MR. JOHN CARROLL:* Mr. President, Members of the American Society of Photogrammetry, Ladies and Gentlemen: I must first thank you sir, for your kind words of introduction. I appreciate this opportunity of again visiting Washington, the city of beauty and of culture, blazing with photogrammetric light.

Canada has been engaged upon air survey mapping for over a quarter of a century, and the work has been greatly intensified and expanded since the closing years of the Second World War. This paper will present an outline of the means taken to accomplish the air photography and touch but briefly upon photogrammetric methods, since the chief difficulties facing photogrammetrists at present center around suitable photographic coverage rather than methods.

To realize the problems confronting Canadian mapping authorities, it is first essential to refer briefly to Canadian geography and climate. The Dominion embraces an area of approximately 3,700,000 square miles, an area greater than the United States, including Alaska, and contains a population of approximately 12,000,000, most of which is concentrated within a comparatively narrow zone along the International Boundary. The territory to the north of this settled band, stretching to the Arctic Circle and beyond to the Arctic Islands, is altogether unsettled, or contains only isolated settlements. Roads and railways do not penetrate much beyond the southern zone of settlement, and up to the end of the First Great War, travel into the interior was usually by boat or canoe along the many waterways that intersect the territory. Transportation was difficult, time-consuming and costly. Then came the airplane and the job of raising the veil of the unknown from off the face of the hinterland was begun in earnest. Map makers and those interested in the development of the remote areas quickly realized the potentialities of the airplane and air photography. A systematic program of mapping was instituted by the Federal Government, with the objective of obtaining adequate planimetric maps of the unsettled areas and topographic maps of the more settled parts, as funds permitted.

Canadian climatic conditions, however, exert an adverse influence upon progress of photographic coverage. The length of the photographic season is short, varying from about six months in the southern regions to perhaps less than one month in the far north. Within these periods, the number of days and hours which are satisfactory for vertical and trimetrogon photography is severely limited, due to prevalence of clouds, haze or smoke. It has happened many times that the accomplished photography has fallen far behind the objective. These limitations of the photographic season, and often of the photographic day, make a very bitter pill for Canadian photogrammetrists. By the beginning of the Second Great War, approximately 600,000 square miles had been covered with Canadian oblique photography and mapped to a scale of 1:253,440, while approximately 250,000 square miles of verticals had been done and topographic maps issued at scales of 1:63,360 and 1:126,720.

During the closing year of the last war and up to the end of 1946, approximately 417,000 square miles were covered with vertical, and 473,000 square miles with trimetrogon photography.

Execution of Air Survey Photography by the Royal Canadian Air Force.

The major portion of air photography, for topographic and exploratory mapping, for the past twenty-five years has been carried out by the R.C.A.F. Some photography for the Federal Government is contracted to private companies, but the greater portion of this work is confined to operations in relatively settled portions of the country.

* Mr. Carroll's paper is published by permission of the Director, Mines and Geology Branch, Department of Mines and Resources, Ottawa, Canada.

The governing body for the accomplishment of air survey photography is the Interdepartmental Committee on Air Surveys under the chairmanship of the Deputy Minister, Department of Mines and Resources. The membership of this Committee is comprised of representatives of the Department of National Defence (Army and Air) and the Department of Mines and Resources. The function is to receive from all Dominion Government Services, etc., requests for air surveys and be responsible for the program.

As is to be expected, the annual requests exceed the capacity for accomplishment by many square miles, and the first function of the Committee is to decide just what is to be carried out. An annual program of approximately 200,000 square miles of vertical photography is usually approved.

It is desirable for the Committee to examine and pass upon the program the year preceding that in which it is to be accomplished. This is necessary, particularly for those areas lying in Northern Canada away from rail communication. All bulk supplies for survey detachments, including gasoline and oil, must be freighted in by barge down the various rivers during the open season, by tractor-train to other small aerodromes during the winter and, in many cases, by sea-going vessel through the Hudson Straits and down into Hudson Bay prior to the winter freeze-up. If such arrangements are not concluded and supplies shipped in, it is obviously very difficult to do the required surveys during the following year.

When it has been decided what portion of the work will be accomplished by the R.C.A.F., operation orders are then prepared for its execution. The unit charged with the responsibility of air survey photography is No. 7 Photographic Wing based at R.C.A.F. Station, Rockcliffe, near Ottawa. This Wing comprises a Headquarters, two flying squadrons, No. 13 and No. 14, and a photographic laboratory. All federal requirements for vertical photographs are accomplished by No. 14 Squadron, while No. 13 Squadron accomplishes aeronautical charting trimetrogon photography, and the transport of geodetic control parties.

