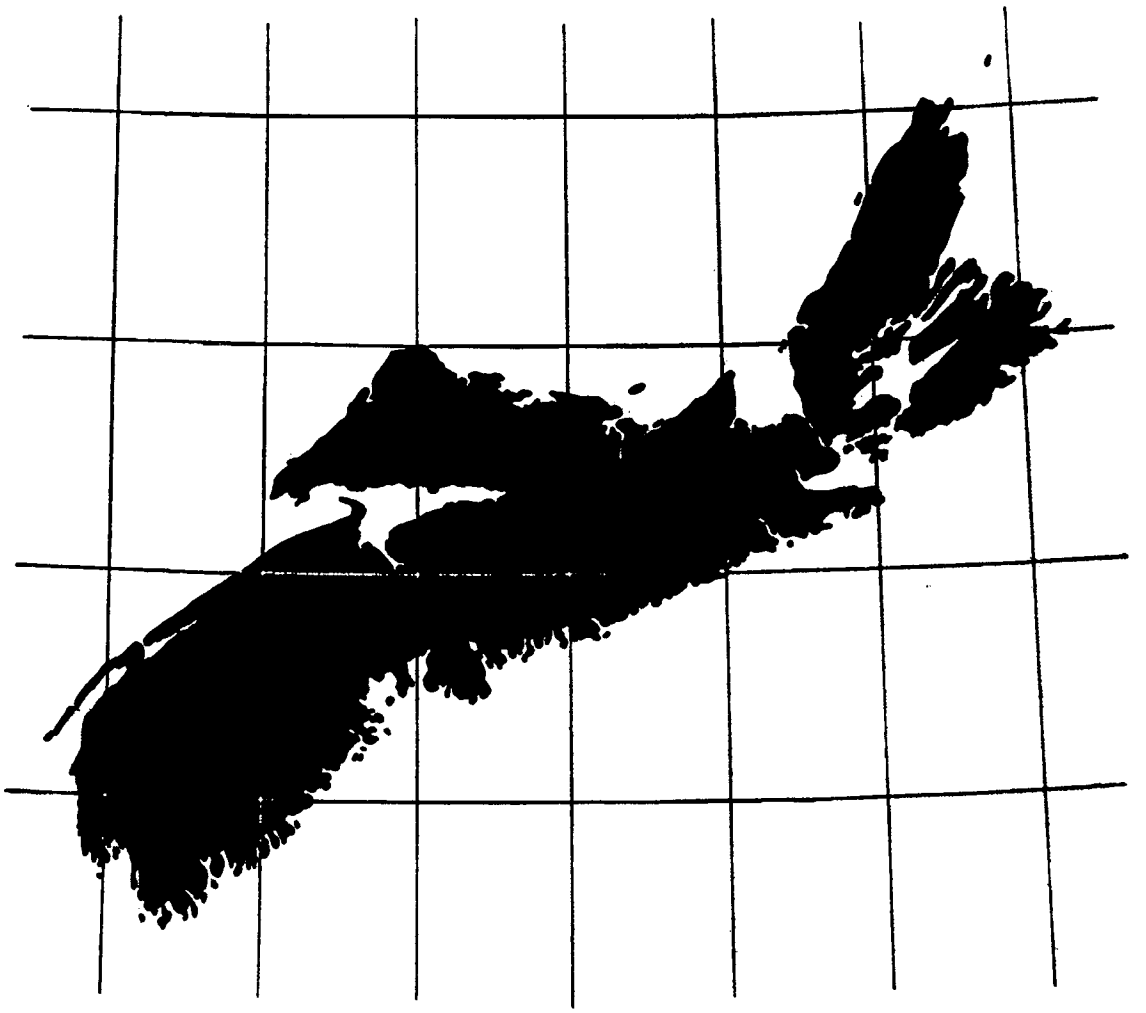
The NOVA SCOTIAN SURVEYOR



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The NOVA SCOTIAN SURVEYOR

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DONALD ELDRIDGE
President

H. B. ROBERTSON
Secretary-Treasurer

R. E. MILLARD
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President's Report – 1961

It gives me great pleasure to open this, our 11th Annual Meeting, and to report on the activities of the Association of Provincial Land Surveyors of Nova Scotia for the year 1961. We have made great strides this year for an organization with a new charter. However, we have a long way to go.

This year, for the first time, our financial situation is in fair shape. We are in the black, but, maybe not after this meeting (however, we are now). This is due to several things: (1) The special levy of last year. (2) Better response from surveyors as to annual dues. (3) Examinations more than paying their own way this year, which is the way it should be. We have been able to erase our four (4) year debt to our hard working secretary-treasurer, Mr. Bert Robertson. I would like to take this opportunity to give praise and thanks to Mr. Robertson for his diligent and hard work over the past year. His devotion and loyalty cannot be measured in money and I am sure the Association as a whole, wishes to thank Bert for a job well done. The job of secretary-treasurer of an organization of this size is a tremendous job. We have been very fortunate to have the wonderful service of Bert; however, it is not quite fair to a man with a growing family and a permanent position to ask so much of his time without proper payment. We also would like to thank Mrs. Robertson for allowing her husband to spend so much time on Association work. It is, therefore, at this time, I propose in the near future that we do 1 of 2 things. Hire the services of a permanent full- time or part-time secretary-treasurer, preferably a retired Land Surveyor or give an honorarium commersurate with the amount of work done. These thoughts I will leave with you and hope that they will be brought up for discussion later on in the meeting.

Our membership at the present time stands at 270 members. This gentlemen, gives you an idea of the size and work connected with this Association. I have not taken the time to work this out, but I feel we would have more surveyors per mile than any other Province in Canada. Of course, some of these members are in arrears slightly, but, I am sure that this is only an oversight in their busy lives. ARE YOUR DUES UP TO DATE? — Check with Bert, he will soon take your money or give you that OK nod!

Your Association was represented at various other Land Surveyors Meetings this year. I was privileged, as your President, to represent you in Ottawa at the Annual Meeting of the Canadian Institute of Surveying. This meeting in Ottawa, with the C.I.S. body, was very enlightening. It is here, at the cross-road of the nation, that one meets Land Surveyors and those connected with Land Surveying from all walks of life. It is here that the various aspects of surveying are brought home. Only too often we tend to think that we are the only ones that have problems. At this meeting one meets the presidents of the Associations from the various Provinces stretching from the Atlantic to the Pacific. Their problems are very similar to ours. It was a pleasure to visit their Annual Meeting and enjoy their hospitality.

In speaking of hospitality, I was also privileged to attend the Newfoundland Land Surveyors Meeting held in St. John's. Last year, Mr. Servant tried in vain to get air-borne to attend their Annual Meeting, but the weather was against him. This year the Surveyor General of Canada, Mr. Thistlewaite, Col. Bing Thompson, and for the first time one of our Presidents attended the St. John's meeting. His plane was forced to land at Gander and he had the wonderful experience of having a trip on "The Newfoundland Bullet." This I am told, is an experience that one never forgets! Their President, Mr. Jim Canning, was a wonderful host. Their problems are very similar to ours and when Jim talks of some of their early surveys being run off by the Trawl Dory Compass and a piece of cod-line, I am sure that some of our early surveys were run off by the same high cost instruments. When it comes to entertaining and showing hospitality "Buddy", we need to take a page out of the Newfoundlanders book. That famous expression in Newfoundland "Stay where you're at and I'll come where you're to" shows the manner in which their hospitality expounds.

Your secretary-treasurer, Mr. Robertson visited, at his own expense, the Annual Meeting of the Massachusetts Institute of Engineers and Land Surveyors in December of last year. He also visited the New Brunswick Land Surveyors Meeting while I was in Newfoundland. He will tell you of these meetings.

