THE MYTHICAL CITY OF COLUMBIA

EXPLANATORY NOTE

On November 27, 1951 the Columbia River Section held its annual meeting in Portland, Oregon. A short description and the program will be found on pages 306 and 307 of the 1952 Yearbook. Limitations on space and the greater urgency for printing other material necessitated postponement of printing even digests of the papers discussing the very interesting and unusual problem presented by the mythical City of Columbia and for which aid from the Columbia River Section was requested. This delay was much regretted. Even now it is not possible to publish all papers and some have been abstracted.—*Editor*

Annual Meeting of Columbia River Section, Portland, Oregon, November 27, 1951.

THE PROBLEM

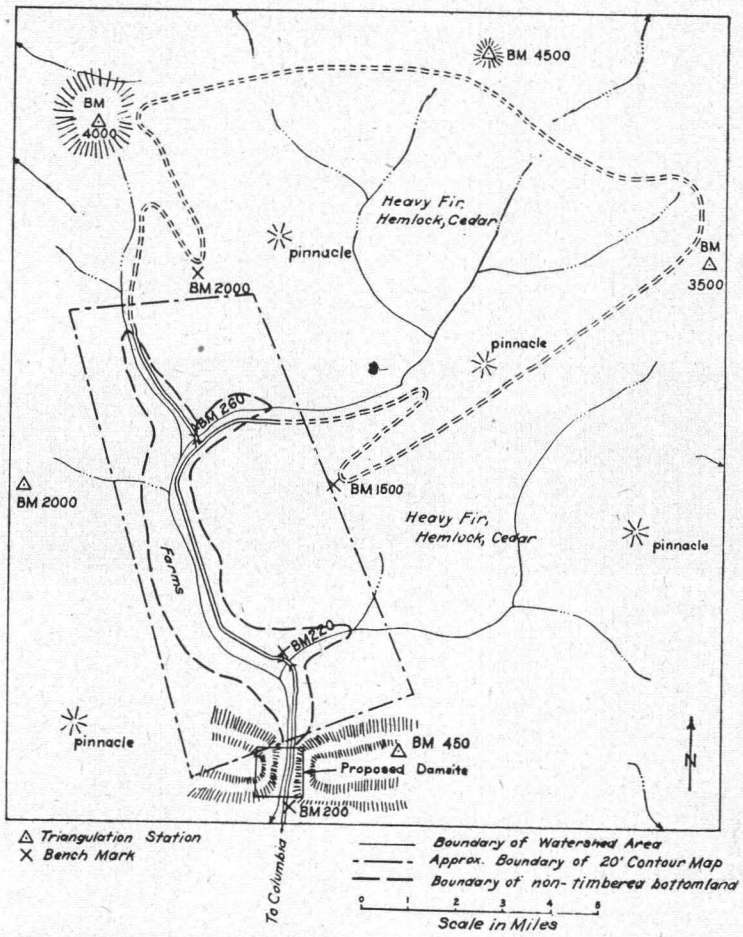
THE City of Columbia has acquired a watershed area which drains approximately 250 square miles, as indicated on the accompanying sketch. It is desired to create a multiple-purpose reservoir to provide a water supply for approximately 250,000 persons, to generate power, to serve for possible irrigation and flood control, and for possible recreation.

The area is typical of the west side of the Cascade Mountains, is rugged and heavily timbered with the exception of approximately 10 square miles of bottom-land which is under cultivation. Just outside the timber belt, the valley is constricted by barren hills rising 200 feet above the valley floor. It is at this point that the dam is expected to be placed. The only maps available are $\frac{1}{2}$ inch per mile planimetric maps prepared from Land Office Survey plats. Horizontal and vertical control are as indicated on the sketch.

The products desired are:

1. A reconnaissance topographic map of the entire area at a scale of 1:62,500 with 100′ contours, detail to be comparable to modern U.S.G.S. sheets of this scale.
2. A wall mosaic of the entire area at a scale of 1:31,250 with roads and geographic names in white. Mosaic to be "semi-controlled" to the extent of holding to the basic control from which the reconnaissance map is made.
3. Two sets of waterproof contact prints and photo indexes from all acceptable photography flown for mapping.