Each squadron is divided into detachments and each detachment has a series of operation orders for accomplishment.

No. 13 Squadron had in operation during 1944–46, three aircraft of the Mitchell B25 type. As these become unserviceable, they are being replaced by the Lancaster type.

Each of these aircraft carries a tri-camera mount which can be corrected in level for change in attitude of aircraft. These mounts were specially designed by the National Research Council to fulfil the following requirements: (1) Optical axes of the three cameras to lie in parallel planes. (2) Transverse fiducial axes of each camera to be parallel to the same planes. (3) The interlocking angles between the optical axes of the right and left with the center camera axis to be reliably known, and about 60°. (4) Cameras to be interchangeable in mounts.

The mounts are calibrated before the opening of the photographic season and checked at the close. Results indicate that the mounts are adequately rigid and that the calibration is maintained to an accuracy of one or two minutes. All three camera shutters are synchronized.

Cameras currently used for trimetrogon photography are the Fairchild K17 type, with 6 inch Bausch and Lomb metrogon f/6.3 lens. Each camera, however, has been modified by the National Research Council so as to have the fiducial marks delimiting the principal point position attached to the lens cone and the lines joining opposite fiducials normal to each other. These modifications reduce the format size to about $8\frac{1}{2}'' \times 8\frac{1}{2}''$, but it is felt that the increased camera precision over-rides this disadvantage.

The photographic aircraft of No. 14 Squadron engaged upon vertical photography over the same period has been the Anson type. As these aircraft become unserviceable, they are being replaced by the Dakota type, which has a higher ceiling, higher speed and longer range.

Owing to the intensive expansion of the post-war photographic coverage requirements of many Federal departments, and the demand for specific picture scales, all available cameras were pressed into service and comprised the following types: (1) Fairchild 7″×9″ F.3 camera with 8¼″ Ross Express f/4.0 lens. (2) Williamson 9″×9″ F.49 camera with 6″ Ross Wide Angle Survey f/5.5 lens. (3) Williamson O.S.C. Mk.1, with 6″ Ross Wide Angle Survey f/5.5 lens. Size of camera format is 9″×9″, with an additional strip upon which the readings of various instruments are photographically recorded. Records of watch times and altimeter heights will be obtained which, it is hoped, will give a fair estimation of change in length and inclination of the air base.

Each of these camera types has, attached rigidly to the cone, a focal plane glass plate against which the film is pressed during exposure, and upon which the fiducial marks and principal point are etched. This register plate on the British made precision camera, Williamson O.S.C. Mk.1, is of optical glass and, together with the lens assembly, forms an integral part of the optical system. The principal point is etched thereon and its position is without error. For topographic mapping, the trend is towards the use of this camera.

The Photographic Wing is backed by scheduled R.C.A.F. air transport services, and the detachments are kept constantly supplied with perishable items such as aero film, etc. The peak of any summer's operation, which usually commences about the first of April, may see detachments scattered from the Maritime Provinces on the east to British Columbia on the west, and north to the Arctic Circle and beyond.

For efficiency of operation, the Photographic Squadrons maintain their own wireless section and meteorological observation parties. The whole operation is designed to permit flexibility so that, in the case of adverse weather being forecast as likely to continue in any one area, a detachment working at that point may be rapidly moved several hundred miles to a more suitable situation. The detachment will return to its original job with the return of good weather. A review of meteorological trends for the past ten years has been compiled and sufficient information is now available to spot detachments in various parts of Canada at such periods of time as are most likely to produce suitable photographic weather.

Probably the unique part of the R.C.A.F. survey operations is the return of all exposed film to the central laboratory at Rockcliffe. Film is flown out from detachments to the nearest railhead and shipped by special express to Ottawa for processing. While photographers in the field process short test films to ensure proper camera functioning, all survey rolls as such are processed in the laboratory at Rockcliffe and not in the field. This system of operating has been in effect for many years and all air survey film is processed by sensitometric control in continuous processing machines at the main laboratory. Exposures in the field are determined by solar intensity value for given latitudes and longitudes for various calendar periods. The gamma of the negative is then controlled to yield the best possible print for that type of terrain. For instance, negatives exposed over flat prairie country are developed to a higher contrast than are rolls exposed over mountainous country where shadows will be much denser, and where it would be quite easy to lose important survey detail. Both exposure and processing control are now at the point where quality is consistent and a line

of flight finishing an operation last year will be identical in quality to neighbouring lines taken during this year. Such elaborate precautions and control go a long way to ensuring that the various grey scales on a photograph always mean the same thing. Another added advantage to such elaborate precautions is that approximately 90 per cent of all survey prints can be made upon one grade of paper and thereby small stocks can be carried each year.