A short word about your quarterly magazine Nova Scotia Surveyor. Your editor, Mr. Eric Millard, puts in a lot of time and hard work free of charge in order that we may have our own magazine. To Mr. Millard, we say "Thank You" for a job well done. Gentlemen, this is your magazine and needs your support. I am sure that if you have a worthy subject, Mr. Millard will see that it is published. The last issue of the Nova Scotia Surveyor, I believe was the best one published to date, even though Mr. Millard still puts Walter Servant down as being President for the year 1961.

Gentlemen, as you came in here today, you were privileged to see our distributors in the other room. These gentlemen have gone to considerable time and expense to be here. With their wonderful support our meeting will be bigger and better. I am happy to announce that these kind people are going to sponsor the Social Hour this evening before the annual banquet.

Your program committee under the able chairmanship of Professor Arthur Chisholm, has worked hard to make this Annual Meeting a success. With your support, I am sure that this will be a reality and Art and his committee will be amply rewarded.

Your council had five (5) meetings during the year dealing with the general running of the Association. The metropolitan group under the sponsorship of this Association held two (2) meetings. Members of your council and your President were present at the closing exercises of the Nova Scotia Land Survey Institute in Lawrencetown this past Spring.

Numerous meetings of the Board of Examiners were held under the able chairmanship of Colonel Spencer Ball with Mr. Vincent Harrison doing a splendid job as secretary of the Board of Examiners. In looking around, I do not see Colonel Ball. This I believe is the first meeting that he has missed in the eleven years of this Association. I understand he is on his way to British Columbia for a well earned rest. Gentlemen, it is certainly an eye opener to see and work with men such as we have here on the Board of Examiners. Of course, the setting of new exams cannot and will not appeal to all, but in the long run, I feel that the standards of our Association will be raised.

To the out-going council, I wish to express my sincere appreciation for their co-operation during the past year and may I say to you of the Association "Thank You" for the honour of being your President for 1961. In closing, may these two days together provide not only a happy interlude of fellowship, but also give us a clear understanding of the challenges that confront us, not only as an Association, but as individual surveyors as well.

Signed,
Donald L. Eldridge, BSc.F., P.L.S.

Report of the Coordinate Committee

HALIFAX BRANCH, THE CANADIAN INSTITUTE OF SURVEYING

By S. E. Daykin

We have been hearing a good deal lately about co-ordinate systems, primarily as a result of the work presently being carried out in New Brunswick, and in part because of the interest taken towards instituting such a system in Nova Scotia by the Halifax Branch of the Canadian Institute of Surveying last spring.

For the benefit of those of you who may not be familiar with the purpose and need for such a system in this Province, perhaps a word or two of introduction might be in order. No doubt much of what will be said here will be familiar to some of you, however I hope this will help to review the present situation and perhaps instill greater interests in our efforts to initiate co-ordinate surveys in Nova Scotia.

As we all know, any co-ordinate system is a means of locating a point relative to a known reference frame. In survey operations involving large areas the usual co-ordinates are latitude and longitude. Surveys of small area are generally computed on the assumption that the earth's surface is a plane.

The present interest in plane co-ordinates is not concerned so much with local schemes applicable to very small areas, but with schemes that may be applied to rather large areas, so that the positions of Geodetic and other control points may be expressed in plane co-ordinates. Small local surveys may then be connected to these control surveys and hence to each other on a uniform and mutually compatible basis. The necessary computations may then be carried out by simple methods familiar to all surveyors without recourse to the involved procedures of geodetic computations.

This then is the basic purpose of a plane co-ordinate system, first that it enables all surveys to be integrated and tied together on a uniform system. This can be achieved in any area within the Province regardless of the size of the survey. Secondly, because it is a plane co-ordinate system, it can readily be utilized by all surveyors because of its simplicity of computation. It follows then that the accuracy of all future surveys would increase, particularly with respect to each other. And lastly, but by no means least important, a Provincial co-ordinate system would speed up survey work, eliminating much needless duplication of field work particularly by Government agencies, and ultimately help to reduce the overall cost of surveys.

But the ability to use such a system as stated earlier is dependent on locating a point relative to a known reference. At present in this Province the existing framework of Geodetic and Hydrographic stations are too widely dispersed or too inaccessible to be of any practical use for the vast majority of surveys.

It follows therefore that a network of permanent monuments located accurately with reference to a system of plane rectangular co-ordinates applicable to the entire Province is a prerequisite. These monuments should be of such a density that they will be readily accessible and so that a survey can be tied to a monumented point of origin with a minimum of error.

The ultimate advantages and usefulness of such a system should be apparent to all surveyors. Let me enumerate just a few of the survey problems which I am slightly familiar with that would perhaps be solved for the surveyor of the future.

The largest area of land involved with surveys in this Province is of course the Crown Lands of Nova Scotia encompassing some three million acres. To ensure amicable relations and to safeguard the interest both of the public, as the ultimate owner of the Crown Lands, and of the owner of lands adjoining Crown Land, it is imperative and essential that the thousands of miles of common line be ac-

curately located and properly maintained. The majority of these lines are already established and are being adequately maintained, however present day monuments are far from being permanent. We are therefore actually perpetuating the problem of retracement surveys for the surveyor of the future rather than solving it. A co-ordinate system would serve to tie together all these parcels of land in one uniform system, and at the same time permit more accurate mapping of Crown Lands.

Our accelerated highway program could similarly be facilitated by relating these right-of-way surveys to the co-ordinate system. Monumentation of all new highways would also add to this framework of permanent reference points. As a matter of interest, in the Metropolitan Toronto area this summer, the Federal Government has been establishing a system of some 300 co-ordinated monumented points for the Metropolitan Roads Dept. The Superintendent of Surveys, Ralph Smith, has stated that these points will permit more accurate mapping and surveying, and will be used in planning future expressways, sewer projects, and eventually all survey work in the Metropolitan area, including property surveys. An interesting feature here concerns the effort being taken to preserve these reference points for the future, by setting two points in concrete blocks one directly under the other, in the event the upper one is damaged.

To look at yet another field, authorities agree that there is a need for up-to-date accurate property maps for municipal taxation purposes. Control surveys are necessary as a framework for making such maps, and the survey of municipal and property boundaries can be combined with control surveys and used for this purpose. At an Assessor's Conference earlier this year, Mr. D. J. Bird, Director of Community Planning for the Province, estimated that some $3,000,000 in real, personal and poll taxes is outstanding in rural areas of Nova Scotia. At least one half of this sum could be recovered, in his opinion if adequate assessment mapping existed in the counties. This situation could readily be overcome in future if there existed in this Province a co-ordinate system with adequate monumentation to facilitate production of suitable maps. If Mr. Bird's figures are reasonably accurate, the Provincial Government could almost justify the cost of instituting such a system in Nova Scotia on this basis alone.

These are but a few of the more important uses for such a Provincial Co-ordinate System — other users who would benefit from the system would include forestry operations, mining interests, power development and right of ways, watershed control, town planning, industrial development, mapping projects, and in fact any field affected in any way by surveys.

The ultimate long-term use of this co-ordinate survey of course would be its integration into the land registry system. The advantages of plane co-ordinate systems for cadastral surveys are becoming more widely appreciated, and progress toward statutory adoption of them is gaining momentum. The State of Massachusetts has been using such a system with considerable success for a number of years. More recently, the United States Coast and Geodetic Survey has set up a proposed co-ordinate scheme for the new State of Alaska. Here in Canada, an interesting co-ordinate system has already found legal application under the British Columbia Petroleum and Natural Gas Act, which specifies the boundaries of permits and leases on the basis of a geographic grid. Details of this scheme may be found in an article by G. S. Andrews appearing in the November 1960 issue of the Canadian Surveyor.