BERTELL MASON, JR.,
Program Chairman



SKETCH MAP of COLUMBIA WATERSHED

4. Two sets of 4-diameter enlargements, mounted on heavy display board, from four high oblique aerial photographs of the proposed damsite, the photographs to be made from the four cardinal directions. The damsite will appear near the principal point of the photograph, where the scale will be approximately 1:2,500 on the negative. A 12 inch lens on a 9×9 inch plate is specified.
5. Vertical rectified and ratioed photographs on a stable base suitable for plane table sheets of an area 2,000 feet square around the proposed damsite. Scale at the elevation of the valley floor shall be 1″ equals 50′.
6. A topographic map of 25,000 acres including the reservoir area and surrounding timberland; scale 1″ equals 500′; contour interval 20′. This map is to be used for extraction of timber in clearing the reservoir area, for timber development and forest management around the pool, and for capacity studies and other engineering work.
7. Transparent overlays for the 1″ equals 500′ map sheets showing detailed timber types and approximate board-foot volumes per acre per type for timber development and forest management.
8. Transparent overlays for the 1″ equals 500′ map sheets showing cadastral information for damage assessment, condemnation work, right-of-way studies, etc.
9. A topographic map of $\frac{1}{4}$ square mile ($\frac{1}{2}$ mile square) of the vicinity of the proposed damsite; scale 1″ equals 50′; contour interval 2′.

10. 1:12,000 scale vertical photography of a strip 5,000′ wide by 25 miles long from the damsite to the City of Columbia.

Every item not specified (such as focal lengths, sheet size, reproduction methods, etc.) shall be left to the recommendation of the organization submitting the paper.

Control Surveys for Photogrammetric Projects

Commander Fred A. Riddell, U. S. Coast & Geodetic Survey

Abstract

The speaker emphasized the activities of the U. S. Coast & Geodetic Survey which are closely related to the problem under discussion. He mentioned cooperative agreements that the bureau can make for the extension of horizontal and vertical control into a specific area. He also described technical methods employed and the data available for the use of engineers and surveyors.

Uses of Photogrammetry in Solution of Hydraulic Problems

Elliott Flaxman, Sedimentation Engineer, U. S. Soil Conservation Service

Abstract

Aerial photographs can aid The City of Columbia in its hydrologic analysis of the watershed above the proposed dam by the following evaluations:

1. Water yield studies and data on the size and frequency of floods.

   Probably not enough usable records are available on this one particular watershed so it will be necessary to extrapolate data from nearby watersheds with similar conditions. these would include altitude, slopes, aspects, soil types, cover type and density. Aerial photographs will facilitate the determination of all of these data with the probable exception of altitude.
2. In determining the effect of altered watershed conditions on water yield, quality of water and rate of sedimentation.

   Photos indicating excessive gullying, old burns, and the existence of alder and willow growth along the flood plain which cause discoloration of water and water losses of reservoir storage.
3. In determining the effect of the proposed reservoir on downstream improvements.

   Photographs can be used to outline flood plains and to delineate areas of varied land use. Also to serve as a base for delineating other effects of flood discharges and benefits to be derived from their control.
4. In forming a basis for preparing a contour map of the reservoir to determine its capacity and flood control aspects.

   Photographs may be utilized in obtaining area capacity curves and the effect of spillway storage on the rates of outflow, a factor also modifying flood stages downstream. They will also facilitate the determination of sedimentation rate and are a valuable aid in locating the most economical route for the water distribution system.
5. Summary.

   The combined uses will certainly make photogrammetry an invaluable tool to the solution of water supply problems of the City of Columbia.

