REPORT OF PROCEEDINGS

OF THE

ASSOCIATION OF DOMINION LAND SURVEYORS

AT ITS

SEVENTH ANNUAL MEETING,

HELD AT

OTTAWA, FEBRUARY 18 AND 19, 1890.

PRICE FIFTY CENTS.

Ottawa:
PRINTED FOR THE ASSOCIATION BY A. S. WOODBURN.
1890.

To Dominion Land Surveyors.

SHOULD you not be a member of the Association, it is respectfully urged that you at once become such, and by your earnest co-operation assist in making it a means of elevating the standard of the profession, and, by an interchange of ideas, of increasing the scientific knowledge of its members to as great an extent as possible.

Those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements or practical experience fit them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge, are qualified to join as Associate Members.

Should you be acquainted with any Dominion Land Surveyor who is not a member, or any gentleman qualified to join as an Associate Member, use your earnest endeavours to make him become such. "IN UNITY IS STRENGTH." Then let us unite together, and as a body be one man with one end in view,

"The Welfare of the Profession."

Any Dominion Land Surveyor may become a member of the Association upon payment of dues.

Application blanks for Associate Membership may be obtained from the Secretary-Treasurer.

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List of Advertisements.

ASSOCIATION OF DOMINION LAND SURVEYORS

Organized April 24th, 1882.

OFFICERS FOR 1890.

HONORARY PRESIDENT.

THE SURVEYOR GENERAL.....OTTAWA, ONT.

PRESIDENT.

WILLIAM OGILVIE, D.L.S.....GLOUCESTER, ONT.

VICE-PRESIDENT.

SAMUEL BRAY, D.L.S.....OTTAWA, ONT.

SECRETARY-TREASURER.

ARTHUR O. WHEELER, D.L.S.....OTTAWA, ONT.

EXECUTIVE COMMITTEE.

J. S. DENNIS, D.T.S.....OTTAWA, ONT.
OTTO J. KLOTZ, D.T.S.....PRESTON, ONT.
JOHN McLATCHIE, D.L.S.....NEW EDINBURGH, ONT.

AUDITORS.

J. F. SNOW, D.L.S.....OTTAWA, ONT.
F. DRISCOLL, D.L.S.....AYLMER, QUE.

The Eighth Annual Meeting will be held at Ottawa, the Third Tuesday in February, 1891.

STANDING COMMITTEES

FOR 1890.

GEODETIC AND TOPOGRAPHICAL SURVEYING.

O. J. KLOTZ *(Chairman)*, W. S. DREWEY, J. I. DUFRESNE.

LAND SURVEYING.

JOHN McLATCHIE *(Chairman)*, D. C. MORENCY, J. H. BROWNLEE.

PERMANENT MARKING OF SURVEYS.

J. S. DENNIS *(Chairman)*, S. L. BRABAZON, J E. SIROIS.

NATURAL HISTORY.

PROF. JOHN MACOUN *(Chairman)*, J. F. GARDEN, WM. MURDOCH.

NOTE.—The addresses of the Chairmen of the several Committees may be obtained from the "List of Members." (See Index, page 3.)

CONSTITUTION AND BY-LAWS.

Constitution.

ARTICLE I.

Name of the Association.

"The Association of Dominion Land Surveyors."

ARTICLE II.

Objects of the Association.

The promotion of the general interests and elevation of the standard of the profession.

ARTICLE III.

Members.

1. The Association shall consist of Active Members, Honorary Members and Associate Members.

2. Active Members must be Dominion Land Surveyors, and only such shall hold office.

3. Any Dominion Land Surveyor may become an active member upon payment of the fees prescribed by Article IX.

4. Honorary Members must be nominated by two Active Members, and the nomination approved of by a unanimous vote of the Executive Committee. The nomination with approval must be in the hands of the Secretary-Treasurer at least one month before the Annual

Meeting. Persons nominated for Honorary Membership shall submit a paper to be read at the Annual Meeting. They shall be elected by ballot in the manner hereinafter provided for the election of officers of the Association. The number of Honorary Members shall not at any one time exceed twenty, and they shall be exempt from payment of dues.

5. (*a*) Associate Members shall be those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements, or practical experience qualify them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge.

(*b*) Provincial Land Surveyors of any Province, and Articled Pupils of Dominion and Provincial Land Surveyors, shall be eligible as Associate Members.

(*c*) Associate Members shall be nominated by one active member in writing to the Secretary-Treasurer, and on approval of such nomination by the Executive Committee shall at once be admitted upon payment of fees prescribed by Article IX.

6. Associate Members shall not vote.

ARTICLE IV.

Officers.

1. The Surveyor General of Dominion Lands shall be Honorary President of the Association.

2. The Officers of the Association shall consist of an Honorary President, a President, Vice-President, Secretary-Treasurer, and an Executive Committee, all of whom, except the Honorary President, shall be declared elected at the Annual General Meeting by letter ballot.

3. No member of the Association shall fill the office of President for more than two consecutive years.

4. Nominations for Officers of the Association shall be made to the Secretary-Treasurer in writing by two Active Members, at least two months before the Annual General Meeting. The Secretary-Treasurer

shall prepare and forward ballot papers to the members of the Association, who shall return them marked in sealed envelopes to the Secretary-Treasurer before the date of the Annual General Meeting.

5. The letter ballots shall be opened at the Annual General Meeting, and the majority of the ballots cast in each case shall decide the election.

6. In case of an even or tie vote, the election shall be decided by the members present at the Annual Meeting voting by ballot.

7. Should the Secretary-Treasurer not receive three nominations for each of the offices of President, Vice-President and Secretary-Treasurer, or six nominations for members of the Executive Committee, the Executive Committee shall add to the ballot papers a sufficient number of names, to make up the number of three candidates for each of the offices and twelve for the Executive Committee.

ARTICLE V.

Meetings.

1. The Annual General Meeting shall commence on the third Tuesday in February, at Ottawa.

2. Special Meetings of the Association may be called by the President, or by the President when requested in writing by three or more members.

3. Eleven members shall form a quorum at any meeting for the transaction of business.

ARTICLE VI.

Amendments

1. Any member of the Association, who may desire a change in the Constitution of the Association, shall give notice of such contemplated change to the Secretary-Treasurer, at least two months before the next Annual General Meeting, and the Secretary-Treasurer shall, in his notice of such meeting to the members, notifiy them of the name of the party proposing such change, and the nature thereof.

2. No by-law or rule shall be altered, or new one adopted, except at a General Meeting, and such amendment shall be voted upon at the said General Meeting, two-thirds majority of the votes cast being neces sary for its adoption.

ARTICLE VII.

Executive Committee.

1. The Executive Committee shall consist of the President, Vice-President, Secretary-Treasurer, and three members; and shall have the direction and management of the affairs of the Association. Three members to form a quorum.

2. The Meetings of the Executive Committee to be held at the call of the President, or Secretary-Treasurer.

ARTICLE VIII.

Auditors.

Two Auditors, to be elected by ballot, shall audit the accounts of the Association annually, and present their report of the same at the Annual General Meeting.

ARTICLE IX.

Subscriptions.

1. The fee for membership for Active Members shall be five dollars, and an annual subscription of two dollars for each subsequent year; both payable in advance.

2. The fees of Active Members shall be forwarded to the Secretary-Treasurer with the ballot papers for election of Officers, and any ballot unaccompanied by the fees mentioned in sub-clause No. 1 shall not be counted in the Election.

3. Associate Members shall pay a fee of two dollars annually.

4. The names of members twelve months in arrears shall be struck off of the roll.

By-Laws.

ORDER OF BUSINESS.

1.

1. Reading of Minutes of Previous Meeting.
2. Reading of Correspondence and Accounts.
3. Propositions for Honorary Membership.
4. Balloting for Honorary Membership.
5. Reports.
6. Unfinished Business.
7. New Business.
8. Election of Officers.
9. Adjournment.

2. All motions must be in writing, and shall contain the names of the mover and seconder, and must be read by the Chair before being discussed.

3. Reports of Committees must be in writing, signed by the Chairman thereof.

4. No member shall speak on any subject more than once, except the introducer of the subject, who shall be entitled to reply; every member, however, shall have the right to explain himself, subject to the discretion of the Chair.

5. When a motion has been finally put to the meeting by the Chairman, all discussion thereon shall be closed.

6. The Chairman shall appoint two scrutineers when a ballot is taken.

7. Every member while speaking shall address the Chair.

DUTIES OF OFFICERS.