Operating by these means, twelve aircraft, backed by four immediate reserves, have been able to accomplish approximately 180,000 to 200,000 square miles of vertical photography per annum.

Flying this type of photography, particularly in the northern parts of Canada, is a very difficult task since existing maps are very often badly misleading as to terrain detail and, in many cases, no maps exist whatsoever. While crews receive intensive training, yet under such adverse conditions, some gaps are bound to occur. Therefore, a special effort is made to have all exposed film shipped to Ottawa immediately.

The main laboratory at Rockcliffe rushes out a set of index prints of each operational area and a loose mosaic is laid down as the work progresses. Gaps show up immediately on the loose mosaic and an overhead travelling camera is used to photograph the mosaic at a much reduced scale. Where gaps occur, the small mosaic is returned by air to the detachment in question, and the pilot and navigator use the mosaic when flying to fill in the gaps. This method of operation has been so successful that in the season just closed, all gap flying was completed before the aircraft left the field.

A very close liaison is maintained at all times between the Department of Mines and Resources and the R.C.A.F., and engineers of the department are kept constantly informed as to weekly progress and, in cases of extreme importance, the daily reports are made available.

The R.C.A.F. has been charged with the responsibility of completing trimetrogon photography for aeronautical charting over all areas where adequate charts do not now exist. Areas are not flown by the trimetrogon method if they have been previously covered by vertical requirements, or by U. S. A. A. F. wartime photography, if adequate.

The same Squadron (No. 13) which accomplishes the photography for the aeronautical charting work is also responsible for the transport required in establishment of astronomical control points. Engineers of the Geodetic Service are carried by the Northern Survey Detachment of No. 13 Squadron. This detachment consists of one Canso amphibious aircraft, better known in the United States as the Catalina or PBY. The detachment is also equipped with four Norseman seaplanes, a Canadian aircraft designed especially for float operations in the Canadian North. The Canso acts as a mother ship for the other seaplanes, and for the past three years even the gasoline used by the Norsemans has been flown to them by the Canso. Geodetic control operations at the present time are working in such remote areas that the establishment of gasoline caches has not been possible.

While working in the Canadian North, the season for such operations is very short since many of the lakes remain frozen until the end of June or early July, or even later. Intensive preparations are therefore made to do the greatest amount of work possible during the open season. To illustrate the complexities of the operation, it should be noted that from June 15 until August 18 of 1946, the Canso of this detachment carried 168,000 pounds of freight, 212 passengers, and the crew flew 418 hours in two months and three days. During this time, one very lengthy rescue operation was flown when a United States Government em-

ployee, who had been seriously injured at Chimo, Northern Quebec, was flown out to the Goose Bay Hospital, Labrador, under conditions which had grounded all public transport aircraft. This flight of some six hundred miles was made entirely on instruments, and the landing at Goose Bay was accomplished with a ceiling of less than three hundred feet. Aircrew employed on these operations must, of necessity, have much experience and receive intensive training. They roam over several thousand square miles of territory without benefit of adequate map or radio range, and must have some of the characteristics of a homing pigeon to be successful.

Throughout the entire conception and execution of an air survey program, Canada places the stress upon complete cooperation between all departments concerned. While the R.C.A.F. owns the aircraft and cameras, yet matters of installation, calibration, etc., must meet the approval of the Associate Committee on Photographic Research, which is at complete liberty at all times to request modifications. Similarly, the performance of aircrew on air surveys is greatly improved by virtue of the fact that, during the non-survey winter months, they spend considerable time in photogrammetric mapping offices, taking instruction on plotting and mapping problems.

It is emphasized to these photographic crews how essential it is that tilt should be kept at a minimum, air base kept horizontal and length between controls not only constant, as determined by equal exposure times, but such as to be as great as the camera field and existing relief allow, in order that best results may accrue from the photogrammetric techniques at present used.

Trimetrogon Photogrammetry.

Trimetrogon photography has replaced the pre-war Canadian tri-camera high oblique, and is now being used in the production of aeronautical charts at scaleof 1/506,880 which, in the form of the National Topographical Map Series, will eventually cover the entire Dominion.