Use of Photogrammetry in Electrical Transmission Line Location

Lester S. Tubbs, Chief, Civil Engineering Unit, Bonneville Power Administration

The use of photogrammetry is being employed more extensively and in a wider range of projects everyday, and it is meetings of this type which tend to promote it. By the papers which are presented, the exhibits which are shown, and through the association and exchange of ideas much is to be gained in developing a wider use of photogrammetry. At present we are employing the use of aerial photography and photogrammetry in conjunction with the state rectangular coordinate system to good advantage in the location of electric power transmission lines, and we believe that by the use of these methods we will be able to bring power to the City of Columbia more economically.

The Bonneville Power Administration markets the energy generated at the Federally-owned and operated power plants here in the Northwest. Most of these power plants are located east of the Cascade Mountains, and at the same time a large percentage of the electric energy used in this area is along the coast on the westerly side of the Cascade Mountains. Long, high voltage, electric power transmission lines are therefore required to transmit the power from the power plants east of the mountains to the load centers west of the mountains. Our problem is to find the locations for these transmission lines, and it is in this location work that we make use of photogrammetry. The problems encountered in locating a transmission line from Grand Coulee or McNary Dam, for instance, to the City of Columbia, located west of the Cascade Mountains, are many and varied. On the easterly side of the mountains the terrain is open and rolling, with good access. On the mountainous section the terrain is rough, rugged and rocky, with a great deal of the area covered with a heavy, dense growth of timber. As a rule, access is very poor and there are snow slides and avalanche areas to be avoided. On the westerly slope of the mountains, in most areas, the timber has been logged off some years ago and the terrain is now covered with thick brush or second growth timber. On this westerly side of the mountains, as we approach the coastal area, the population becomes more dense and it is more difficult to find open areas or corridors through which transmission lines can be constructed. Generally speaking, the access is good on the westerly side of the mountains as old logging roads can be utilized near the foothills and in the more thickly settled areas public roads are adequate.

As soon as a project is authorized, aerial photographic coverage is obtained either by purchasing the photography from an agency which has previously had it flown or by contracting and flying it. This photography is used in the form of controlled and semi-controlled mosaics and in the study of the stereoscopic pairs. By studying the mosaics and the stereoscopic pairs, our Location Engineers are able to save themselves an untold amount of time and field work in arriving at a line location. The aerial mosaics and contact prints are used by our surveyors in the field on location work. Many times we are able to make projections from the pictures and run all or sections of a project without surveying a preliminary line. By the use of stereoscopic plotting instruments we make studies of critical areas, contour and topographic maps, and timber studies. We are able to supplement much of our field work with information transferred from the aerial photographs to our line maps such as areas of timber, cultivated areas, streams, miscellaneous topography, various man-made improvements, etc.

We have recently started making aerial mosaics of the line location available to prospective clearing and construction bidders. It is our experience that in the more remote areas the contractors are reluctant to make a careful examination of the route, and we have found that by making the mosaic available to them they are able to get a better picture of the terrain and a better idea of clearing, available access and other factors affecting the cost; with this information available to them they are able to submit a more favorable bid.

One of the more important uses we have made of photogrammetry to date is in the survey of the microwave radio communication system. At present the Administration is installing microwave communica-

tion for control and operation of the power system. Without the aid of photogrammetry and use of the state rectangular coordinate system, the amount of ground survey work and time involved would have made this project almost impracticable. This system of communication operates on a straight line uninterrupted beam path. The transmitting and repeater stations are located at strategic high points at intervals of from 20 to 50 miles apart, and it is absolutely necessary that there be no intercepting ridges or hills between stations. With our photogrammetric techniques we have made profiles of the ground between the stations and have been able to satisfactorily determine the feasibility of the station locations.

This briefly outlines some of the uses we are now making of photogrammetry. We expect to continue and to extend our use of photogrammetry as rapidly as practical.

Photogrammetry as an Aid in Forest Management

Lester E. Calder, Land Manager, Springfield Division, Weyerhaeuser Timber Co.