1. The President shall preside at all meetings at which he is present; in his absence the Vice-President; and in the absence of both the meeting shall appoint a Chairman.

2. The presiding officer shall only have a casting vote, not a deliberate one.

3. The Secretary-Treasurer shall keep an accurate record of all meetings, conduct all correspondence, announce all meetings, receive all fees and subscriptions and other moneys, pay no bills unless sanctioned by the Executive Committee and signed by their Chairman, make an annual report of all receipts and disbursements, and shall perform such other duties as may from time to time be assigned him by the Executive Committee

Programme.

TUESDAY, FEB. 18th, 9.30 A.M.

Meeting of Executive, Standing and Entertainment Committees.

Reading of Minutes of previous Meeting.

Reading of Correspondence.

Report of Secretary-Treasurer.

Report of Auditors.

Appointment of Scrutineers of Ballots

TUESDAY, 2 P.M.

Reports of Standing Committees on "Geodetic Surveying" and "Publication."

Questions, etc., submitted to the Association.

PAPER—"Want of Precision in Surveys."

JOHN MCLATCHIE, D.L.S., New Edinburgh, Ottawa, Ont.

PAPER—"Remarks on a trip to Alaska and return, via Mackenzie River."

WM. OGILVIE, D.L.S., Gloucester, Ont.

TUESDAY, 7.30 P.M.

President's Address.

LECTURE—On Astronomy.

W. F. KING, D.T.S., Ottawa, Ont.

Illustrated by Sciopticon Views by H. N. TOPLEY.

PAPER—"Hydrographic Surveying."

Staff Commander. J. G. BOULTON, R.N., Ottawa, Ont.

PAPER—"The Railway Belt in British Columbia."
OTTO J. KLOTZ, D.T.S., Preston, Ont.

REMARKS—On Natural History with Special Reference to Canadian Fish.
Prof. JOHN MACOUN, F.L.S.,
Geological Survey of Canada.

WEDNESDAY, FEB. 19th, 9.30 A.M.

Reports of Standing Committees on "Land Surveying," "Permanent Marking of Surveys," "Natural History and Geology" and "Topographical Surveying."

Unfinished Business.

Report of Scrutineers of Ballots.

New Business.

Arrangement of Committees for 1890.

WEDNESDAY, 1.30 P.M.

Meeting of Standing Committees for 1890.

PAPER—"Plans and Field Notes of Surveys of Dominion Lands."
P. B. SYMES, Technical Br. Dept. of Interior.

PAPER—"A Graphic Solution of Spherical Triangles."
W. F. KING, D.T.S., Ottawa, Ont.

LECTURE—"A Practical Chemical Demonstration of the Gelatino Bromide Process."
H. N. TOPLEY, Photographer to the Dept. of Interior.

ADJOURNMENT.

Full discussion after each paper, open to all.

WEDNESDAY EVENING—ANNUAL DINNER.

Minutes.

TUESDAY, February 18th.

Morning Session.

The Annual General Meeting was held in the St. Andrew's Hall.

At 10 a.m. the President, J. S. DENNIS, took the Chair and declared the meeting open.

The President then left the Chair to enable the Executive and other Committees to meet.

On the President resuming the Chair, the Minutes of the preceding Annual Meeting were read and, on motion, adopted.

The Secretary-Treasurer read the following communications :—

Circular from a Committee of the University of Pennsylvania, offering prizes of $400, $200 and $100 for the best three papers on Road Making and Maintenance, and inviting the members of the Association to enter for the competition. Papers to be submitted by April 5th, 1890.

Moved by WM. OGILVIE, seconded by C. A. BIGGER, and *Resolved* :—

That the communication read by the Secretary-Treasurer, entitled "A move for better roads," be received and placed on file, and that the members of the Association be informed of the offers contained therein.

Letter from W. H. C. Smith, of the Geological Survey, stating that he had been unable to prepare his promised paper in time for the meeting, but if permissible, would prepare same for publication in the Annual Report.

Letter from W. H. C. Smith (Associate Member), tendering his resignation. Accepted.

WM. OGILVIE expressed an opinion that Mr. Smith should be given the opportunity of having his paper published in the Annual Report,

did he so desire it, the more especially in view of the late friction between the Association and the Geological Survey Staff. C. A. BIGGER agreed with Mr. Ogilvie. The PRESIDENT and SECRETARY-TREASURER thought no action should be taken in the matter.

Moved by WM. OGILVIE, seconded by C. A. BIGGER, and *Resolved* :—

That the offer of W. H. C. Smith, of the Geological Survey Staff, to contribute a paper to the Annual Report of the Association for 1890, be received, and that the Secretary-Treasurer be instructed to acknowledge the same and allow him to exercise his own pleasure in the matter.

Letter from J. White (Associate Member), of Geological Survey, tendering his resignation. Accepted.

The Secretary-Treasurer presented his Report accompanied by a statement of Receipts and Expenditures. Received and laid over for report by auditors.

Moved by WM. OGILVIE, seconded by J. F. SNOW and *Resolved* :—

That John McLatchie, J. E. Sirois and J. J. McArthur do act as scrutineers of ballots for the Election of Officers for the year 1890.

Auditors' Report received and together with Secretary-Treasurer's Report adopted.

Afternoon Session.

The meeting opened at 2 p.m., the President in the Chair.

The Report of the Committee on Geodetic Surveying was presented by its Chairman, OTTO J. KLOTZ. Received and adopted.

This Committee also reported upon two Problems, submitted to the Association by S. L. BRABAZON, D.L.S., and furnished solutions for the same. Received and adopted.

A question relating to the insertion of the words "more or less," in a description for deed or patent, was submitted by A. O. WHEELER.

Moved by W. S. DREWRY, seconded by WM. OGILVIE, and *Resolved* :—

That the question submitted by Mr. Wheeler *re* the words "more or less" to be inserted in the description for a deed or patent, be referred to the Committee on Land Surveying, for report thereon during the present meeting.

The Report of the Committee on Publication was, in the absence of its Chairman, presented by J. A. BELLEAU.

The reading of this report raised the question of printing the Constitution and By-Laws yearly in the Annual Report. After discussion it was

Moved by O. J. KLOTZ, seconded by J. F. SNOW and *Resolved* :—

That the Report of the Committee be adopted, and the matter of Constitution and By-Laws be left to the Committee on Publication for the year 1890.

The PRESIDENT brought forward the matter of Railway Right of Way Surveys through Dominion Lands, and stated briefly the action taken so far by the Association. He referred to the Memorial, and Letter accompanying the same, prepared in 1886 by a Special Committee, and forwarded to the Minister of the Interior, both of which were published in the Fourth Annual Report; also to the President's Address as published in the Fifth Annual Report; and read the reply received from the Deputy Minister of the Department of the Interior to the above-mentioned Memorial, stating that "So far as this Department is concerned there is nothing in the fact that a licensed surveyor has not made the surveys of a right of way, and certified the maps or plans, to prevent the lands included in a Crown grant being properly described with reference to such right of way.

Mr. Dennis pointed out that in the Railway Act, section 134, it was distinctly stated that the Railway Company *must* file with the Registrar, within six months, a plan of the Right of Way Survey; and further that the Territories Real Property Act necessitated any survey so registered being made, and the plan thereof being signed by a Dominion Land Surveyor. It was not discretional with the Registrar, as the Railway Act distinctly stated the course to be pursued.

The matter had again been brought before the Association.

He had received a letter from one of its members in the North-West Territories, enclosing the opinion of an eminent lawyer to the effect that such surveys could, legally, only be made by Dominion Land Surveyors.

The member who had submitted the above opinion suggested that a branch should be formed in the North-West Territories to work with the Association, and that the said branch should take this matter in hand.

After discussion it was moved by OTTO J. KLOTZ, seconded by WM. OGILVIE, and *Resolved* :—

That the question of Right of Way Surveys in the North-West Territories be referred to the Executive Committee of 1890 with full powers to act.

A PAPER "Want of Precision in Surveys," was read by JOHN MCLATCHIE and followed by discussion.

A PAPER "Remarks on a trip to Alaska and return via Mackenzie River," was read by WM. OGILVIE.

Evening Session.

The meeting opened at 8 p.m., the President in the Chair.

The PRESIDENT read his Annual Address.

PRESIDENT'S ADDRESS.