During the war years, the U.S.A.A.F. photographed approximately 1,300,000 square miles, including about 500,000 square miles of the Arctic islands, and prints from all these negatives are now in the possession of the Canadian Government. When this photography is found to conform to the essential Canadian photographic requirements of "terrain free from snow and clearness of image," it is used in the photogrammetric mapping of the terrain covered. There remains, very roughly, about $1\frac{1}{4}$ million square miles to be photographed for complete coverage of the Dominion. In 1946 about 250,000 square miles were photographed, and it is expected that this will be exceeded in following years.

In the Canadian Far North, where the photographic season is very short and the number of days available for good trimetrogon photography is severely limited, the problem confronting the map maker is that of getting adequate photographic coverage; resort may possibly have to be had to small scale verticals.

The Legal Surveys Division of the Federal Department of Mines and Resources has been charged with the responsibility for the production of aeronautical charts of scale 1/506,880 or smaller.

The photogrammetric methods used in plotting the trimetrogon photographs follow closely those developed during the war by the Alaskan Branch, U. S. Geological Survey, and need not be elaborated.

On a normal operation at 20,000 feet altitude, the flight lines are spaced sixteen miles apart, and run north and south to cover definite blocks of terrain several thousand square miles in extent. Essential requirements are that photogra-

phy must be done only when the terrain is free from snow, and when a horizon will be visible upon at least one of the wing photographs. The meridian direction for the flight lines was chosen because of the greater ease in keeping the aircraft on its proper course by the Fairchild navigator or solar compass with which each aircraft is equipped, as in the east and west direction adjustments to the solar compass at these latitudes would be necessary at very short intervals.

On present operations in country of low relief, the pilot is given discretion to change the normal flight altitude of 20,000 feet to as low as 10,000 feet if, by so doing, a visible horizon can be brought into the obliques. For this purpose, the navigator is furnished with the necessary charts and tables to enable him to lay off upon the operation map new flight lines, which will be so spaced as to place the principal points of the oblique photographs within approximately four miles of the principal points of the opposing obliques. In order that the navigator may correctly position the aircraft upon the newly projected flight line, he is provided with a perspective camera sight, by means of which the point on the ground, the required horizontal distance from the aircraft, may be selected. It has been felt that this procedure is, at this time, a practical method of making progress in the face of the adverse weather often encountered. It is a tentative solution to weather difficulties.

The wide range in altitude involves, of course, much additional work in plotting the photographs, not only because of the increased number of photographs, but also because planimetry has to be taken off the photographs by the oblique sketchmaster at a reduced scale, then afterwards projected, by means of the vertical sketchmaster, to fit into the 1/63,360 acetate manuscript.

When working out tilt analysis of the trimetrogon sets this past year, it was noticed that the values obtained for the interaxial angles were frequently at variance with the calibrated values. A study of these apparent inaccuracies made by the National Research Council revealed that the errors resulted, not from any lack of rigidity of the mount, but from local variations in film or emulsion dimensions. These errors are erratic and may amount to as much as 12 minutes. When paper prints are used, the errors would probably be increased.

The present potential output of the photogrammetric section of the Legal Surveys Division is approximately 170,000 square miles of planimetry per annum.

Trimetrogon photogrammetry, other than for aeronautical charting, is also done by the Topographical Survey of the Bureau of Geology and Topography, in the production of maps at scale 1/253,440. Tilt analysis follows a pattern developed in Canada, while plotting and laydown are performed by purely graphical methods.

Ground control for trimetrogon photography consists almost entirely of fixes by stellar observations. These are spaced fifty miles apart in so far as is possible, having regard to suitability of terrain and errors in navigation. Unfortunately, it has not been possible to have the photography precede the ground control, and control points are therefore not always placed most advantageously for the photogrammetry. To assure identification, each control survey party, after having established position, covers the surrounding terrain for a radius of several miles with subsidiary air photographs. A net of this type of control now extends over Northern Canada almost as far north as the Arctic Circle.

Vertical Photogrammetry.

Stereoscopic plotting machines have been used in Canada only to a very limited extent, chiefly because of the basic reason that the pressing requirements

always confronting mapping authorities lay in the production of maps of large areas to a scale of 1 mile to 1 inch or smaller, with all possible economy and speed.

The well known methods of radial triangulation by slotted templets or strip plots have been standard photogrammetric practice for some time and are still in general use by all the various federal, provincial, and commercial mapping organizations. A limited number of larger scale maps are turned out, but the accuracy of these is usually achieved by an increased percentage of ground control rather than by special photogrammetric technique.