Abstract

Mr. Calder recommended the production of 1:12,000 scale aerial photography (1,000 feet per inch) and the making of a good planimetric map from the photos with allowable error not greater than 50 feet horizontally. He also recommended production of a reconnaissance topographic map at a scale of 1″ per mile with 100-foot contours for the whole watershed and a more detailed map for the immediate area to be logged at a scale of 400 feet per inch with 20-foot contours. He recommended photos be pretyped before field work to show the following land classes; barrens, non-merchantable timber, second growth, and old growth, and that boundaries of these classes be transferred to the planimetric map for acreage determination. During a subsequent field cruise more information on types would be obtained along with volume estimates, and section corners would be pinpointed on the photos wherever accurate ground identification of photo detail could be made.

Lester E. Calder

Application of Photogrammetry in Property Assessment

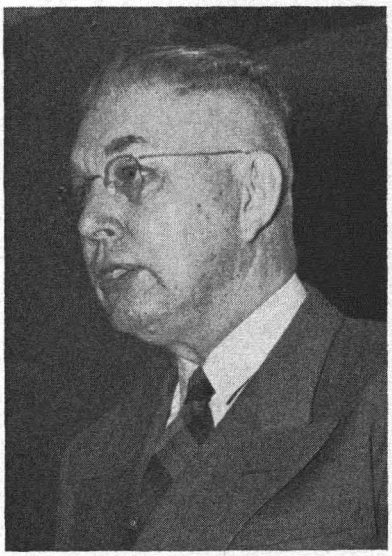
Walter W. Trantow, Assessor for Cowlitz County, Washington

Abstract

The speaker stated that the most important action in assessing property is to arrive at an equitable value on all classes of property. In the last five years aerial photographs have come to be used widely in the State of Washington to help in making equitable assessments.

The following steps were recommended for any assessor in a timbered county typical of the Northwest: (1) Hire a timber cruiser trained in both forestry and photogrammetry, and also a good draftsman. (2) Contract for aerial photos at a scale of 1,000 feet per inch and get one complete set of contact prints for stereoscopic study.

(3) If funds permit order one set of enlarged photos at a scale of 400 feet per inch. (4) Draftsman to produce overlay maps for each section to fit over the enlarged photos. These should show legal owners with tax numbers and acreage. (5) Timber types should be interpreted by photo interpretation and field checking. (6) During field check all known section corners should be spotted on photos and overlays. (7) A timber cruise should be made of all commercial stands. (8) From the foregoing data proper assessment rates should be applied and calculated for each property. Currently, Trantow said, Cowlitz County is also making ground photographs of every building in the county. The classification and condition of the buildings will then be estimated from the pictures.



WALTER W. TRANTOW

NECESSARY INFORMATION FOR THE PLANNING OF PHOTOGRAMMETRIC PROJECTS

Kendall B. Wood, Consulting Forest Engineer

ABSTRACT

Probably the greatest obstacle to competent photogrammetric operation is the inadequacy of specifications presented. Too often specifications contain conditions manifestly impossible and frequently glaring errors are evident. Another criticism is the lack of appreciation of the time required to prepare accurate work. It is suggested that users of photogrammetric services employ a qualified photogrammetric engineer in a consulting capacity to supervise the preparation of intelligent specifications.

PLANNING AND EXECUTION OF AERIAL PHOTOGRAPHIC PROJECTS

Leonard H. Delano, Delano Aerial Surveys, Portland

The city, county or company official, engineer or assessor who is called upon to procure aerial photography for engineering purposes or evaluation will do well to understand its abilities and problems. These cannot be taken for granted even though the flying and lab work may seem routine compared to the photogrammetric phase.

Among the problems first are the seasonal and weather limitations. It is wise to remember that the aerial photography part of the job should be requested as well in advance of seasonal limitations as possible. There is still no substitute for good weather for aerial mapping photography in spite of all the technological advances made in many fields. The client's consideration of this factor is necessary and it is hoped that he will request photography before weather becomes unsettled.