TO THE MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,

I have very much pleasure in welcoming you to this, the seventh annual meeting of the Association, and the pleasure is strengthened when I note the large attendance of members and the apparent intention on the part of all to contribute in making the meeting a success.

Before speaking to you of the programme to be followed out during our session, I wish to refer briefly to the work accomplished by the Association up to date, and more particularly to the results of the past year during which I have had the honour to be your President.

It is needless for me to speak of the history of our Association, that subject was very fully treated of by the President in his address last year. I wish, however, to bring before you some of the practical results which have accrued to us as a profession from the formation of this Association, with the hope that our members, realizing these benefits, will work heartily in promoting its continued success.

You have heard the report of our zealous and hard working Secretary-Treasurer, and have I feel sure been gratified with the favourable showing both as regards our financial position and our membership; it is not, therefore, necessary for me to say anything further on those heads.

The first matter to which I wish to draw your attention is that of our Annual Reports. These Reports have grown, from very small beginnings, to a volume during the past year, of which any professional society might well feel proud. The subject matter of our reports during the last two or three years cannot but have been of great interest and value to our members, covering as it has many branches of professional knowledge, and affording food for thought and study on the part of all.

Through the exchange of our Reports we have been able to provide our members with the Reports of a number of sister Societies, and thus keep them in touch with fellow workers in all branches of our Profession. In a Society such as ours, which has for its object the advancement of the knowledge of its members, the yearly

Report should contain all subjects which are likely to induce inquiry and study, and in this direction I think our Annual Report is doing a good work; this is evidenced by its increasing size and the range of subjects discussed. Our Report of last year has received very favourable notice at the hands of many of the leading newspapers, and the Association has been complimented on the work it is doing.

To speak more particularly of the work of the Association during the past year I beg respectfully, on behalf of the Executive Committee, to state as follows :—

Six meetings of the Executive Committee have been held, at which all matters of interest to the Association have been discussed and, in as far as possible, dealt with. Among these I may mention the following :—

SURVEYS OF INDIAN RESERVES IN BRITISH COLUMBIA.

Shortly after our last Annual Meeting the attention of the Committee was drawn to the fact that certain gentlemen who were being, or had been, employed by the Government in surveying Indian Reserves in the Railway Belt of British Columbia, were not Dominion Land Surveyors. On behalf of the Association, I opened a correspondence with the Hon. the Minister of the Interior and Superintendent General of Indian Affairs, on this subject. Several communications have passed between us on the matter, and I have now very much pleasure in announcing that the Deputy Minister of Justice, to whom the matter was referred, has decided that all surveys of Indian Reserves, which have been made in the Railway Belt since it became Dominion Lands, should have been performed by Dominion Land Surveyors. This decision will, I am sure, be as gratifying to the members as it was to the Committee. The correspondence on this subject is in the hands of the Secretary-Treasurer, for perusual by any of the members who desire to see it.

GEOGRAPHICAL NOMENCLATURE.

This subject was, as you are aware, taken up at the Fifth Annual Meeting of the Association. Its importance justified the attention then paid it, both by the Committee, and those gentlemen who so kindly assisted in bringing it to the notice of the proper authorities, and it is very gratifying to note that our efforts have received recognition, and that the steps necessary to put our suggestions in working shape are being taken. This question is one that should interest all surveyors, for they are more directly concerned in the naming of geographical features, than any other class in the country, and any steps having in view the adoption of uniform rules for their guidance should receive hearty support. In this connection attention is drawn to the valuable paper on this subject by A. T. Drummond, Esq , to whom the Association are indebted for much kind interest ; and it is suggested that the Secretary-Treasurer be instructed to forward a copy of this paper to the Minister of the Interior.

AFFILIATION OF THE DIFFERENT ASSOCIATIONS OF LAND SURVEYORS.

During the past summer it suggested itself to me that the interests of the Profession throughout the Dominion would be strengthened by the affiliation of all the

Associations of Land Surveyors. With this in view I submitted a scheme for the accomplishment of this end to the Executive Committee. The scheme was as follows :—

"At the present time there are four Associations of Land Surveyors in Canada, viz : the Provincial Associations of the Provinces of Quebec, Ontario and Manitoba, and the Association of Dominion Land Surveyors.

Of these, two Associations, those in Quebec and Manitoba, are incorporated Societies, having power to control the examinations for admission to the Profession, and generally to administer matters relating to surveying. The other two Associations are simply Societies governed by a constitution and by-laws, and have in view the advancement of professional knowledge and feeling, by holding annual meetings, and publishing an annual report.

It has suggested itself to the undersigned that the general welfare of all the Associations would be materially advanced by the adoption of a system of affiliation somewhat as follows :—

1. That one joint annual meeting of all the Associations should be held, instead of each Association holding its own meeting as at present, and that this joint meeting be called the Annual Convention of Canadian Land Surveyors.
2. That the Annual Convention be held alternately at points in the different Provinces, most central for the members of the Association of that Province
3. That each Association maintain its own individuality and issue its own annual report, containing papers contributed by its members, as at present, the report of each Association containing only a short account of the proceedings of the Annual Convention.
4. That the Annual Convention be conducted as follows :—

(*a*) The Meeting to extend over two days, being ended by an annual dinner or some other social gathering.

(*b*) A certain portion of the first day to be allotted to each Association for the transaction of its individual business, appointments of committees, etc., or these sub-meetings might go on at the same time, as is the practice with the different sections of the Royal Society. The first evening and the second day (except the evening which is to be devoted to the social event above mentioned) to be spent in the reading and discussion of such papers, from among all those submitted to the different associations, as may be selected by a committee composed of the Presidents, Secretary-Treasurers and two elected members of each Association.

(*c*) The joint annual convention to be presided over by the Presidents of the different Associations in turn.

If the aforementioned scheme meets with the approval of the different Associations arrangements for carrying it into effect could be made by the appointment of the President and two other members at their next Annual Meeting of the Associations, who would act with a like committee from each of the other Associations in drawing up the necessary and defined scheme of rules, etc. to give effect to the above; this joint committee could meet at some point mutually agreed upon.

7th Annual Meeting - 1896

It is evident that if a joint convention of all the Associations was held the attendance would be large enough to insure success in every way. Cheap railway fares could be obtained, and the holding of some social entertainment in connection with the meeting would be an inducement for members to bring their friends and families with them. The large attendance would make it an object for the city in which the convention was held to extend its hospitalities to the members. And there is no question that any action taken by all the Associations at a joint convention would carry very much more weight than the individual actions or representations of Associations now do.

Again, the bringing together of Surveyors from all the Provinces cannot but result in mutual benefit in many ways, and the undersigned feels confident that if the proposed scheme is carried into effect the results will be an increased interest in our Profession not only by its numbers but by the press and public generally."

With the consent of the Executive Committee a copy of the foregoing, with the following letter, was sent to each of our sister Associations : –

"The Executive Committee of this Assocation have had under consideration a scheme for the affiliation of the different Associations of Land Surveyors in the Dominion, which has been submitted by Mr. J. S. Dennis.

The outlines of the proposed scheme are set forth in the copy of the memorandum relating thereto which is enclosed herewith.

At the last meeting of the Executive Committee it was resolved that the proposed scheme should be submitted to the Executive Committees of the different Associations so that their views regarding the possibility of carrying the proposed scheme into effect might be obtained.

In submitting this scheme I am directed to say that our Executive are unanimous in thinking that the welfare of all the Associations would be very materially advanced were some scheme of affiliation agreed upon.

The scheme submitted is of course a mere outline, and would have to be elaborated by a committee composed of representatives of all the Associations.

The object in submitting this scheme is to obtain from the Executive Committees of all the Associations their views on the subject, so that if the scheme receives favorable consideration the necessary further steps may be taken to have the matter dealt with by the different Associations.

Will you kindly submit this to your Executive Committee as soon as possible, and acquaint us with their views thereon."

The object of sending this was if possible to obtain from the different Associations an expression of opinion on the subject, so that we might be able to lay it before you for discussson and action. So far we have heard only from the Manitoba Association, and their reply is, I regret to say, unfavorable. However, the scheme is now before you for discussion, and such further action as may be deemed necessary.

I cannot leave this subject without saying that personally I feel very strongly that could some scheme of affiliation be successfully carried out, not only the different Associations but the Profession as a whole would benefit largely.

THE SURVEY OF RIGHTS OF WAY FOR RAILWAY PURPOSES.