There is, however, at present a trend of thought towards the more general employment of multiplex for topographic mapping of unsettled and mountainous country, and for this, as well as for other special purposes, it is anticipated that the Topographical Survey of the Bureau of Geology and Topography will shortly be supplied with Williamson wide-angle multiplex equipment, and the Geographical Section, General Staff, Department of National Defence, with Bausch and Lomb wide-angle multiplex.

At present all Canadian holdings of multiplex equipment, which comprise twenty-four normal angle projectors, are located at the Geographical Section. These are, for the most part, being used in bridging vertical control across several overlaps to provide spot elevations for use in contouring with parallax bars.

A problem which has provoked considerable discussion among photogrammetrists is that of picture scale. In a country such as Canada, where topographic mapping has often had to be carried on coincident with development studies, this has been in the past unavoidable, because there appears to be no picture scale universal enough to fit in with the requirements of all interested agencies—agriculture, geology, forestry, mapping, etc. Due to this, and other reasons, photography subsequently used for 1/63,360 mapping has had to be done at scales varying from about 1/15,000 to 1/40,000 to fulfil also the needs of other picture users.

Opinion, however, is now crystallizing that basic topographic mapping should be carried out, as a distinct and prior operation, at a picture scale best suited to that purpose, having regard to accuracy and economy. The trend is towards a general photograph scale of the order of 1:30,000 as promoting an equable balance between coverage and image identifications, when such can be obtained, having regard to limitations of aircraft altitude with respect to terrain relief.

Properly spaced ground control still remains the essential requirement in all photogrammetric mapping in order to achieve a standard of accuracy commensurate with picture scale and publication scale. Since vertical air photography is now done prior to the establishment of ground control, image points can be selected by the survey parties in positions most effective for photogrammetric requirements. Horizontal control is based upon triangulation, plane table, and chain traverse, although in the unsettled and difficult lake country of the North, stadia traverse is used. Vertical control is usually obtained along the lateral overlap of the photographs and is based upon spirit levels supplemented by aneroid and stadia readings. The density depends upon the intricacy of relief and the facility with which the control can be placed.

Procedure for contouring by parallax measurements follows a more or less standard practice of recording parallax measurements of image points along lines roughly normal to the air base, commencing at known elevations directly opposite. The false parallax, as determined on closure, is then distributed as a straight line correction along such line, a parallax table, computed to give the

absolute parallax for the air base length, being first computed and then used with the known data in obtaining the corrected readings.

The standard topographic map sheets, scale 1/63,360, are contoured at intervals of 25, 50 or 100 feet, depending upon the ruggedness of the terrain.

The unit adopted by the Topographical Survey, Bureau of Geology and Topography, the largest topographic mapping agency of the Federal Government, for 1 inch to 1 mile sheets, is composed of an area covering 15′ of latitude and 30′ of longitude, and laid down usually upon a polyconic projection. General practice is to assign to each sheet a group of personnel to complete, in entirety, the planimetric mapping of the sheet, using strip radial plots for fixing intersections to serve for transferring planimetry by sketchmaster from the photographs to the $\frac{1}{2}$ mile to 1 inch manuscript.

Present potential output is approximately 40,000 square miles of planimetric mapping per annum.

Terrestrial Photogrammetry.

Photo-topographic surveying for the production of 1/63,360 and 1/253,440 topographic maps in the mountainous regions of the West, using the ground photographs both for mapping and for the control of vertical and trimetrogon photographs, is being currently accomplished by the Topographical Survey as requirements arise.

The type of photo-topographic camera at present used on Federal surveys is designed for precision and portability. It comprises a body of aluminum alloy, uses a plate size $3\frac{1}{4}'' \times 4\frac{1}{4}''$, and is fitted with a Ross anastigmat wide angle lens of $4\frac{1}{2}''$ focal length. The camera is interchangeable with the telescope assembly of the small Berger mountain transit theodolite, and has a total weight of under two pounds. Infra-red glass plates are used, and for plotting purposes enlargements to about three diameters are made on bromide paper. Photographs to be plotted are mounted upon a specially designed instrument simulating the taking camera, in which, after correction for principal distance, horizontal and vertical angles to preselected points may be read, from which the plan position and elevation of each may be determined in the usual way. Contours are then sketched in.

Research.

Canadian authorities recognize the extreme importance of research. Headed by the President of the National Research Council, the Associate Committee on Survey Research and the Associate Committee on Photographic Research, each made up of representatives from the various National Defence and civil organizations concerned with the problems, deal with all phases of research upon equipment and methods for surveys and mapping.