On the other hand, it is possible to obtain satisfactory photography in certain more level areas at a time when forestry photography is out of the question because of shadows. Furthermore when a fortunate circumstance of a job calling for larger scale, lower level photography can be combined with a high, thin cloud, overcast, the results can be highly satisfactory. An example is a job we did on the Cowlitz River for a government agency. It was helped by the fact that the shadows along the banks were eliminated because of the

overcast. I understand that these were more valuable than if they had been shot in absolutely clear weather.

But too often the clouds are not high nor are they thin. You can't request a high thin overcast in the specifications but if one comes along it might work.

Being in the aerial mapping photography business certainly develops a weather consciousness that is only exceeded by that of the weather man himself. Having been in this work in the Northwest a number of years, it has been forcibly brought to not only my attention but to my contemporaries, that too many people who look out the window and see a little sunshine are quick to call it a beautiful day for aerial map photography.

I don't say that we haven't been in the embarrassing situation of missing a good day in our time. But I do say that there would be much better understanding of the aerial map photo problem if others saw the weather from the tops of the flight lines instead of alongside of them.

Occasionally, in the middle of the day after rainy periods, clouds have a habit of developing on a flight line while you are actually flying it. There is a tendency for this to happen in the Cascades and higher ridges. Of course, in late summer, smoke is a problem in forest areas.

For photography over actual city areas in many Northwest cities it may be an advantage to have leaves off the deciduous trees to open the area underneath them. Many streets and drainage areas are lined with trees which block visibility from above during summer. This might call for early spring or late fall photography over these areas.

A factor in procuring aerial photography is the responsibility of the contractor, as in any other engineering phase of work. Questions which might also be asked are, does he maintain or keep available his own plane and flight crew? Does he have financial responsibility? Does he have good equipment: what sort of lab facilities does he have? Does he have good storage facilities for the films in his care? Does he carry insurance covering liability, fire and other losses?

Multiplex Aero-Projectors

Louis A. Woodward, Jack Ammann Photogrammetric Engineers, San Antonio, Texas

Abstract

Consideration must be given to many factors in the solution of any mapping problem. Beside the primary factors of time and cost, which are greatly affected by the specifications for a particular job, there is the availability or proximity of airplane and field personnel, the various types of office equipment that may be used and the type of area to be mapped. For example, to prepare the drainage area map, the use of high altitude photography is desirable, but at the present time our equipment for such a flight is on the East Coast. Consequently, under the circumstances, the over-all cost will be less if the photography is obtained at a lower altitude with our plane that is in the area.

Flights would be made at 30,000 and 12,000 feet of the watershed and reservoir, respectively, using either a 6″ or a 5.2″ focal length precision camera. From this aerial photography the desired watershed and reservoir maps would be drawn with our multiplex equipment.

Instead of a semi-controlled mosaic, it is recommended that the tip, tilt and scale data, that is obtainable from the multiplex extensions, be used to make rectified ratioed prints for a controlled mosaic. On this mosaic there will be feature names and certain planimetry emphasized. A photographic copy should be made on completion, so that additional reproductions could be made at a relatively small cost.

Because there is considerable displacement of the photographic image at the large scale proposed for the damsite map it is not recommended that rectified and ratioed prints be used to prepare it. Instead, either a photogrammetrically prepared planimetric map transferred in non-photographic blue to a plane table sheet, to which the contours can be added by a field crew; or, and preferably due to the small area involved, that the complete survey be made by a ground survey method is recommended.

For information regarding detailed timber types and the approximate board-foot

volumes per acre per type for timber development and forestry management, we have found it more satisfactory to work with foresters thoroughly familiar with the timber types of local areas.

Zeiss Stereoplanigraph and Wild Autograph*

Fairchild Aerial Surveys, Inc.

Abstract

An accurate topographic map of the entire watershed at the requested scale of 1:62,500 can be prepared with either the Zeiss Stereoplanigraph or Wild A-5 from aerial photographs taken at an approximate scale of 1:60,000. However, it is suggested that a controlled mosaic, instead of the topographic map, be prepared from the foregoing photography. There is sufficient existing control to make rectified ratioed prints from which a highly accurate mosaic can be assembled. This mosaic, when used in conjunction with the contact prints, will no doubt furnish all of the desired preliminary information. Its cost will be a fraction of that of a topographic map.