This subject received considerable attention at the hands of the Association in 1887, however, our efforts at that time failed in getting a decision in accordance with our views. The subject has lately come home to some of our members in the North-West Territories, and has come before the Executive Committee; owing, however to press of other matters we have been unable to move regarding it. It is respectfully suggested that the incoming Committee take the matter in hand, and see whether anything can be done to protect what we consider the rights of our Profession.

TRIGONOMETRICAL SURVEY OF THE DOMINION.

The Committee are unable to report anything further than has been noticed in the last Annual Report regarding this much to be desired work. There is no doubt the subject has received much attention at the hands of the proper authorities, but it is a work requiring careful thought and consideration before being undertaken, and the probable large cost of carrying it out no doubt delays its initiation. However, we know the importance of the work and realize that it is only a question of time until our progressive country will follow in the footsteps of other countries in carrying out this national undertaking.

NATURAL HISTORY.

I beg to call the attention of our members to the debt we owe Professor Macoun for his great kindness in reference to the above subject. He has gone to great trouble, and much personal inconvenience in bringing this subject to our notice and we owe it to him to do anything we can to carry out his wishes regarding the collection of specimens.

In this connection, and more particularly in regard to the paper read by Mr. Drummond at our last meeting, entitled "Suggestions for Surveyors Reports" I would refer you to a Botanical Catalogue prepared by Professor Macoun with the aid of which surveyors will be enabled to name the different species of trees and plants met with, and it is suggested that the Committee take steps to try and secure copies of this catalogue for our members.

IRRIGATION IN THE NORTH-WEST TERRITORIES.

Among the many valuable papers read at our last annual meeting was that by Mr. Pearce on "Settlement and Irrigation in the North-West Territories." The Committee desire to interest the members of the Association as far as possible in this important subject, not only on account of its importance in relation to the future welfare of the Territories from an Agricultural standpoint, but also on account of the benefit which is sure to accrue to the Profession were a scheme of development on the lines suggested by Mr. Pearce, undertaken.

The subject of Irrigation is receiving considerable attention at the hands of the press in the Territories, and the matter has also been discussed at some length in the Legislative Assembly. In bringing about this result, which is but the forerunner of some action in the matter, Mr. Pearce's paper has played an important part and has

been extensively quoted. This is one more important subject brought to public notice through the medium of our Annual Reports.

REPORTS OF STANDING COMMITTEES.

The Executive Committee have referred the following matters to the proper committees, for reports at this meeting:—

1. The problem by Mr. Irwin "Subdivision of a Quadrilateral Figure," to the Committee on Land Surveying.
2. The problems submitted by Mr. Brabazon at last annual meeting, to the Committee on Geodetic Surveying.
3. The paper by Mr. Kirk, "A standard of Precision," to the Committee on Land Surveying.
4. The paper by Mr. Brabazon, "Azimuth by two Stars," to the Committee on Geodetic Surveying.
5. The paper by Mr. Drummond, "Suggestions for Surveyors Reports" to the Committee on Natural History and Geology.

ANNUAL DINNER.

The Committee are of opinion that the pleasure and interest in our annual meetings will be very much strengthened by holding an annual dinner; surveyors as a rule do not get an excess of the social enjoyments of this life, being, as they frequently are, for long periods away from civilization; having this in mind, and also the old, but true saying, that "All work and no play makes Jack a dull boy," we have undertaken a dinner in connection with this meeting, and have received every encouragement from the members, and trust that all will contribute in making it a success. We hope to have the pleasure of having most of our honorary members with us and trust that this social gathering together of our members will strengthen the interest in the Association.

This address was intended to be brief but I am afraid it has extended to almost wearisome length, however my desire to bring before you all subjects of information and interest must be my excuse for detaining you so long.

In closing I desire to express my thanks to the members for the honor done me in making me your President during the past year, and I also wish to convey to the members of the Executive Committee my appreciation of their readiness at all times to assist in furthering the welfare of the Association, which should be the constant aim of all.

In conclusion, I beg to call your attention to the very instructing programme of papers to be read during the meeting, and I bespeak for them the attention which their importance deserves.

I would also say that it is hoped that full and free discussions will follow the reading of each paper, for by this means members will add to the interest of the proceedings and evidence their desire to make the meeting a success.

Respectfully submitted,

J. S. DENNIS,
President.

OTTAWA, February 18th, 1890.

Moved by OTTO J. KLOTZ, seconded by JOHN MCLATCHIE and *Resolved* :—

That the President's Address be received.

A PAPER, "Hydrographic Surveying," was read by Staff Commander J. G. BOULTON.

Moved by OTTO J. KLOTZ, seconded by WM. CRAWFORD and *Resolved* :—

That a vote of thanks be tendered Commander Boulton for his interesting and instructive paper on Hydrographic Surveying.

A PAPER, "Railway Belt in British Columbia," was read by OTTO J. KLOTZ.

A LECTURE on Astronomy was delivered by W. F. KING and illustrated by Sciopticon views by H. N. TOPLEY.

A LECTURE on the Gelatino Bromide process was delivered by H. N. TOPLEY.

WEDNESDAY, February 19th.

Morning Session.

The meeting opened at 10 a.m., the President in the Chair.

The Report of the Committee on Topograhical Surveying was submitted by its Chairman, W. S. DREWRY.

Moved by WM. CRAWFORD, seconded by J. F. SNOW, and *Resolved* :—

That the Report be received and adopted.

Moved by WM. CRAWFORD, seconded by A. O. WHEELER, and *Resolved* :—

1. That it would be of great benefit to the Profession, and the Public generally, were the work of E. Deville Esq., Surveyor General, on Photo-Topography published, and thus placed within the reach of professional men.

2. That this resolution be transmitted to the Surveyor General, and the hope expressed that he may find it possible to have steps taken to carry out such publication.

The PRESIDENT drew the attention of the members to the exhibit of Surveyors and Draughtmen's instruments and supplies made by Messrs. Hope & Co., of Ottawa, and referred to the interest taken by Mr. Hope in the Association and the Profession.

The PRESIDENT also referred to the encouragement and assistance given to the Association by the Grand Trunk Railway in the shape of a yearly advertisement in the Annual Report, and hoped that the members would, when travelling, give that Road the preference.

The Secretary-Treasurer read the Report of the Committee on Permanent Marking of Surveys as published in the Sixth Annual Preceedings of the Association, the said Report not having been presented at the Sixth Aunual Meeting.

Moved by WM. OGILVIE, seconded by J. F. SNOW and *Resolved*:—

That the Report of the Committee be received, and be referred to the Committee on Permanent Marking of Surveys for the ensuing year, for action thereon.

The Report of the Committee on Natural History and Geology was presented by its Chairman, PROF. MACOUN.

Moved by WM. OGILVIE, seconded by WM. CRAWFORD and *Resolved*:—

That the Report be received and adopted.

Moved by J. J. MCARTHUR, seconded by WM. CRAWFORD, and *Resolved*:—

That the in coming Executive Committee take steps to secure a sufficient number of Professor Macoun's Botanical Catalogues to distribute among the Members and Associate Members of the Association.

The Report of the Committee on Land Surveying was presented by its Chairman, JOHN MCLATCHIE.

Moved by J. E. SEROIS, seconded by WM. CRAWFORD, and *Resolved*:—

That the Report be received and adopted.

The PRESIDENT finding it necessary to leave the hall on business, the Chair was taken by the Vice-President.

The Committee on Land Surveying submitted a report on the question relating to the use of thewords "more or less" in a description, and after discussion it was

Moved by J. F. SNOW, seconded by THOS. BREENE, and *Resolved*:—

That the Report of the Committee be received and adopted.

The Report of the Scrutineers of Ballots showed the following Officers to be elected for the ensuing year:

President	WM. OGILVIE,
Vice-President	SAMUEL BRAY,
Secretary-Treasurer	A. O. WHEELER,
Executive Committee	J. S. DENNIS, OTTO J. KLOTZ, JOHN MCLATCHIE,
Auditors	J. F. SNOW, F. DRISCOLL,

Moved by WM. CRAWFORD, seconded by J. F. SNOW, and *Resolved*:—

That the Report of the Scrutineers be received and adopted.

Afternoon Session.

The Meeting opened at 2 p.m., the President in the Chair.

The President's Address was brought up for discussion.