Your own Association has long been aware of the growing interest in this question of a co-ordinate survey system, and appreciates its potential value in coping with survey problems in the years ahead. Some 18 months ago a committee was formed from your membership to investigate this in some detail.

The Halifax Branch of the Canadian Institute of Surveying felt that it could aid and assist this endeavour by enlisting through its membership, the support of

other groups in the Province interested in the field of surveying and mapping. Accordingly a series of three general meetings were organized for this purpose. The first of these was held on March 1st, and was extremely well attended by members of a great variety of associations, as well as Provincial and Municipal officials. Willis Roberts, Director of Surveys from New Brunswick, and the driving force behind that Province's co-ordinate system, outlined the organization and development of their system, as well as describing their field operations to date.

From this meeting a Committee was formed to consider the subsequent course of action to be taken with regard to instituting a similar system in this Province. This Committee was made up of the following members:

Mr. J. E. R. March — as Chairman of the Provincial Land Surveyors Co-ordinate Committee for his advice as Director of Surveys for the Dept. of Lands and Forests, and for his guidance as Provincial Councillor of the Canadian Institute.

Major J. A. H. Church — from the Nova Scotia Land Survey Institute at Lawrencetown.

Professor A. F. Chisholm — Vice President of the N. S. Land Surveyors Association.

Mr. Bob Cameron — representing the N. S. Association of Engineers.

Mr. Ed Richard — from the Public Service Commission.

Mr. Wm. Crooker — Nova Scotia Power Commission.

Mr. P. J. Dumaresque — Architect, Planner and Engineer, as well as a P.L.S.

Mr. G. W. Lacroix — Regional Hydrographer, Dept. of Mines and Technical Surveys.

Mr. M. G. Goudge — from the Nova Scotia Dept. of Mines.

Mr. W. E. Servant — as Chairman of the Halifax Branch of the Canadian Institute.

On March 15th this Co-ordinate Committee met in the Provincial Building. The Dept. of Highways and Dept. of Municipal Affairs were also invited to send representatives, however none of their staff was available at that time. Unfortunately only about one-half of the committee members were able to attend due to a particularly bad storm. Prof. Cameron who had been nominated to chair this committee was also among the missing. Despite the lack of numbers, we were able to cover a considerable number of worth-while aspects, and agreed on the following recommendations. The Halifax Branch should officially approach all Provincial Government Departments, all professional associations, as well as all Companies and individuals concerned in any way with surveys to ascertain (a) whether they would make use of the system if it existed, (b) whether they would be willing to lend their support to our endeavours, and (c) to invite them to appoint an official delegate to this committee. This request would be accompanied with an outline of the co-ordinate survey system explaining its usefulness and showing what this could mean in terms of future values to surveyors.

Creating this control network in the Province will likely have to be achieved by having the Federal Government increase the density of Geodetic points to the greatest extent possible, and then create a Provincial organization to further extend this control to the ultimate density required to ensure maximum usefullness. It might be appropriate therefore to obtain some expression of willingness to cooperate and render assistance from the Federal Government at this stage.

With all this information in hand, including letters of interest and support from all local bodies concerned, and with some assurance of Federal assistance, a brief might then be prepared outlining such a Provincial co-ordinate system to the Nova Scotia Government complete with information concerning methods and costs, requesting that they give this urgent consideration.

The recommendations from this committee meeting were subsequently presented at the next general meeting on March 29th, and were endorsed unanimously by the Halifax Branch on a motion by Mr. G. W. Lacroix, seconded by Orin Clarke. At this meeting papers were presented on this same subject from the last Ontario Land Surveyors general meeting.

Our third general meeting, when we had hoped to hear details concerning the Massachusetts Co-Ordinate system, had to be cancelled inasmuch as Mr. Schofield was unable to attend.

Bob Cameron has already prepared a summation of our request which was presented to the Council of the Association of the Professional Engineers of Nova Scotia in March. He has since advised that they endorsed the recommendation that the Provincial Government undertake a study to determine the best system to employ, its cost, and the method of implementing its adoption.

Regrettably no further action has been taken by this committee during the past summer. This has been an extremely busy season for all of us, and we, like you, have simply not had the time to devote to other considerations. Professor Harcourt Cameron has advised me however that he expects to have a little more free time this month to attempt to complete the task we have undertaken. It is hoped that we can accumulate all the data necessary in the next few months with a view to submitting our request to the Provincial Government early next year.

It should be realized that we will not derive any real benefits from this system for a good many years. According to Willis Roberts' estimates, one can effectively monument and control something in the order of 600 square miles per year. At that rate it will take more than 30 years to completely cover the 20,000 square miles of Nova Scotia. We can only hope that his estimates are conservative or that their recent experience has increased this rate of progress.

We are therefore not considering something which we can commence work on next year and hope to make use of in the next few months or even years. But we must make a start now, for each passing day further compounds and prolongs the problem for the future. This new system may not be the panacea for all our surveying difficulties, but it will indeed provide remedies for many of our problems such as undetected errors and loss of survey evidence on the ground.

If I may borrow a closing phrase from Willis Roberts again, let us not perpetuate our past fallacies for another two generations or indeed for even another decade.

Report of the Board of Examiners

ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF NOVA SCOTIA

Mr. President:

As usual, your Board of Examiners met at irregular intervals, due to a variety of causes. Mr. Servant's illness and my own absence in England, combined with business demands and weather conditions, all contributed their share of interruptions, with the result that the final work for arranging the spring examinations was delayed.

Since this was to be the first year to hold the intermediate and finals examinations as a first step towards implementing the courses of instructon as laid down in the Holloway report, and also, since it was the first year of the transition period between the old order and the new, considerable time and thought were devoted to the examinations to be set in the Spring. Finally, after consultation with Major Church, a satisfactory syllabus was produced and the necessary papers were set.

The majority of the candidates were from the N. S. Survey Institute, which presented ten for the finals and fifteen for the intermediate papers. Three others sat in Halifax.

Invigilation was arranged for Halifax by Prof. Chisholm, and for the Lawrencetown School by the Department of Lands and Forests.

Results showed six final and nine intermediate candidates successful. Those who failed in the Spring examination will have the opportunity of writing supplementary or other examinations in December next.

It was the unanimous opinion of the Board that the results were very satisfactory, under the circumstances of the transition period, and the examinations themselves were a dedicated advance towards the goal we have in view. It is our policy at present, to increase the subjects and progressively extend the coverage in these subjects, year by year, until we have attained the standard of training which the Association has decided must be set.

There is little doubt that much greater opportunities will offer for those who qualify to our ultimate standards, and the extra work required for special goals, either the university degree or the specific government positions, will hold no fear for such students.

It is likely that the demand for our members, from outside the Province, will increase as our standards are raised, and the openings for our home market will follow the same trend.

As I am about to leave in a few days for an extended sojourn in the West, I wish to take this opportunity to assure you that your interests and your problems are in the very capable hands of an exceptionally able Board; I have had ample opportunity to gauge their quality, and gentlemen you are fortunate in the extreme! The members of your Board are not only well qualified, they are a dedicated group. Sacrifice of time and business interest has not prevented their devoted attention to the task in hand, and they stand ready to serve you until the end of the road. These members have come at the invitation of the chairman, at all times without complaint, indeed, with enthusiasm but for the present, I fear, without any compensation. It is my hope that this may be corrected in the not too distant future.