Because the damsite area is timber free it is recommended that this 1 to 600, 2-foot contour damsite map be prepared from a single stereo-model from a special low altitude flight, instead of using a rectified and ratioed photograph as a plane table sheet.

With a few additional control points an extremely accurate reservoir map can be prepared from a single flight strip flown at an altitude of 25,000 feet, provided the timber cover is not too dense, in which case the contour could not be guaranteed to be closer than one-half of the tree height plus one-half of the contour interval.

* Paper was read by Carl W. Berry.

The Kelsh Plotter*

D. H. Rutledge, Chief of Photogrammetric Division, U. S. Geological Survey, Sacramento, Calif.

If I were in business and had limited financial resources, I would be able to purchase only one stereo plotting instrument. My choice would be a Kelsh plotter: I would then be able to compete with anybody in producing topographic maps on various scales and different contour intervals. I will run through the various mapping or topographic mapping items on the schedule for this meeting and state what I would try to do.

Number one is the reconnaissance map of the entire area at a scale of 1:62,500 with 100′ contours. I would ask that the photography be taken from as high an elevation as possible, say around 30,000′ so as to be 24,000′ to 26,000′ above the average ground. I would make use of existing control. Being unable to bridge horizontally with the equipment, I would have to resort to some other method. One possibility would be slotted templets or radial line templets; the other possibility would be establishing more horizontal control. Because of my experience I would be a little reluctant to undertake extensive vertical bridging even with the Multiplex. I would plan control on every model and would be able to get ample horizontal control while I was getting the vertical. The vertical control would be obtained by the method most convenient to the man doing the field work. Some might be done with a transit; others would work with the plane-table triangulation. In either case you might fill in the valleys and along the roads with precision altimetry. In this way I would be able to compile a map with 100′ contours with satisfactory accuracy; the manuscript scale with a Kelsh plotter would be probably 1:10,000.

Item 6 involves a topographic map of 25,000 acres including reservoir areas and surrounding timber lands at scale of 1 inch equals 500 feet. It would be compiled from photos taken at a slightly lower altitude and I would still have control of every mile. I would probably ask for 5 control points instead of just 4, and in that way would be able to get good contours. If I were able to match the camera to the projecting lens of my Kelsh plotter, I could

* Extemporaneous statement transcribed from tape recording.

probably produce a model that could be used with a stereoplanigraph.

The third item requires contours of the Map of the Dam Site: This I would compile with 2 foot contours from photographs flown at about 3,000′. This would probably mean two models and I think I would try to establish the control and mark the points on the ground by means of flight triangles or something of that sort, before the photographs are taken. I am sure that when I finished my results would be as good as anyone's.

The Ryker, PL-3 Plotter*

Morris J. Boyd, Photogrammetric Unit, Bonneville Power Administration

The Ryker PL-3 Plotter has been used very extensively by my organization since 1948. But in considering the map products desired for the watershed survey, I feel that the only map that could be made with this machine is the 1:62,500 reconnaissance topographic map with 100′ contours.

This plotter consists of a large stereoscope, very readily constructed to hold its position with allowances for raising or lowering the mirrors and lens assembly so that the viewing distance to the spacial model can be computed. The machine is based on the Lage Wernstedt principle in which the floating dot moves vertically within the spacial model to determine differences of parallax and thereby different elevations. To mechanically duplicate this theory, two plastic disks on a carriage which moves in both the X and Y directions are mounted between the stereoscope and the plate holders. These holders consist of two aluminum plates to which two contact prints can be attached, usually with rubber cement. By setting up a series of contact prints on glass plates which are held to the aluminum plates, our work is considerably expedited.

The plates mentioned above can be moved in the X tilt or Y tilt and the X and Y direction, thereby making possible orienting the spacial model to vertical and horizontal control.