Regarding affiliation of the several Surveyors' Associations in Canada, it was

Moved by W. S. DREWRY, seconded by A. O. WHEELER, and *Resolved*:—

That Wm. Ogilvie, O. J. Klotz and John McAree be appointed a Committee of this Association to act at the coming Session of the Association of Provincial Land Surveyors of Ontario in completing the necessary arragements to bring about a scheme of affiliation; and that they are hereby empowered to enter into an agreement for affiliation on the lines suggested by Mr. Dennis in his memorandum on this subject. The Committee to report to the Executive Committee.

Mr. Drewry explained that his reason for naming the gentlemen mentioned in the above motion was that they would in all probability be present at the Annual Meeting of the Ontario Association and would therefore be competent to take action in the matter.

Moved by JOHN MCLATCHIE, seconed by J. E. SIROIS, and *Resolved*:—

That the President's Address be adopted.

Moved by OTTO J. KLOTZ, seconded by W. S. DREWRY, and *Resolved*:—

That a hearty vote of thanks be accorded to our indefatigable Secretary-Treasurer, and furthermore that the sum of thirty dollars be paid him as a slight recognition of his valuable services.

Moved by JOHN MCLATCHIE, seconded by D. C. MORENCY, and *Resolved* :—

That the Executive Committee be authorized to strike the Standing Committees for 1890; also to arrange list of Exchanges for current year.

A PAPER, "Plans and Field-Notes of Surveys of Dominion Lands," was read by P. B. Symes and discussed.

A PAPER, "Graphic Solution of Spherical Triangles," was read by W. F. King and illustrated by diagrams on the black-board.

Remarks by Professor Macoun on Natural History, with special reference to Canadian Fish, gave rise to a good deal of discussion (see synopsis under LECTURES.)

Moved by JOHN MCLATCHIE, seconded by WM. CRAWFORD, and *Resolved* :—

That this meeting do now adjourn until the third Tuesday in February, 1891.

NAMES OF MEMBERS PRESENT.

Honorary Members :

Bell, Robert, M.D., LL.D., Assistant Director of the Geological Survey of Canada.

Boulton, J. G., Staff Commander, R.N.

King, W. F., D.T.S., Chief Astronomer to the Department of the Interior of Canada.

Macoun, John, F.L.S., Botanist and Naturalist to the Department of the Interior of Canada.

Active Members :

Belleau, J. A.
Bigger, C. A.
Brabazon, A. J.
Bray, Samuel.
Breene, Thos.
Cozens, Joseph.
Crawford, Wm.
Dennis, J. S.
Drewry, W. S.
Dumais, P. T. C.
Green, T. D.
Klotz, Otto J.
Morency, D. C.
Mountain, G. A.
McArthur, J. J.
McLatchie, John.
Nelson, J. C.
Ogilvie, Wm.
Rauscher, R.
Sirois, J. E.
Snow, J. F.
Vicars, John.
Webb, A. C.
Wheeler, A. O.

Associate Members :

Dowling, D. B.
McEvoy, Jas.
Smith, Jacob.
Symes, P. B.

Visitors.

Rev. W. Murphy, O.M.I., B.A.....University of Ottawa.
L. A. Hamilton, Land Commissioner....Canadian Pacific Ry. Co.
Col. Anderson.....Marine Dept., Ottawa.
R. Sinclair.....Dept. Indian Affairs, Ottawa.
P. M. Barker, Inspector of Registry Offices, North West Territories.
J. L. Coté, D.L.S.
J. A. Burrows.....Winnipeg.
Horrace Snow.....Winnipeg.
Martin Brady.....Surveys Branch, Dpt. Interior
J. Macara..... " " "
W. McGreevy .....University of Ottawa.
A. Dufresne..... " "
A. McDougall..... " "
J. L. Laferriere..... " "
J. Coté..... " "
N. McKenzie.....Ottawa.
H. G. Wheeler.....Ottawa.
Horrace Lepierre.

NEW MEMBERS.

Active.

Dickson, H. G.....Selkirk, Man.
Dufresne, L. A.....Montreal, Que.
Jephson, R. J. .....Portage La Prairie, Man.
Reid, J. L .....Port Hope, Ont.
Thompson, W. T.....Qu'Appelle Station, Assa, N.W.T.

Associate.

Clayton, Frank .....Ottawa, Ont.
Hébert, E. A.....Nicolet, Que.
Smith, Jacob.....Banff, Alberta, N. W. T.

Reports.

REPORT OF SECRETARY-TREASURER.

For 1889

OTTAWA, February 17th, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

I beg to report as follows for the past Association Year extending from February 16th 1889 to February 17th 1890 (inclusive).

Exchanges were effected with the following societies :—Michigan, Ohio, Illinois, Indiana, Arkansas, Connecticut and Iowa, and copies of the Reports of Proceedings of each Society, with the exception of two, were distributed amongst our members. The two exceptions referred to were, the Indiana Reports which failed to issue, and the Ohio Reports received only a short time ago. They will be distributed as soon as possible.

One thousand copies of the Sixth Annual Report were printed, of which number thirty-five are still on hand. The remainder have been distributed to our members, to our exchanges and to the public, while some few have been sold.

The following gentlemen have become members since the publication of the last list in the Sixth Annual Report :—

H. G. Dickson, of Selkirk, Man. ; L. A. Dufresne, of Dufresne Mills ; R. J. Jephson, of Milwood, Man., and W. T. Thompson, of Qu'Appelle, N.W.T. The Executive Committee have admitted E. A. Hébert and J. Smith to Associate Membership.

In response to the application of the Association, the Minister of the Interior has kindly furnished as complete a set as possible of Geological Survey Reports and Maps as a contribution to the library of the Association.

Up to the 18th inst., 317 letters have been received and 571 letters have been written.

I beg further to submit herewith a statement of Receipts and Expenditures for the past Association Year, and would like to draw your attention to one or two comparisons before leaving the same in your hands, viz :—

By sale of 5th Annual Reports, $2.52; by sale of 6th Annual Reports, $5.40; by advertisements in 5th Annual Report, $39.00; by abvertisements in 6th Annual Report, $63.00, and $12.00 still outstanding; by dues received during year ending February 1889, $297.00; by dues received during year ending February 1890, $215.00.

The falling off in the last mentioned source is chiefly due to the smaller number of new members.

In conclusion, I may say that the present membership of the Association is 99 all told, as follows :—Eleven honorary, seventy-four active, and fourteen associate members.

Trusting, gentlemen, that we may soon attain to the hundreds,

I have the honor to be,

Your obedient servant,

ARTHUR O. WHEELER,
Sec.-Treasurer.

RECEIPTS AND EXPENDITURES

For the Year Extending from February 16th, 1889, to February 17th, 1890 (incl.).

Receipts.

By Balance on hand		$277 69
" Sale of Annual Reports		5 40
" Refund of pre-paid duty on Exchanges, 1888		1 75
" Advts. in Fifth Annual Report		3 00
" " Sixth " "		63 00
" dues for 1885		2 00
" " 1886		2 00
" " 1887		3 00
" " 1888		20 00
" " 1889		94 00
" " 1890		93 00
" " 1891		1 00
		$565 84

For 1889
Receipts 289.15
Exp. 540.49
Deficit 252.34
On hand 89 - 277.69
On hand 1890 25.35

Expenditures.

To Rent of Hall for Annual Meeting	25 00	
" Vote to Sec.-Treasurer	50 00	
" Lithographing for 6th Annual Report	30 00	
" R. Dunlop for services	3 00	
" Shorthand writer, 6th Annual Meeting	15 00	
" World Type Writer	10 00	
" R. Hunter, type-writing	2 50	
" Joseph Edwards, taxidermist	3 00	
" Printing and Publishing 6th Annual Report by J. Lovell & Son	262 80	
" Discount on American Silver	15	
" Stationery and Printing	82 50	
" Freight and Expressage	19 36	
" Cab hire and cartage	7 25	
" Duty on Electros for Advts	45	
" Postage	29 48	
		$540 49
Balance on Hand		$ 25 35

Amounts Unable to be Collected.

By arrears of dues	$10 00
" National Manufacturing Co., 160 Sparks Street, Ottawa, advertisement in 6th Annual Report of the Association	5 00
	$15 00

Note :—Referring to the last item it may be stated, that although the National M'f'g Co. have used the pages of our Report as an advertising medium. it has been found impossible to obtain payment for the same.

REPORT OF AUDITORS.

OTTAWA, Feb. 18th, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

We, the undersigned auditors, have examined the accounts of the Association, and find them correct.