Now, it remains only for me to thank all members of the Board, members of Council and members of the Association at large, who have been so wonderfully helpful and unfailing in their assistance.

Mr. President, gentlemen, it has been a privilege to serve you.

Respectfully submitted,

Spencer Ball,
Chairman, Board of Examiners.

FINANCIAL REPORT

for period October 31, 1960 to September 30, 1961

Bank Balance October 31, 1960	$ 134.24	
Receipts	4,103.95	
Expenditures		$ 3,116.11
Bank Balance September 31, 1961		1,122.08
	$4,238.19	$ 4,238.19

DETAIL OF RECEIPTS

Annual Membership Dues	$ 1,520.85	
Special Levy	500.25	
Examination Fees	1,050.00	
Annual Meeting	773.50	
Advertising in the "Nova Scotian Surveyor"	199.20	
New Members	50.15	
Major J. A. H. Church donation for prize to be awarded to the student making the best progress during the 1st year at the Nova Scotia Land Survey Institute	10.00	
		$ 4,103.95

DETAIL OF EXPENDITURES

Stationery	$ 39.82	
Postage	75.00	
10th Annual Meeting	1,150.50	
Ladies Entertainment at 10th Annual Meeting	76.27	
Expenses due to Meetings of the Council	15.00	
Flowers for the funeral of the late Mrs. Robart	11.20	
Printing Expenses "The Nova Scotian Surveyor"	523.34	
Embossing Membership Certificates	10.00	
Legal Fees: Re By-Laws, and Regulations	175.00	
Typing and Stencil Service	169.10	
Post Office Box Rental	6.00	
Major J. A. H. Church prize for best student during first year at Nova Scotia Land Survey Institute	10.00	
500 — 12 page examination booklets	40.22	
Preparing and marking P. L. S. Examinations	407.00	
Presidents expenses re: C. I. S. Convention, Ottawa	95.00	
Presidents expenses to attend Annual Meeting Association of Newfoundland Land Surveyors	113.00	
Honorarium to Secretary-Treasurer for year 1959	150.00	
Flowers for funeral of late Aubrey McKay, P. L. S.	10.50	
Flowers for the funeral of late W. H. Orton, P. L. S.	10.50	
		$ 3,087.45

BANK CHARGES

Exchange deducted from cheques	$ 9.41	
Service Charge	3.00	
Transfer of $960.00 Examination fees from Lawrencetown, Annapolis County	1.25	
Debit on cheque returned N. S. F.	15.00	
		$ 28.66
Total Expenditures		$ 3,116.11

Respectfully submitted,
H. B. Robertson, P.L.S.
Secretary-Treasurer

SOME STATUTORY ASPECTS IN Cadastral Use Of Photogrammetry

By G. S. Andrews
The Canadian Surveyor, Volume XV, No. 5, November 1960

Fundamentals

Cadastral surveys are those concerned with demarkation on the ground of boundaries defining parcels of land for legal title, i.e. ownership, and delineation of these boundaries on a suitable plan, showing clearly the relationship of a parcel so defined to adjoining legally established parcels and boundaries. The real purpose of a legal boundary is to prevent trespass or encroachment across it in either direction.

Ownership of land, stemming from remote antiquity, is one of the most jealously guarded of human rights, such that custom, precedent and law pertaining to it tend to be deeply entrenched in prejudice. Elected legislators are therefor loathe to amend such laws, in whose long evolution the advantages of photogrammetry could hardly have been anticipated.

Costs of cadastral surveys by orthodox procedures have been rising at an alarming rate. If photogrammetry can serve to reduce these, without compromising accuracy and other requirements, then indeed the door should be open for its use. Aerial photogrammetry as applied nowadays, with suitable well known equipment, by proven methods, may, with good cause, be called an exact science. With proper specifications it is fully capable of the accuracy required for cadastral surveys. The extent to which photogrammetry may be economically applied in this field depends on circumstances such as size, location, purpose, and other variables, of the job in question.

Typical Statutory Requirements

In this discussion, the writer will refer to statutes of British Columbia, and regulations thereunder, because he has some familiarity with them and because they are probably typical of broader application. The more important of these are:

(a) For the alienation of land and natural resources from the Crown under various forms of tenure:
- The Land Act
- The Mineral Act
- The Placer Mining Act
- The Forest Act
- The Petroleum and Natural Gas Act

(b) For subdivision of land and registration of title (under the Torrens system):
- The Land Registry Act.

(c) For the principles of survey and remedial procedures:
- The Official Surveys Act.
- The Special Surveys Act.

(4) For the Land Surveying Profession:
- The Land Surveyors' Act.

These Acts enunciate fundamental requirements of survey and authorize the Surveyor-General of the province to issue regulations and instructions in amplification of them. These comprise a considerable mass of detail recently revised and consolidated in official pamphlet form totalling some ninety pages of close text and diagrams.

Only some of these need be mentioned here, viz:

(1) All corners and angles of boundaries shall be posted on the ground, by a variety of standard monuments, and referenced by mounds, cairns, pits, stakes, and bearing trees, depending on conditions.

(2) All boundaries shall be "run", that is, surveyed, and if through bush or timber, cut out and/or blazed.

(3) Natural boundaries shall be traversed, with suitable offset measurements.

(4) The survey of the perimeter shall comprise a closed traverse, with maximum allowable error of normally 1/2,500, in certain circumstances 1/1,000, and in others 1/5,000.

(5) Existing boundaries of adjoining parcels shall be retraced (proven) and reconditioned as necessary.

(6) Suitable ties shall be made to adjoining or nearest surveys if within reasonable distance, or to a triangulation station, and failing these, to a prominent topographic feature, or to air photo detail.

(7) The survey shall be done under the personal supervision of a professional British Columbia Land Surveyor, and certified by him under oath, on the plan and in the field notes.

Although photogrammetry could take care of a proportion of such legal requirements of survey, a visit to the ground by qualified personnel seems obligatory, for confirmation of the necessary tie points of existing or control surveys, and for legally posting new corners. The chief role of photogrammetry, in brief, would seem to be to coordinate all required ground points, thus saving ground traverse to prove existing control and to propagate the new corner locations.

What about marking the boundary lines connecting the new corners? Has anybody devised a technique for cutting out and blazing boundary lines through brush or timber in a first order stereoplotter? Perhaps this requirement of legal surveys is a spot where the law could give just a little bit. Is the marking of the line always a primary necessity? Could it be delayed as a joint responsibility between the adjacent owners, with perhaps the State acting as arbiter if needed? There may be many cases, where the "running" of the line by a surveyor could well be delayed until such a time as further subdivision of the original or an adjoining parcel occurs. Generally, the boundary line can be very closely delineated on the air photos, sufficiently so probably for normal requirements, even for building a fence, depending on the nature of the ground, topography, vegetation, photogenic character, and, of course, the values of the land. Regulation (2) referred to above requires that the blazing of trees shall be confined within six feet on either side of the true line, implying a maximum width for the line marking of twelve feet. This represents a line width of about one tenth of a millimeter on a photo scale of 1/31,680 (2 inches per mile). In the survey of small holdings it is not customary to cut out or mark the lines, and, of course, in open country this problem does not arise. In cases of longer straight line boundaries, the setting of intermediate line monuments might be an acceptable alternative to "running" the full line, and this certainly could be done photogrammetrically. The length and bearing of straight line boundaries fixed by photogrammetrically coordinated extremities may be derived, of course, by simple computation.

