54) WOLFF, G., (1960), Zur Verbesserung der Methodik von Holzvorrat-sinventuren mit Hilfe des Luftbildes: *Archiv. F. Forstwesen* 9 (4) 1960: (365–80).

Comparison of random and systematic sampling designs using aerial photography stratification into 3 stand heights, 5 crown closure, 8 stand height classes of 5 m each.

Cost and accuracy analysis is made with IBM procedures. When compared to the design of one sample/ha systematically distributed, then 1) the systematic but unevenly distributed design of one plot/ha is 9% less expensive and 7% less accurate, 2) the systematic but evenly distributed design is 21% less expensive and accurate, 3) the systematic but randomly distributed plot design is equally expensive but 11% less accurate.

(55) WORLEY, D. P. AND M. E. DALE, (1960), Recording tree defects in stereo: *Central States For. Exp. Sta., Techn. Paper* no: 173, 1960: 11 pp.

Stereopairs of sample trees are used as a photographic record of surface defects and defect changes on live trees. PI from the stereograms proved only slightly less accurate than a field method using binoculars and a sectional measuring pole; but only ⅛ to ¼ of the time was needed for independent and repeated PI.

(56) ZINKE, P. J., (1960), The soil-vegetation survey as a means of classifying land for multiple use forestry: Paper 5th World Forestry Congress, Seattle, Wash. 1960: SP/56/I-USA: 10 pp.

Extensive use of aerial photography is made in this soil-vegetation survey, preliminary delineation of soil types and vegetation cover are made on the photography and later are field checked. Possibilities using the soil-vegetation map and the aerial photograph for the multiple uses of the forest land are indicated.

OBITUARY—JACK AMMANN

THE American Society of Photogrammetry learned, with much remorse, of the death of Jack Ammann on June 14, 1961. His loss to the photogrammetry profession as well as to his family will be deeply felt.

Jack Jordon Ammann was born on October 28, 1908, in Washington, D. C. Jack, as he was familiarly known to all of us, took his early education at Kemper Military School, Boonville, Mo., during the period 1925–28. In 1932 he received his B.B.A. degree from the University of Texas. Later he attended St. Mary's University in San Antonio for special post graduate courses.

For many years Jack served as a member of the Board of Governors of St. Mary's University. He was one of the original members and a past chairman of the Education Committee of that Board. Jack was deeply concerned that none of the universities in San Antonio offered an engineering degree; largely through his efforts St. Mary's University established its engineering department. This year six young men are receiving their B.S. degrees in Industrial Engineering. In 1957, in appreciation of outstanding service to St. Mary's, Jack received the Rho Beta Gamma award.

Jack's successful venture into business began soon after his graduation from college, when he became a partner of the firm of Kargl Aerial Surveys. In 1940 he purchased the interests of all partners and changed the company name to Jack Ammann Photogrammetric Engineers. In 1954 the company was incorporated, and with the issuance of public stock Jack became President and Chairman of the Board of Directors. The company name was changed in 1960 to Jack Ammann, Inc.

In addition to his business duties Jack took part in many other activities. His organization memberships and activities included: Association of Professional Photogrammetrists (member Excutive Committee), American Society of Photogrammetry, American Congress on Surveying and Mapping, Texas Surveyors Association, American Institute of Industrial Engineers, Registered Professional Engineer, Rotary International of San Antonio, Board of Directors Edna Gladney Home, of Fort Worth, Past Treasurer Good Samaritan Center, San Antonio, and Sigma Nu Fraternity.

For many years Jack Ammann Photogrammetric Engineers was a regular and leading advertiser in PHOTOGRAMMETRIC ENGINEERING. Jack and his firm were widely known in the U. S. and elsewhere for their accomplishments and major activity in the great use of photogrammetry for mapping and other purposes.

Jack was so interested in photogrammetry that he took a leading part in promoting the sale of the Second Edition of the MANUAL OF PHOTOGRAMMETRY. For many years the Jack Ammann Award was offered to those making over and above a specified number of sales of the MANUAL. Many Society Members profited and the promotion of sales was most successful.