There is a balance to the credit of the Association of $25.35.

There are no outstanding liabilities.

Mr. Wheeler deserves the thanks of the Association for the methodical manner in which he has kept the accounts.

W. S. DREWRY,
J. J. McARTHUR,

REPORT OF COMMITTEE ON GEODETIC SURVEYING.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

Although no active steps have as yet been taken by the Government for a Geodetic Survey, yet it is gratifying to find that the public is becoming alive to the necessity of obtaining some of the practical results that would flow from a geodetic survey, as outlined in the comprehensive memorandum prepared by the committee in 1888.

Quite recently an influential deputation from Montreal waited upon the Government and urged the necessity, in the interests of commerce and shipping, of having an accurate hydrographic survey made of the Gulf of St. Lawrence, as also tidal observations taken. We believe that the deputation directed the attention of the Minister of Marine and Fisheries especially to their request, presuming that such work belonged properly to that department.

It is to be hoped that if the Government favorably entertains the survey of the Gulf of St. Lawrence, that the work will be laid down on such broad lines as to be included within a matured scheme of triangulation, to include, in the meantime, the older Provinces.

It may not be out of place to state that the Department of the Interior is, of all the departments, the best suited for carrying out the

primary triangulation, for that department has more to deal with the geography of the country than all the others, and, besides, is provided with the necessary astronomic instruments for such work, and has men who have been engaged in geodetic work. The latter department has begun a triangulation of the Rocky Mountains as a basis for orientation of the photographic surveying that is being carried on there.

Little by little geodetic work is being done here and there, but what is so sadly lacking is the bond of union, a harmony, an interdependence, a scheme for that net of triangles to unite all parts of Canada, and last but not least, an appropriation—though it be small—to begin the primary triangulation.

Questions referred to the Committee.

Problem.

The following problem submitted by S. L. Brabazon, at the last Annual Meeting, has been referred to the Committee on Geodetic Surveying:—"Suppose a triangulation of part of the St. Lawrence, where the course is easterly and westerly, triangles say three or four miles in average length of side, initial and terminal points say 150 miles apart; how would you obtain from such a triangulation the difference of latitude and longitude between the first and last stations? Having regard in a spherical solution, to use that sphere most nearly coincident in curvature with the terrestrial surface involved in the case. Deduce formulæ for working, and illustrate by rough diagram or projection."

This is a problem which is solved in various text books and other publications, and hence it is deemed unnecessary to encumber the Proceedings with a solution.

If, however, there are members of the Association who have not access to any of the publications alluded to, the following, with consent of the Association for publication, may be given. It is the solution as given in Appendix No. 19, 1875, Coast & Geodetic Survey.

"When we know the geographical co-ordinates of latitude and longitude of a point on the earth's surface, and the distance and azimuth to another point, we may treat the problem of computing the latitude and longitude of the second point, and the reverse azimuth in two different ways.—We may either solve the spheroidal triangle formed by the two points and the pole as a whole, arriving at trigonometrical

functions of the sought co-latitude, azimuth, and difference of longitude, or we may seek expressions for the differences of the sought, from the given data.

The former or direct method has the inconvenience of requiring the use of ten places of decimals in the computation, in order to give the positions with a degree of exactness corresponding to that of the known distance between the two points, while the second leads to very convenient expressions, on account of the smallness of the differential arcs in most cases of triangulation.

When, however, the arc between the two points reaches several degrees in length, the direct method must be resorted to. This solution has been very completely and elegantly performed by Bessel, and is given in *Astronomische Nachrichten*, No. 86, 1826.

Adopting the second method, we follow in the main Puissant, in the development of the difference of latitude of two points on the spheroid in terms of the distance, azimuth, and latitude of the given point. It will be convenient first to recall the expressions of several lines of an ellipse in terms involving the latitude, L, which is the angle that the normal to any point on the ellipse makes with the major axis.

Designating the major or equatorial semi-axis by a, the minor or polar semi-axis by b, then the *ellipticity* or ratio of their difference to the former is :—

$$\varepsilon = \frac{a-b}{a}$$

The eccentricity e is expressed by

$$e^2 = \frac{a^2-b^2}{a^2}$$

being shown in Fig. 1 by CF, the distance from the centre to the focus ; the normal

$$nl = \frac{a\,(1-e^2)}{(1-e^2\,Sin^2\,L)^{\frac{1}{2}}}$$

The normal nm produced to the minor axis

$$N = \frac{a}{(1-e^2\,Sin^2\,L)^{\frac{1}{2}}}$$

the abscissa

$$ed = no = N\,cos\,L$$

FIG. 1

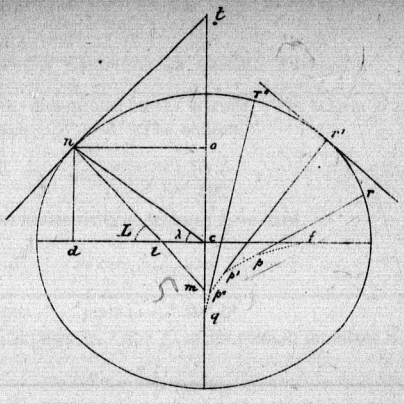
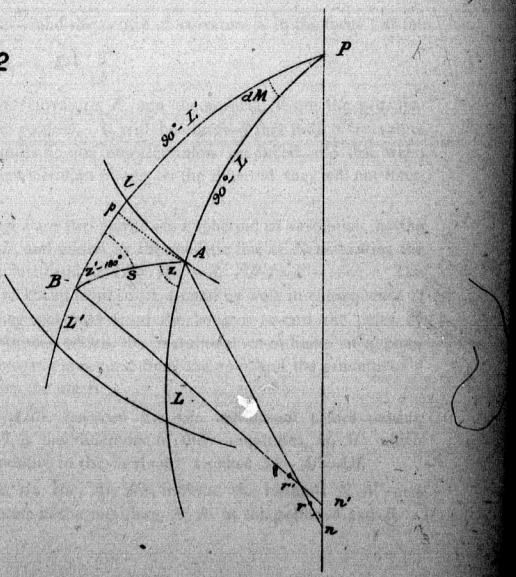


FIG. 2



this is the radius of a parallel on the spheroid. The tangent *nt* ending at the minor axis $= N \cot L$. The ordinate

$$nd = \frac{a\,(1-e^2)\ Sin\ L}{(1-e^2\ Sin^2\ L)^{\frac{1}{2}}}$$

The reduced or geocentric latitude being λ, we have

$$tan\ \lambda = \frac{b^2}{a^2} tan\ L$$

The radius vector $\rho = a\,(1-e^2\ Sin^2\ \lambda)^{\frac{1}{2}}$

The radius of curvature rp, $r'p'$, $r''p''$, at any point in the ellipse is

$$R = \frac{a\,(1-e^2)}{(1-e^2\ Sin^2\ L)^{\frac{3}{2}}}$$

The terminal points F, p', p'', q form an evolute; at the equator where $Sin\ L = o$ $R = \frac{b^2}{a}$ and the centre of curvature is in the focus; at the pole, where $Sin\ L = 1$, $R = \frac{a^2}{b}$

The radius of curvature, R, and the normal, N, are the principal functions used in geodesy. It will be observed that radii of curvature for different latitudes do not intersect unless produced, and that when they lie in different meridian planes on the spheroid they will not intersect at all.

A, B, in Fig. 2 are two points on a spheroid of revolution, having the latitudes L, L', and joined by the geodetic line $A\,B = s$, making the angles with the meridian, $PAB = 180° - Z$, $PBA = Z' - 180°$. The azimuths, Z, are reckoned from south around by west in consequence of the latitudes being reckoned from the equator toward the poles, by settled custom, without which the meridional co-ordinate of a point would be more properly measured from the pole, and the azimuth of a line reckoned from the north.

The angle APB, between the two meridional planes passing through A and B, is the difference of their longitudes, M, M', which being reckoned positive to the westward, we have $M' - M = dM$.

Furthermore, An, Bn', Ar, Br', indicate the normals N, N', and the radii of curvature in the meridian, R, R' at the points A and B.