Where natural boundaries serve as legal demarcation of land, usually the high water mark along either fresh or tidal waters, it is likely that the photogrammetric delineation is the better, if properly interpreted by actual ground inspection. Natural boundaries are in most cases obvious on the ground, as well as in the photos, and in that respect are superior to artificial boundaries, although they may be subject to special problems such as erosion and accretion. In certain extensive types of tenure over large tracts of land, such as Tree Farm Licences, natural boundaries, both along high water mark and along conspicuous heights of land, offer great advantages and could in many areas be used to a large extent if the delimiters, in specifying such boundries, would go to a reasonable amount of effort and care. The elegant basis for this job is the modern high class topographic map produced by photogrammetry, supplemented by study of the air photos.

The pattern of requirements for primary cadastral surveys for the original alienation of Crown (public) land was set during the pioneering era of the country's

development, when large areas of virgin land were being divided up to meet the demands of, and to provide the opportunity for, settlement. We who are concerned with these matters now have inherited this survey set-up from our fathers and grandfathers. We should remember that at that time not only was the country practically unmapped, but much of it was unexplored. There was no such thing as an aerial reconnaissance, either by flying over it, or by inspecting air photos. The legal requirements of early cadastral surveys were quite logical under the circumstances. They led to an orderly system of dividing the land, usually into rectangular parcels oriented in the cardinal directions, exemplified in the township systems, with all the boundaries "run". This meant that large tracts of country were gridded on a rectangular system by surveyed lines, usually spaced a mile apart. The survey of each parcel was closed, and the settler knew where to locate his fences. These outlines of the primary cadastral surveys preceded topographic and natural resources surveys. Indeed, at the government department concerned, consolidation of the surveyors' field notes and plans resulted in the first topographic maps of the country, as most of the important natural features, etc. were thus tied in. Great attention was given to the returns and reports of the early surveyors, not only for the geography but also for classification of soil and assessment of other natural resources. In this connection I heartily endorse remarks during our discussion here yesterday, by Charlie Lindsay, in tribute to the pioneer surveyors for their praiseworthy role in the original opening up of our great country. Nowadays, thanks to air photography, we no longer need depend on cadastral surveys for topographic mapping or for stocktaking of natural resources.

The rectangular system of primary lots, and groups of them, oriented in the cardinal directions, has, of course, some disadvantages. One of these may be called the "root 2 penalty", and it applies to road and fence mileage as well as to boundary surveys. That is, to proceed in an oblique direction, it is necessary to do so by a series of rectangular jogs. This penalty maximates for directions at 45 degrees from the meridian, at square root of 2 or -.416. In surveys where each angle of a boundary must be posted, the jog system imposes a considerable additional burden. Some frightful examples of the jog system ad absurdum, may be found in the boundaries of many of the old timber limits in the E. & N. Railway Land Grant on Vancouver Island. Here the old timber cruises were summarized in "forties" — rectangles of forty acres — so the "scrub line" along the mountain slopes, running haphazardly in all directions, with no respect whatever to astronomic, magnetic, or any other kind of north, was conventionalized in 20 chain jogs (meant to be) in cardinal directions. The cost of legal survey of such boundaries nowadays is certainly astronomic, whether or not their original azimuths were. Fortunately, the tendency now is to allow more flexibility in the direction of boundaries, as in the case of lots fronting on main highways and on water and in other special cases.

Under present day conditions, with a significant and increasing proportion of the country being covered with excellent air photography and topographic maps, some reform in statutory requirements for cadastral surveys seems desirable, to take advantage of the economic and other virtues of aerial photogrammetry. Concessions would include waiving the requirement of "running" out the boundaries between monuments, the acceptance of simple straight boundaries on other than cardinal directions, and efforts toward increased use of natural boundaries, which, in certain circumstances, could be conventionalized into straight line segments, with each angle posted or witnessed.

Photogrammetric Considerations

Applications of photogrammetry to cadastral survey could well fall into more than one category of accuracy, according to the density of the cadastral pattern and the land values.

A fully rigorous photogrammetric procedure could take the following steps:

(1) With existing air photo cover, make a preliminary plot of the scheme, if one is not already available, locate on it the approximate positions of all tie points and the new points, and transfer these back to the photos.

(2) Take the annotated photos into the field, find and target all the required control points. In some cases, targets will reference the true points. Also target the closest proximity possible of the new corners.

(3) Cover the area with new, high quality photography, at suitable scale, in which all targets may be clearly identified.

(4) Process the new photography in a fast-order plotting machine, deriving precise coordinates for all targeted positions, and derive distance and bearing from the targets of the new corners to their true required positions.

(5) Return to the field and, by short self-checking measurements from relevant targets, locate the true corners and monument them according to legal requirements. Such a procedure calls for two trips to the field, separated by the interval required for opportunity to photograph and the photogrammetric compilation.

In a first-order test of the above nature, using targets, near Princetown, B. C., bridging about 6 miles, with 10 overlaps of 6-inch Aviogon photography a scale of 1/10,000, in 1958, the position deviations maximating at the middle were in the order of 4 feet, but with hyperbolic adjustment to one midway control point they were reduced to an average of plus or minus 0.7 ft. for 16 check points.

In another test at Savona, B. C. in 1959, on a six-mile strip of 11 RC8 overlaps at mean photo-scale of 1/14,000, a total of 47 targeted points were recovered, about half of which were cadastral lot corners. Bridging was done in the A7 Autograph with one initial, one intermediate and one terminal control tie, and the mean deviation from control was about 0.8 foot. Using 5 tie points reduced this slightly. The targets were 16-inch yellow squares on plywood, supplemented by lead-in marks (cotton) 15 ft. by 1 ft. Values for a horizontal distance of some 18,000 feet in this test were measured independently by triangulation, by Tellurometer, by the air photos in the A7, and by ground traverse, with the following results:

Triangulation	17966.0 feet
Tellurometer	17967.4 feet
A7	17966.4 feet
Traverse	17966.4 feet

Results such as the foregoing are acceptable for a large class of cadastral surveying. The photogrammetry is rigorous, including the feature of targeting prior to photography. Presumably the probable accuracy is a function of scale, i.e. double the photo scale and double the accuracy. Economics, however, would limit this first-order approach to sizeable projects in order to reduce the pro rata distribution of basic costs.

There is some scope for further experiments to clarify what may be expected in accuracy from first-order photogrammetry with the use of natural photo detail instead of the targeting procedure. This approach would have great economic advantage in that it would eliminate targeting and special photo flights for each job.

It is also interesting to consider the possibilities of existing photography of the basic cover type at scales as small as, say, 2 inches per mile on the nine-by-nine-inch prints. For example, British Columbia is completely covered with air photography at this scale, and most of it is of very good quality and beautifully flown, even though pre-Aviogon. There is no targeted control on it, but we do have special identification photos for all triangulation points established in recent years. The question is, can the alternative of using natural photogenic detail for referring ground points to a coordinate system achieve the accuracy desired for certain classes of cadastral survey? At the scale quoted, 1/100th inch is equivalent to about 25 feet on the ground. However with good full-size diapositives under magnification in a first-order stereoplotting machine, resolution might be as good as 10 feet on the ground. This is a sizeable pointing error, but not necessarily shocking for certain categories of wilderness location.

To investigate this type of approach, in cooperation with our good friends in the Topographical Survey here in Ottawa, who coordinated for us certain photo detail in close proximity to several specific geographic positions, we made a field test in 1958 for location, by this means, of corners of leases under the Petroleum

and Natural Gas Act, in the muskegs of northeast British Columbia, using 2-inches-per-mile photos taken by the RCAF in 1949. Although absolute position errors for four of these points, "recovered" and tied by Tellurometer and Theodolite to our main triangulation stations nearby were in the order of 100 feet, the relative local errors were surprisingly small. The four said points marked the ends of two separate lease boundaries with the following results:

Line: East Boundary Lease No. 232, True Length: 18,261.7 ft., Error: minus 9.5 ft.