Z motion is accomplished by a slight movement of the dot disks in a vertical direction. The carriage which holds the plastic dot disks is attached to a pantograph which can be varied for different manuscript scales. In this way it is possible, within the limits of accuracy of the machine, to fit the spacial model to a given manuscript scale.

The reason I say that the 100′ contour and the 1:62,500 scale map is the only map I would contract for is because of a small size of the spacial model. This is always smaller than the contact prints. Extremely large scale photography would have to be flown to get a closer contour interval, and this would necessitate a great deal of additional horizontal and vertical control as each model must be controlled with four elevation points. The laydown plot would be much more complicated and the whole results would be much more easily accomplished with an instrument of the Multiplex or Kelsh Plotter type.

In listening to the various speakers, I feel that a very important consideration has been neglected. You are contracting to have certain large photogrammetric jobs accomplished by various contractors, but the actual construction and operation of this project has been entirely neglected from a photogrammetric standpoint. I feel that you should have a Consulting Photogrammetric Engineer hired by the Council to work during the survey and construction of this entire project. Without the services of this consultant, the full benefit of the work being contracted for might not be realized by the Council.

At Bonneville Power Administration, where I am the Photogrammetric Engineer, we have utilized the PL-3 Plotter in our far-flung surveys and construction problems. We find it necessary to compare a small area with another area for profile and other problems that need concentrated study before the field work is done and in conjunction with the field work. An illustration is our Microwave Radio System, which we use for voice communication and remote line control. I feel that it would be necessary to have such a radio communication system between the Dam and the City of Columbia in your watershed development. With our photography I would start with locating possible sites for these different stations at each end be-

* Digest of Extemporaneous Remarks.

tween which there must be a line of sight clear of all obstacles. I would then study the photographs in conjunction with the reconnaissance topographic map and determine which of the areas in between would probably interfere with this line of sight beam. We would then contour this area with the Ryker Plotter to get form lines and show us where the critical point is. This point would then be tied by triangulation or other means to our horizontal and vertical control net. The two stations at each end being surveyed in the same manner, we would have a complete solution of the problem as to whether we had a point in the middle that was interfering with this line of sight beam.

This combination of our control data and the use of the Ryker Plotter, as well as other machines, has proven a valuable method of economically solving many survey and construction problems which would otherwise require a tremendous amount of surveying.

Forest Management and Logging Engineering Plan

Page Gilbert, Logging Engineer, Harbor Plywood Corporation

Abstract

Mr. Gilbert's talk was well illustrated by slides. He explained the simpler photogrammetric methods used by logging engineers, including the procedure for adding type lines to maps by radial line work. He discussed at length the scale of photographs and maps proven most suitable for forest management.

GENERAL DISCUSSION

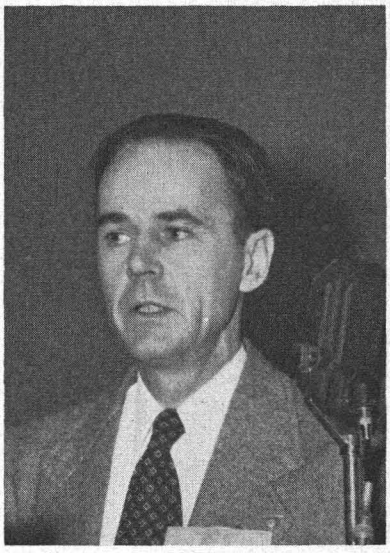
PAGE GILBERT

It's pretty much of a job to get contour photography in light or heavy snow. A light snow is beneficial—but with a heavy snow, you are powerless. In this particular project we will have a considerable area that would probably still have five or six feet of snow. This should be considered when you are figuring on Oregon photography. You can't get it in most of our high Cascade areas before late spring.

I have been very interested in the presentations, particularly for interpretation work that is being done from small scale photography because that is a very determining factor in cost. One would need at least four large-scale pictures to cover the area that would be covered by one photograph at approximately 1 to 20,000 scale. So you will need to multiply all your costs by four if you are going to use large scale photography. I like it and recommend it for development operations. But for appraisal and reconnaissance use I think the small-scale is worth much more on account of the saving in cost.