This being premised, and the latitude L of the point A being given, as well as the length K of the geodesic line AB, and its azimuth Z, we propose to find the latitude L' of the point B, the angle dM, and the reverse azimuth Z', by solving the geodetic triangle ABP. Writing λ, λ', for the co-latitudes, ξ for $180°-Z$, and s for the arc AB, referred to radius=1, we have, in a spherical triangle, for λ' the following equation :—

$$\cos \lambda' = Cos\ \lambda\ Cos\ s + Sin\ \lambda\ Sin\ s\ Cos\ \xi$$

Observing now that s is always a small arc, rarely exceeding 1°, and generally less than 30′, we can develop the increment of λ with reference to that of s in a rapidly converging series, and will have, by Taylor's theorem

$$\lambda' = \lambda + \frac{d\lambda}{ds}s + \tfrac{1}{2}\frac{d^2\lambda}{ds^2}s^2 + \tfrac{1}{6}\frac{d^3\lambda}{ds^3}s^3 + \cdots\cdots \quad (a)$$

In order to determine the differential co-efficients, we consider a differential spherical triangle having the sides λ, ds, and $\lambda + d\lambda$, in which

$$Cos\ (\lambda + d\lambda) = Cos\ \lambda\ Cos\ ds + Sin\ \lambda\ Sin\ ds\ Cos\ \xi$$

and by the known processes of the differential calculus, we find

$$\frac{d\lambda}{ds} = -Cos\ \xi \quad \frac{d^2\lambda}{ds^2} = Sin^2\xi\ Cot\ \lambda \quad \frac{d^3\lambda}{ds^3} = Sin^2\ \xi\ Cos\ \xi(1 + 3\ Cot^2\lambda)$$

Introducing these values in (a), we obtain

$$\lambda' - \lambda = -s\ Cos\ \xi + \tfrac{1}{2}s^2\ Sin^2\xi\ Cot\ \lambda + \tfrac{1}{6}s^3\ Sin^2\xi\ Cos\ \xi\ (1 + 3\ Cot^2\lambda) + \cdots\cdots$$

and substituting L, L', and Z into this expression, we have, for the difference of latitude

$$L - L' = s\ Cos\ Z + \tfrac{1}{2}s^2\ Sin^2 Z\ tan\ L - \tfrac{1}{6}s^3\ Sin^2\ Z\ Cos\ Z\ (1 + 3\ tan^2 L) + \cdots\cdots (b)$$

It will be readily seen that the first term expresses the distance on the meridian PB from B to p, the foot of the perpendicular from A; the second term, the distance very nearly from p to the parallel passing through A; while the third term is a further approximation, and so on.

Referring now our case to an imaginary sphere, having the radius equal to N, or its centre at the point where the normal An intersects the polar diameter of the spheroid, we have

$$s = \frac{K}{N}$$

Substituting which we have

$$L-L'=\frac{K\,Cos\,Z}{N}+\frac{1}{2}\frac{K^2\,Sin^2\,Z\,tan\,L}{N^2}-\frac{1}{6}\frac{K^3\,Sin^2\,Z\,Cos\,Z}{N^3}(1+3\,tan^2\,L)+\cdots\cdots(c)$$

This difference of latitude is, however, referred to a sphere whose radius is N, and requires still to be transformed by referring it to one whose radius is the radius of curvature in the meridian for the middle latitude, R_m. Since we do not at first know the middle latitude, it is more convenient to refer to the radius of curvature R of the starting-point, the latitude of which is known, and then seek the small correction due to the ratio of R to R_m.

Multiplying, then, equation (c) by $\frac{N}{R}$, and dividing, moreover by arc 1″, in order to express dL in seconds of arc we get,—

$$-dL=\frac{K}{R\,arc\,1''}Cos\,Z+\frac{1}{2}\frac{K^2}{R\,N\,arc\,1''}Sin^2\,Z\,tan\,L-\frac{1}{6}\frac{K^3}{R\,N^2\,arc\,1''}Sin^2Z\,CosZ$$
$$(1+tan^2\,L)+\cdots\cdots(d)$$

The computation of this series is facilitated by tables giving the logarithms of the following factors to the argument of L, viz :

$$B=\frac{1}{R\,arc\,1''}\qquad C=\frac{tan\,L}{2\,NR\,arc\,1''}$$

moreover, substituting in the third term the value of the first term, designated by h, we can write it

$$\frac{1}{6}h\frac{K^2\,Sin^2\,Z}{N^2}(1+3\,tan^2\,L)$$

and tabulate another factor

$$E=\frac{1+3\,tan^2\,L}{6\,N^2}$$

when our formula for computation becomes

$$-\delta L=K\,Cos\,Z.B+K^2\,Sin^2\,Z.C-h\,K^2\,Sin^2\,Z.E+\cdots\cdots(e)$$

In order, finally, to obtain the true dL referred to R_m, we must increase δL by $\frac{R-R_m}{R_m}\delta L$

Now

$$R - R_m = a(1-e^2)\left(\frac{1}{(1-e^2\,Sin^2\,L)^{\frac{3}{2}}} - \frac{1}{(1-e^2\,Sin^2 L_m)^{\frac{3}{2}}}\right)$$

$$= a(1-e^2)\frac{\frac{3}{2}\,e^2\,(Sin^2\,L - Sin^2\,L_m)}{(1-e^2\,Sin^2\,L)^{\frac{5}{2}}(1-e^2\,Sin^2\,L_m)^{\frac{3}{2}}}$$

by developing and neglecting terms involving higher powers of e^2; but $Sin^2\,L - Sin^2\,L_m = Sin\,(L-L_m)\;Sin\,(L+L_m) = \delta\;L\;Sin\;L\;Cos\;L$ very nearly, because $\frac{1}{2}\;Sin\;2\;L = Sin\;L\;Cos\;L$

hence we write

$$\frac{R-R_m}{R_m} = \frac{a(1-e^2)^{\frac{3}{2}}\,e^2\,\delta\;L\;Sin\;L\;Cos\;L}{(1-e^2\,Sin^2\,L)^{\frac{5}{2}}(1-e^2\,Sin^2\,L_m)^{\frac{3}{2}}} \times \frac{(1-e^2\,Sin^2\,L_m)^{\frac{3}{2}}}{a\,(1-e^2)}$$

$$= \frac{\frac{3}{2}\,e^2\;\;L\;Sin\;L\;Cos\;L}{(1-e^2\;Sin^2\;L)^{\frac{5}{2}}}$$

making

$$D = \frac{\frac{3}{2}\,e^2\;Sin\;L\;Cos\;L}{(1-e^2\;\;Sin^2\;L)^{\frac{5}{2}}}\,Sin\;1''$$

we get for the desired corrective term,

$$\frac{R-R_m}{R_m}\delta L = (\delta L)^2 D$$

and we finally have for the true difference of latitude

$$-dL = K\;Cos\;Z.B + K^2\;Sin^2\;Z.C + \delta\;L^2 D - h\,K^2\;Sin^2\;Z.E \quad (1)$$

which formula, although of a somewhat complicated derivation, is very simple and convenient in practical computation, with the aid of the tabulated factors B, C, D, E. The term $(\delta L)^2 D$ is here interposed between the second and third terms of the series proper, because the latter is frequently not required, being insensible when the distance K is less than about 10 miles, or log K in metres less than 4.23. The term $(\delta L)^2$D should be used whenever log h exceeds 2.31, and h^2 may be used for $(d\,L)^2$ in all cases where log K does not exceed 4.93.

The term depending on the fourth differential co-efficient, neglected in equation (a), never exceeds 0″.001 for $s = 1°$, or $K = 100{,}000$ metres, and may therefore be safely neglected in practice.

For secondary triangulation, and when the sides do not exceed

about 12 miles, or 20,000 metres, the formula (1) may be advantageously reduced to the following:

$$-dL = K\ Cos\ Z.B + K^2\ Sin^2\ Z.C + k^2 D \qquad (2)$$

In order next to deduce the angle APB between the meridional planes passing through A and B and intersecting in the polar axis, or the difference dM of the longitudes M and M' of the points A and B, counted from east to west, we avail ourselves of the latitude L' of B, which has become known by the previous calculation, and have simply, using the same notation as before

$$Sin\ \lambda :\ Sin\ \xi = Sin\ s :\ Sin\ dM$$

Referring s to a sphere the radius of which is the normal $Bn' = N'$, we have $s = \frac{K}{N'}$ and assuming for the present the small arcs s and dM proportional to their sines, we obtain

$$dM = \frac{K\ Sin\ Z}{N'\ Cos\ L'\ arc\ 1''} \qquad (3)$$

dividing by arc 1″ in order to obtain dM, expressed in seconds of arc. The table gives the logarithm of the factor

$$A = \frac{1}{N arc\ 1''}$$

which must be taken out for L'.