Line: South Boundary Lease No. 230, True Length: 14,597.2 ft., Error: plus 14.3 ft.

This is remarkable, considering the vintage and scale of the photos, growth of vegetation in the interim, and other circumstances. It indicates that, with some improvement in conditions and in the rigour of technique, accuracy suitable for such tenures is feasible with basic cover photography now in hand over enormous areas in Canada.

Coordinate Systems

The advantages of plane coordinate systems for cadastral surveys are becoming more widely appreciated, and progress toward statutory adoption of them gains momentum. Recent articles in *The Canadian Surveyor* by Messrs. W. V. Blackie (2) and J. E. Lilly (3) have helped materially to prepare the way, and already this morning we have heard, with interest and benefit, Mr. Lilly's further discussion of the broad aspects of this theme, (4) and Mr. Roberts' account of field operations in connection with its use in New Brunswick. (5) Many of us are familiar with the excellent work done by the U. S. Coast and Geodetic Survey, both technically and legally, in the acceptance of plane coordinate systems in the United States. (6) The same agency has recently set up a proposed coordinate scheme for the new State of Alaska, of which an interesting feature is the proposal of an Oblique Mercator projection for the "Panhandle" Zone. (7) The full use of coordinate systems for cadastral surveys will of course greatly facilitate photogrammetric applications because, as already mentioned (page 310), photogrammetry excels in co-ordinating a multiplicity of ground points.

An interesting coordinate system has already found legal application under the B.C. Petroleum and Natural Gas Act which specifies the boundaries of permits and leases on the basis of a geographic grid. (8) This has proved eminently successful from the viewpoints of both administration (government) and industry. It received favourable comment here, a year ago, by Mr. J. W. Hill, DLS, ALS, in his address to our 52nd Annual Meeting. (9)

The smallest unit of the B.C. Grid System is a quadrilateral 30 seconds of latitude by 45 seconds of longitude in series commencing at even degree intersections. The north and south boundaries of these units are of parallels, and the side boundaries are true meridians. The areas of these units are, of course, capable of precise calculation without survey, and vary from 200 acres near the 49th parallel to about 160 acres near the 60th parallel of north latitude. This is convenient for taxation and rental purposes. Blocks of 100 such units, that is, tiers of 10 units to the side, are 5 minutes of latitude by 7½ minutes of longitude, and are designated by letter from A to L inclusive, starting at the south-east corner, to cover a standard 1/50,000 map sheet of the National Topographic System. It is thus possible to specify a unit anywhere in the province by the well established NTS argument. For example, the centre of the town of Fort St. John, B.C. having the geographic position of 120 degrees 50' 45" W and 56 degrees 14' 46" N, approximately, falls in the unit designated 94 A 2 K 98. What is probably more important is that geographic coordinates of the corners of each unit may be specified to any order of precision desired. For example, the north-east corner of the above mentioned unit 94 A 2 K 98 has the geographic position 120 degrees 50' 15.00" W and 56 degrees 15' 00.00" N (to the nearest foot).

It is one thing to specify, but quite another thing to occupy, that is to locate these points on the ground. However, to facilitate this a network of some 200 trian-

gulation stations was propagated over the whole of some 25,000 sq. miles of previously unsurveyed country, mostly muskeg, but oil and gas rich, during the years 1954, 1955 and 1956, giving an average distance between control and stations of about 12 miles. This fabulous operation, using wooden towers, was described at the 50th Annual Meeting of this Institute in 1957 by Mr. E. R. McMinn, DLS, BCLS (10). By conversation of the geographic coordinates of the grid corners and the control stations in a work area to a plane rectangular system on a suitable projection, a very convenient method is open, either by field survey or by photogrammetry, to locate any elements of the legal tenures under the said Petroleum and Natural Gas Act.

There is another feature of this scheme. The Petroleum and Natural Gas Act specifies that the locations of oil well sites shall be one per unit (as described above), in the north-east quarter of the unit. From the practical standpoint, the well site position is the dominant feature of the unit location. If it is co-ordinated to a reasonable degree of accuracy, there is then, really, no need to locate the lease boundaries or corners. The well-head site offers a conspicuous target on air photographs taken after drilling, and by suitable precautions could be very satisfactorily co-ordinated by photogrammetry. Indeed it is likely that sufficient accuracy for the purpose could be achieved photogrammetrically by using natural photo detail in the proximity of the well site on blanket photography taken prior to drilling.

It is perhaps ironic that one of the most advanced concepts of cadastral survey practice, a co-ordinate survey system, eminently feasible by photogrammetry based on a good ground control net, should have been applied almost unwittingly in the last stronghold of the untracked wilderness in north-eastern British Columbia. Of course it is in just such virgin areas that new systems are most easily applied, because of the absence of previously established interests or systems of survey. There are, indeed, vast areas of Canada that fall into this category and in which like benefits may yet be gained.

Integration of Surveys

Just a few weeks ago, at the 55th Annual General Meeting of the Corporation of B.C. Land Surveyors in Vancouver, our good friend, Mr. T. J. Blachut, gave a most stimulating address entitled "The Integration of Surveys and its Requirements" which we hope will be published in due course. With Mr. Blachut's kind indulgence, I may drastically condense his theme on that occasion, for the purposes of this discussion, to the concept that the ultimate in survey — in its broadest sense — is embodied in the large-scale precise map or plan, which shows every significant feature of the ground situation in exact location and identity. This map shows, in addition to the cadastral corners and boundaries, all bench marks and control stations, fences, buildings, lone trees, clumps of trees, hedges, sidewalks, curbs, gutters, fire hydrants, poles, manholes, etc., in full character and detail, as well as accurate contours at close interval. This is the all-purpose map, competent not only for land title registration, but also for assessment work, all types of engineering, planning, and so forth.

In this type of surveying precise photogrammetry is a "natural", but, of course, must be supplemented by a significant proportion of ground checking for qualitative interpretation and for auxiliary measurements, such as for example of eaves of buildings.

A distinct advantage of photogrammetry for integrated mapping is that all the features mapped in each overlap are of uniform precision. And, of course, for this very intensive class of survey each overlap would be fully controlled by suitably conditioned ground points, and under such circumstances, the precision of first-order photogrammetry may be much greater than the results of bridging as quoted earlier in this discussion (page 312).

The full-dress integrated survey plan will go a long way to mitigate the problem of lost survey monuments, simply because there is so much detail accurately shown on the plan that a missing corner may be simply and effectively relocated

by reference to prominent detail close by. This is particularly so in built-up areas with the usual improvements such as manholes, curbs, sidewalks, fire hydrants, lamp standards, and the rest.

By way of contrast to the conventional integrated survey plan, let us now review for a moment the ordinary run of conventional subdivision plans as commonly acceptable in a Land Registry Office. No matter how competently done, can you conceive of a more extreme example of a one-purpose job? The plan has an acceptable legal title, monuments of various classes are shown by symbols, both for the old ones found and the new ones set, boundaries are drawn with bearings and distances shown, the azimuth derivation is noted, and the usual surrounding embellishments such as the Surveyor's Oath duly sworn, owners signatures, approvals, etc.—and, if all is ship-shape, the Registrar's signature and number. Except for the identification and acreage, each parcel is, however, an absolute blank. Apropos of this rather amazing singleness of purpose which characterizes our cadastral plans today I cannot resist quoting Lewis Carrol's classic lines about the Bellman's Map. (11)

He had bought a large map representing the sea,
Without the least vestige of land:
And the crew were much pleased when they found it to be
A map they could all understand.