DON JACKSON, U. S. Forest Service

The scale on aerial photographs has been



PAGE GILBERT

of considerable interest to the Forest Service. We are primarily map users and in keeping with the rest of the Dept. of Agriculture program of photography, we have flown a great many thousands of square miles, mapping too from the photographs, using a photographic scale of 1:20,000. During the last few years I have watched with much interest a sort of definite pattern coming up. The map makers are continually working toward smaller scales and the timber men, foresters and others, are continually moving to larger scales. For the Columbia Project I suggest that you get the coverage with small scale mapping, But by all means extend the same full coverage with large scale photography for later use in the long range program in manage-

ment of these resources—timber and otherwise. Thereby you will save money.

MR. MASON

I should like to hear other opinions on photographic scale. I have some personal opinions which have been supported by other people who have done some timber typing. I can draw finer distinctions in timber typing with smaller scales of photography. But for analysis of the individual tree you must go to a larger scale. Mr. Dilworth, who is an instructor in forestry, photogrammetry and so forth should have some opinions.

MR. DILWORTH

We have one area of photography at 1:10,000 one at 1:12,000, one at 1:20,000, which we cover regularly. For mapping purposes it is obvious that the smaller scale is adequate and much cheaper, since you don't need as much control. But for what we like to call "Forest Inventory," we have good 1:20,000 and we have good 1:12,000. The 1:12,000, even though it costs a little more, gives so much more information that it is well worth the approximately one cent an acre increase in cost. For type mapping, an unusually good small scale—about 1:20,000 or not much smaller—in fairly large timber is very good for type mapping because it stands out very clearly. But for smaller timber, where small differences in crowns are important in second growth, the larger scale of photography is a little better. In general, for type mapping and cruising we prefer the 1″ to 1,000′ because we wouldn't want to buy photography for both—one for type mapping and one for cruising. I feel that the extra cost of 1″ to 1,000′ is justified for inventory purposes.

MR. MASON

Mr. Calder said he wouldn't necessarily recommend making the contour maps from photogrammetry for the liquidation of the timber in the damsite area. Another statement during the program was that the accuracy in the timbered area would be figured at one half the height of the timber plus one half the contour interval. I should appreciate hearing comments on those two points.

MR. GILBERT

I and several others here have supported Mr. Calder in most of his views. I believe we use a little different procedure, however, in our actual engineering and layout work which I wasn't able to describe in the paper. Our actual measurement work and delineation for stereo vision is done on 1:12,000 photography. We put everything on—roads, section lines and we even bend them where they go over the ridges to take care of displacement if any. We put in the spar trees as closely as possible and also the cutting lines; this is done both before, as a preliminary measure, and afterwards as a final record. Much of the layout work is actually done by our bulldozers and superintendents. Naturally, they prefer the 400′ to inch map which has been standard in the industry for a good many years. Our procedure in that regard is to photographically enlarge our maps of much smaller scale. Actually we don't have the detail. We aren't too concerned about the contours in the heavy timber; we are more concerned with the kind and location of timber. We use the photography in picking the most economical and practical route but we verify this on the ground. If we run into any impossible conditions, we try something else.

MR. CALDER

I feel that I can clear up a point or so. Some 29 years ago Carl Berry and I tramped the hills together putting contours on the maps the hard way. It is pretty hard for an old die-hard like myself to believe that somebody else can come along now and do it the easy way. I've tried to bring out some points that I think needed clarifying, but we should recognize now that our present day methods of logging do not require the map accuracy we were accustomed to years ago. In spite of what I said about ground mapping, I believe photogrammetrists can give the logger today a topographic map good enough for his work in laying out his logging and his truck road development. My point has been that there is no use asserting that you can go out and do the work with the very great accuracy that is claimed.

MR. DEAL

I am sure that we have all spent a very enjoyable and instructive day. I hope you are not too confused with all the information we have tried to give to you. We have tried to bring the discussion down to grass roots and I hope we have done some good.