Research problems brought to the attention of these committees are directed to groups of experts, forming subcommittees, to investigate and report.

Many problems are currently receiving attention, among which may be mentioned those dealing with the investigation and development of the application of radar for level control over the vast Canadian northland, and for controlled air photographs for the production of topographical maps.

Investigations are also being carried out with respect to photographic materials and processing techniques best suited to winter photography for forestry studies.

All vertical photography accomplished by the R.C.A.F. or commercial companies must conform to specifications prepared by the Associate Committee on Survey Research.

Air Photograph Library.

The National Air Photograpic Library, located in the Federal Department of Mines and Resources, Ottawa, now contains more than 1,525,000 individual air photographs covering all parts of the Dominion where air photography has been undertaken through the agency of the Federal Government.

These prints are available for study by interested organizations.

British Columbia Photography.

A discussion upon Canadian photogrammetric operations would be incomplete without reference to the excellent work being carried out by the photogrammetrists of British Columbia who, through the classic application of ground survey photography to the mapping of mountainous territory inspired by the late Dr. Deville, were early introduced to, and became well versed in, photogrammetry.

When vertical air photography became available, these men were quick to exploit the complementary possibilities of both types. A standard technique has been evolved whereby the ground photographs, within the framework of a triangulation net, are used to propagate horizontally and vertically controlled photo points, which are also identified upon the vertical air photographs to provide abundant and tight control for detail stereoscopic contouring and planimetry from the latter.

The post-war reorganization of the provincial government air survey photography has consolidated all operations in an Air Survey Division of the Surveyor General's Branch, Department of Lands and Forests, Victoria. A representative interdepartmental committee formulates all photographic projects, and maintains liaison with the similar committee of the Federal Government in order that photographic flying by the R.C.A.F. and the British Columbia Air Survey Division will not overlap.

So far all provincial flying has been done with commercial aircraft and pilots chartered for the season. Government owned cameras and accessories are installed, and all phases of the work are carried out under the direct supervision of provincial government engineers, with government navigator and camera operator making up the air crew of three, including the pilot. During 1946 Anson V type aircraft were used and a total of 19,500 square miles of vertical photography accomplished.

The British Columbia Air Survey Division favours small size air cameras, and currently uses the British made precision 5×5 inch Eagle V with $3\frac{1}{4}$ inch Ross wide angle survey f/5.5 lens. This camera has a register plate of polished optical glass which not only locates the film precisely in the focal plane during exposure, but also serves as a yellow filter (between Wratten Aero 1 and Aero 2). Upon the lens side of the register glass a graduated neutral wedge of metallic rhodium is deposited to produce more uniform illumination over the negative. The glass-air surfaces of the optical elements are treated with cryolite for antireflection.

This camera has been used for topographical mapping at altitudes above sea level of 17,500 feet with lens apertures of f/8 and f/11 at 1/100 second.

All 5×5 inch negatives are projected to 9×9 inch bromides by means of a precision enlarger combining intense concentrated illumination, proper regulation of that illumination by condensors, and projection of the negative by a high quality lens.

The Air Survey Division photogrammetrists consider that, with well-trained

personnel and careful technique in negative exposure and processing, the resulting 9×9 inch bromides from negatives taken with the small 5×5 inch camera, give the same practical results as obtained by the contact printing from large 9×9 inch camera negatives.

Radial line plotting in conjunction with a dense net of control of both planimetry and altimetry is the standard method employed in present topographic mapping.

More than sixty years ago the late Dr. Edouard Deville, first photogrammetrist of note in Canada, and indeed in the western hemisphere, stated in the preface of his book on Photographic Surveying, "The proper administration of the country required a tolerably accurate map."

Down through the years that thought has inspired Canadian photogrammetrists, and those interested in the development of the country's bountiful natural resources, to keep pressing onward towards the goal of complete coverage of the Dominion with adequate topographic maps.

The Second World War not only brought air photography and its auxiliaries, aircraft and radio, to a high state of development, but also very clearly indicated the necessity of proper maps from a national standpoint. It may, therefore, not be too much to hope that at long last Deville's concept will soon be realized.

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At the conclusion of Mr. Carroll's paper, an excellent movie "Photo Canada," in color and with sound, was shown. It depicted the steps of photogrammetric mapping as practiced in Canada. Although short, it missed none of the steps followed, from planning to reproduction. Photography, arrangement and narration were of the best.

At its conclusion President FitzGerald adjourned the meeting until 8:00 P.M.