"What's the good of Mercator's North Pole and Equators,
Tropics, Zones, and Meridian Lines?"
So the Bellman would cry; and the crew would reply
"They are merely conventional signs!

"Other maps are such shapes, with their islands and capes!
But we've got our brave Captain to thank"
(So the crew would protest) "that he's bought us the best—
A perfect and absolute blank!"

Conclusion

This is an era in which man's technical prowess seems to have far outspaced his philosophical and moral progress. Military technology has certainly jet-propelled far ahead of our attainments in international ethics and jurisprudence. It is not surprising, then, that our habits in the area of statutory regulation of cadastral surveys seem to lag somewhat behind, in the wake of advances in survey technology.

Photogrammetry, one of the most remarkable and useful of these survey developments, shares the stage with others that, fortunately, are of a complementary nature. In the outdoor workshop could be mentioned the opticla-reading theodolite, the self-adjusting level, distance-measuring devices based on the speed of light or radio waves, improved mobility and accessibility by rotary and fixed wing aircraft, and radio communication. These devices have revolutionized control operations, the essential basis for photogrammetric procedures. Indoors, augumenting the imposing array of photogrammetric plotting equipment with co-ordinate recording adjuncts, electronic computing and data processing machines offer a vast new area of facility, also in support of photogrammetric compilation.

The combined and balanced use of these tools for the reduction of all significant points to a system of three-dimensional co-ordinates, primarily based on the ellipsoidal geographics, on the continent-wide datum, but locally applied in plane rectangulars by suitable projections, do offer safeguards for cadastral requirements, which not only render some of the surviving statutory specifications obsolete, but indeed, provide remedies for many of the troubles that the old system has failed to cure, such as undetected errors and loss of survey evidence on the ground. This remarkable balance of techniques, now at our command, opens the way to a utopia in the survey needs of modern society.

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The Survey Engineering Course

THOUGHTS AFTER COMPLETION OF THE FIRST TERM

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The most recent issue of The Canadian Surveyor, January 1961, might well have revived the discussion on survey education in Canada. In it there is a review of the content of two papers presented at last year's annual meeting of the Association of New Brunswick Land Surveyors. Mr. S. G. Gamble concisely described the problem of the nature and training of "the educated surveyor" as it was set out at the 1959 colloquium on survey education at Ottawa. Professor Ira M. Beattie, head of the Civil Engineering Department of the University of New Brunswick, outlined the past approach to this problem in the Engineering Faculty of our University and explained why we went about finding a new approach.

We felt that the Ottawa colloquium had clearly indicated what type of man was wanted as the surveyor or mapping scientist of tomorrow. We also knew that interest in such a man had been expressed by the entire surveying profession, from the land surveyor to the private photogrammtrist or the geodetic engineer, and not just by one of the professional groups.

We realized that so far only Laval University had been successful in integrating the needs for education in the surveying profession, now well established in Canada. We also realized that the faculties of civil engineering, forestry, and other disciplines, because of the increasing complexity of their own courses, were well justified in cutting down the number of surveying credits. We furthermore realized that only a few people with a good background in mathematics or physics have been showing interest in surveying, while, on the other hand, many civil engineering graduates have turned unwillingly to survey for a few years after graduation while getting a start in their own fields.

We felt that because of these existing trends the young surveyor was inadequately prepared for his professional career, much to his disadvantage by comparison with other branches of engineering, forestry, law, or other fields, and that because of this he lacked public recognition. No doubt, the experienced and devoted surveyor will gain just as much recognition and professional knowledge, even though his university education may be in another field of study, but there is no reason why his way to success should not be made easier by the university.

Is it true that the values of a university education are basic and general, but it is just as important to receive technical instruction together with all the basic knowledge. In this world of specialization the concept of university education must be different from the one that existed 300 years ago if we want to stand with our feet on the ground. One hundred years ago there was only a general engineering course: fifty years later there were separate courses in mechanical, electrical, and civil engineering. Twenty years ago the chemical engineers separated from the mechanicals. Why should it not be possible for the surveyors to separate from the civil engineers now? Someone has to make the start at an English-speaking university.

We felt we could do it, so we started; and we had to start from scratch. The only thing we four representatives from Fredericton had to start with after the 1959 colloquium was the will to do something about survey education.

The colloquium was successful in giving to the participants, and through The Canadian Surveyor to the rest of the Canadian profession, a well rounded picture of what was needed in survey education—a graduate with his main interest in surveying, with a sound knowledge of mathematics and physics, and a broad understanding of all the different surveying fields, including geodesy, topographic surveying, property surveying, construction surveying, and so forth, and with a willingness and ability to use methods such as photogrammetry and electronic surveying and computing. We planned what we would do about this problem on the train going back to Fredericton. We did not have much sleep that night, but when we arrived in Fredericton we had a brief prepared and ready for the typist, to be presented to the President of our University. Excerpts from the speeches by Dr. Howlett, Mr. Gamble, Professors Thompson and McNair and, last but not least, the statistical material compiled by Mr. Hamilton relative to the quantitative estimates for university graduates in this field, gave us the proper background.

Back at U. N. B. we conferred individually with other departments—mathematics, physics, electrical engineering, mechanical engineering, forestry, and law—to see what courses they would be willing to offer towards the necessary rounding out of the planned course.

It was fortunate that our plan met with full-hearted co-operation from the Federal and Provincial governments, the Association of Land Surveyors, the Canadian Institute of Surveying, the Engineering Institute of Canada and even of the Association of Professional Engineers. This co-operation alone made it possible to announce after a preparation period of less than six months that U.N.B. would initiate a survey engineering course in the fall of 1960.

To make our course effective we aimed at giving the graduate a very broad professional background, with a wide range of employment possibilities, and not to make him only a specialist in a narrow field. We felt that we had a responsibility to protect the student, who expects that his chances in this field of study will equal those of any other, from getting into a narrow alley. He should be able to work as a geophysicist or a numerical analyst, should the opportunities in the specialized fields of surveying with the Federal or Provincial governments, the armed services, private photogrammetric firms, construction firms, or private land surveying firms not be numerous or attractive enough for him. From this point of view we agree with criticisms aimed at a surveying course that teaches specialized techniques but we intend to so educate a man that his first and primary interest will be in being a surveyor.

The results of our thoughts appear in our Survey Engineering curriculum, which you have all had an opportunity to read.

We have been fortunate enough to receive advice and help from several prominent persons in the Federal Government, the National Research Council, our own Provincial Government, and from educators abroad. We have been able to purchase or to obtain on loan important surveying and photogrammetric instruments and we hope to acquire more of such equipment in the near future. We therefore are, or will be, able to incorporate into our laboratory programme student exercises with precision theodolites, geodimeters, tellurometers, tacheometers, balplex, multiplex, stereoscopes, stereocomparators and a first-order photogrammetric plotter—the only one at a Canadian university. This will enable us to do work in aerial triangulation and its adjustment during our undergraduate programme, something that in European or United States universities is possible only in post-graduate courses. We also have an LGP-30 computor, which is ideal for instruction and engineering use.

We have reason to believe that with all this equipment, valued at many thousands of dollars, we are not worse equipped to undertake a course in survey engineering than many European universities that have been offering such a course for fifty years.

Perhaps it would be well to give some explanation of the general principles on which we built our curriculum.

It is a tradition at the University of New Brunswick that all courses in the freshman year shall be the same, regardless of the department of enrolment. This gives the student an opportunity to verify his interests, intentions and capabilities. This also holds during the second university year, during which most engineering students have common courses. In this year the students are introduced to their first engineering subject—plane surveying. Here, already, we introduce modern survey procedures and combine computational methods with those of analytical geometry.

In the third year specialization takes place between civil, mechanical, electrical, and chemical engineering. We decided to keep survey engineering in this year common with civil engineering for two reasons. First, the survey engineer of tomorrow should be familiar with the basic background of the civil engineer, such as strength of materials, statics, soil mechanics, and the like, in order to keep civil engineering and surveying related. Second, in their third year our civil engineers receive the basic courses of Advanced Surveying and Photogrammetry, in which they are briefly introduced to modern methods such as the tellurometer, survey adjustments, and photogrammetric plotters. In these subjects the student can develop an interest in modern surveying, which may possibly lead to specialization in that field; or, at the very least, he will become aware of the presence of this equipment and its use.

In the fourth year specialization in surveying begins. Courses such as Advanced Surveying II and Photogrammetry II cover in a strict mathematical and physical sense the subjects to which the civil engineer because of lack of time could be only generally introduced. These include the measurement of distances, by chain, optical devices, electronic and light interference methods, the accuracies of these methods and their reduction, the precise measurement of angles in triangulation and the computation of the measured quantities, even to the possible use of electronic calculators. In photogrammetry the theory of stereomodels, stereoplotters and photographic materials and equipment are pursued further.

The course in Adjustment Computations introduces the student to statistical thinking and to the theory of least squares and its practical application.

Geographical Astronomy goes beyond the usual knowledge of azimuth determination used in land surveying to the coverage of position and azimuth determination required for first-order triangulation.

Map Projections treat mathematically the properties and distortions of a number of possible projections of sphere and spheroid onto plane, cylinder or cone.

The coverage of these subjects necessarily must be complemented by additional courses in *Mathematics*, in which matrices, complex numbers, differential geometry, vector analysis, spherical harmonics, and other similar mathematical formulations are introduced.

Optics and Electronics, with their laboratories, provide for a more thorough understanding of physical properties.

A course in *Computers* gives the students the numerical aspect of mathematically formulated problems and gives them practice in programming and operating an electronic computer.

Subjects like *Physical Geography,* which presents the significance of land forms in relation to rocks, soils and climate; *Descriptive Geometry,* which develops the three-dimensional concept; and *Cartographic Drawing,* which shows the value of the end product of any survey, a good map—these help to round off the scope of the curriculum.

During the fifth year, *Geodesy* gives a thorough mathematical coverage of the methods of geometric measurement and computation of the size and shape of the earth, *Physical Geodesy* deals with the determination of the earth's surface by means of gravity and artificial satellites, and *Geophysics* covers the methods of prospecting by means of gravimetry, seismology, and magnetic, electric and telluric methods.

Photogrammetry III gives the student practice and theory of the latest trends in the subject, covering first-order plotting, analytic work in conjunction with the computer, and aerial triangulation and its adjustments.

For *Cadastral Surveying* we are fortunate to have the services of Mr. Willis Roberts, of the Department of Lands and Mines of the Province of New Brunswick, who, in co-operation with the Law Faculty, will conduct lectures and laboratory periods in property surveys.

In *Topography,* where the relation between measurements and topographic features is outlined, the field of photo-interpretation is presented by our experienced foresters.

Civil Enginering, which covers the general outline of the specialized fields, with special emphasis on highway engineering and town planning, should give the surveyor a background equal to that of the civil engineer in those areas of his work where surveys are necessary.

Cartography should give the student a review of map history, its art and its reproduction techniques.

To supplement the subjects listed and to round off the training of the survey engineer, options are available in *Radar Survey Methods, Hydraulics, Soils, and Forestry.*

Educators will realize that this curriculum puts the teachers at a disadvantage because almost no adequate textbooks are available on the subjects named. Since such texts as do exist are outdated, teachers have to rely on international literature, which, aside from the translation difficulty, first has to be introduced into the libraries. Furthermore, the curriculum imposes a heavy teaching load and requires competent personnel. This is the reason why our president has decided to obtain two additional surveying staff members, and it is expected that these will be graduates of South Africa and Delft in The Netherlands and that they will come to us from the United States.

These arrangements will enable us, from the academic year 1961-62 on, to give graduate courses in photogrammetry and geodetic sciences similar to those given at Ohio State University, where I have just attended a symposium on modern geodesy. This graduate programme will enable us to carry out small research activities in geodesy and photogrammetry in order to keep in close contact with the National Research Council and other research activities in these fields throughout the world. We feel certain that our surveying staff, drawn from widely separated parts of the world and consequently having a wide range of experience, will be able to create a fruitful interchange of ideas on surveying, and we are grateful that our friends both in Ottawa and in Fredericton are guiding us along. We have had visits

from officers of the Federal Government, who have given us talks and demonstrations in the fields of gravity surveys, shoran trilateration, hydrographic surveys and special types of adjustments, and we expect to have more of these in the future. Also, the administration, staff, and students are greatly impressed by the encouragement we have received from the Canadian Institute of Surveying.

None of us at the University of New Brunswick believes that our course is the one and only solution to the problem of survey education. We are aware that different circumstances may lead to different solutions in other parts of Canada. We think that there is a need for several survey engineering courses throughout the country, and if any other university makes an attack on the problem through new courses we shall be ready to co-operate.

Since the time has come to separate the professional surveyors and photogrammetrists on this continent from those on the technician level, we believe that this distinction must also be made in the universities, and any established survey course based upon a solid foundation will help to do this. The cause is identical to that for which the Canadian Institute of Surveying has been fighting in the past decades, the cause of promoting interest and furthering knowledge in surveying and enhancing the usefulness of this profession to the public.

It seems to us that Canadian surveyors at present are divided into two groups, with very different interests. On the one hand we have the government surveyor, geodeaist or programmetrist, and on the other the private land surveyor. The two groups speak different languages because of their different educational backgrounds, and often they can find no common ground. We hope through our survey engineering course to educate men who will be able to appreciate and, most important, to co-ordinate one another's problems. Integrated surveys, which when intelligently planned can serve the public and preserve the usefulness of all measurements, are today the aim of almost every country. However, such an integrated survey is possible only with the co-operation of each individual land surveyor. A common language must be found, and we are making every attempt to so plan that our graduates will be the interpreters.

We neither intend nor expect sudden changes. On the contrary, we are concerned at the thought that our graduates will be in a strange position at first, going out highly trained and with great expectations and high hopes for their professional career, only to find that they have first of all to fight a battle for recognition. However, I am sure that if they had the courage to sign up for our course they will make their way. But the greatest wish they have—and I must say this in front of this convention—is that the Canadian Institute of Surveying will make it known to the public that men with specialized training, devoted to surveying, are waiting for professional careers, not only in the government service, but also in private practice, not only in one narrow field but in any field from geophysics and data processing to legal land surveying.

We now have six eager students enrolled for the fourth year of our survey engineering curriculum, and I hope to introduce them to you at the next annual meeting. There are indications that the enrollment for next year will not be less.

In initiating our curriculum we are relying on the support of the Canadian Institute of Surveying. Please do not weaken that support now. Help us to settle the problem of recognition and employment in government service, in private contracting, in photogrammetry, in geophysics, in land surveying. Help us to find means of sending our best graduates on to post-graduate studies so that they will be able to take over teaching positions at the universities or at the technical schools. The technical schools are very important, for they should turn out perhaps twice as many technicians as the universities should turn out engineers, and the entry of the survey engineering graduate into the teaching staff of the technical schools will make possible the co-ordination of all surveys.

Great things are expected of the Canadian surveyor of tomorrow, and he is fortunate to have such stimulus awaiting him. Please do not place barriers in his path, but rather help him to remove those that exist, wherever you see them.