In order to correct for the assumption that the small arcs s and dM are proportional to their sines, we use a table giving the differences of the logarithms of the arcs and sines. ----------

We obtain, finally, the reverse azimuth Z' by considering that in the spherical triangle APB (fig. 2) we have the following relation:

$$Cot\ \tfrac{1}{2}(\xi + \xi') = tan\ \tfrac{1}{2}\ dM\ \frac{Cos\ \frac{1}{2}(\lambda + \lambda')}{Cos\ \frac{1}{2}(\lambda' - \lambda)} = tan\ \tfrac{1}{2}\ dM\ \frac{Sin\ \frac{1}{2}(L + L')}{Cos\ \frac{1}{2}(L' - L)}$$

but $$\xi = 180° - Z$$

therefore $$Cot\ \tfrac{1}{2}(180° - Z + \xi') = -tan\ \tfrac{1}{2}(\xi' - Z)$$

or $$-tan\ \tfrac{1}{2}(dZ) = tan\ \tfrac{1}{2}(dM)\ \frac{Sin\ \frac{1}{2}(L + L')}{Cos\ \frac{1}{2}(L' + L)}$$

Assuming the tangents of $\frac{1}{2}\ dZ$ and $\frac{1}{2}\ dM$ proportional to their arcs, and writing λ for the middle latitude, we have

$$-dZ = dM \frac{Sin\ \lambda}{Cos\ \frac{1}{2}\ dL}$$

and $$Z' = Z + 180^\circ + dZ$$

When the difference of longitude is very large, it may be necessary to correct for the error in the assumption that

$$tan\ \tfrac{1}{2}\ dZ : tan\ \tfrac{1}{2}\ dM = dZ : dM.$$

By an obvious transformation, we find the correction to be

$$+\tfrac{1}{12}\ dM^3\ Sin\ \lambda\ Cos^2\ \lambda\ Sin^2\ 1'',$$

for which we write $+dM^3 F$, where F is to be taken from a special table, ----. This term is only 0".01 when log $dM = 3.36$ and need never be used for secondary triangulation."

By this means we obtain the differences in latitude and longitude between consecutive points in a series, and hence the difference between the initial and terminal points.

This latter difference we may obtain by two other methods. Firstly, by means of polar triangles, assuming as pole a conveniently situate station of one of the triangles. In the first polar triangle will be known from the triangulation the two sides and the included angle, and as radii vectores are drawn to the other stations of the triangulation net, their position becomes known.

The computation continues until the initial and terminal points are included within one triangle, whence the differences of latitude and longitude can be obtained by the formula already given.

Secondly, by projecting the lines connecting the stations upon a meridian by parallels of latitude, and determining the lengths of the projections.

For difference of longitude the side of each triangle can be projected onto the mean parallel of the extremities of the side, and then the projections of the sides forming a continuous broken line between the initial and terminal points projected onto a common parallel, the one about symmetrically situate with regard to the series of triangles. The projections of the two remaining sides of an individual triangle serve as a check upon the projection of the other side.

From Professional Papers No. 24 U.S.A. we find: "Helmert gives the following formula for the difference of longitude in seconds of arc, of the ends of a geodetic line on a spheroid, the length of the line

being s, the latitude of its ends B_1, B_2, and the azimuths at its ends $a_{1,2}$ and $a_{2,1}$.

The equatorial radius and the eccentricity of the spheroid are a_o and e. The formula is

$$(1)\ L_{1,2} = \rho'' \frac{s}{a_o} W \sec B \sin a \left\{ 1 - \frac{1}{24} \cdot \frac{s^2}{a_o^2} (W^2 [1 - \sec^2 B \sin^2 a] - e^2 [10 \sin^2 B - 1] \cos^2 a) + \frac{1}{1920} \cdot \frac{s^4}{a_o^4} (1 - \sec^2 B \sin^2 a)(1 - 9 \sec^2 B \sin^2 a) + G l_6 \right\}$$

In this equation $W^2 = 1 - e^2 \sin^2 B$; $B = \frac{B_1 + B_2}{2}$; $a = \frac{a_{1,2} + a_{2,1} - 180^\circ}{2}$

ρ'' is the number of seconds in radius ; and Gl_6 represents terms of the 6th order, $\frac{s}{a_o}$ being of the first.

Representing the arc of the parallel of B included between two meridians by $P_{1,2}$ its value will be

$$P_{1,2} = a_o \cdot \frac{L_{1,2}}{\rho''} \cdot \frac{\cos B}{W}$$

and (1) may be written

$$(2)\ P_{1,2} = s \sin a \left\{ 1 - \frac{1}{24} \cdot \frac{s^2}{a_o^2} (W^2 [1 - \sec^2 B \sin^2 a] - e^2 [10 \sin^2 B - 1] \cos^2 a) + \frac{1}{1920} \cdot \frac{s^4}{a_o^4} (1 - \sec^2 B \sin^2 a)(1 - 9 \sec^2 B \sin^2 a) + G l_6 \right\}$$

AZIMUTH BY MEANS OF TWO STARS.

The Executive Committee has requested the Committee on Geodetic Surveying to report on the paper "Azimuth by means of two stars," which appeared in last year's proceedings.

It is not very clear what practical purpose this method serves, when we have the superior and simpler method, given in the Manual of Dominion Land Surveys.

It appears somewhat antiquated for a surveyor in this progressive

age to observe time and azimuth by standing behind a plumb line and noting the time of simultaneous occultation of two stars behind the string.

Thereafter pursuing a mathematical calculation from which evolve seconds of arc and seconds of time for azimuth and time respectively, quantities carried to a minuteness which does not appear warranted by the method of observation.

It is not explained how the computed azimuth can be utilized on the ground; whether a picket is lined in with the plumb line and stars; nor even for what purpose the surveyor wants to know his watch correction to seconds.

Seconds of time become a desirable quantity when observing Polaris for azimuth, when not at elongation and especially when near culmination.

In that case the surveyor will determine time with his instrument and not by watching behind a plumb line, and if he is going to determine time by means of Polaris and another star in the same vertical he would undoubtedly choose the method of the Manual instead of that of the plumb line quoted. The former method is preferable too from the fact that it is not dependent upon the simultaneous occurrence of two events—Polaris and another star in the same vertical at the same moment. In the method of the Manual, Polaris is observed at any time, the instrument clamped in azimuth and any other star near culmination observed in that vertical.

The surveyor that does any kind of work must have an instrument commensurate with the accuracy of the work aimed at; there must be harmony in methods, instrument, observation and work.

"Figures don't lie" is very true, but from them very wrong inferences can be drawn. From the most indifferent observations we can, by the inexorable formulæ of trigonometry deduce values expressed to fractions of a second; but are such values an index of the merits of the work? Certainly not. No chain is stronger than its weakest link.

To return to the method and formulæ of Mr. Brabazon. His formulæ are interesting from a mathematical point of view to show how the azimuth and hour angle may be computed, and as such merit the perusal of surveyors, but for application in the field the method of the Manual, as stated, is preferable.

OTTO J. KLOTZ,
Chairman of Committee on Geodetic Surveying

REPORT OF STANDING COMMITTEE ON PUBLICATION.

To the President and Members of the Association of Dominion Land Surveyors.

Gentlemen,—

The Standing Committee on Publication beg to submit the following Report of the printing and publishing performed since our last annual meeting:

As will be seen, the printing of the last report of the proceedings of this Association was again awarded to J. Lovell & Son, of Montreal, and we hope that you will all agree with us in saying that the style of the above report is very creditable and that it is now in such a form as may be continued from year to year.

The total amount of printing and publishing is, as follows:

1000 Copies of the Sixth Annual Report of the proceedings of this Association.
1000 Book wrappers with name of the Association and the Sec.-Treasurer's address.
1000 Sheets of letter paper with engraved headings.
400 Folder programmes of this meeting.
250 Circulars containing a synopsis of the Sixth Annual Report.
250 Receipt forms and book.
125 Circulars of notification of this meeting requesting presence and a contribution to the same.
125 Circulars of enquiry regarding assistance towards inaugurating an annual dinner.
100 Nomination papers.
125 Ballot papers with voting instructions.
100 Ballot papers or slips containing name of one candidate for the Executive Committee.
125 Ballot envelopes.

Owing to the increased demand for the Annual Reports, it was deemed necessary to have one thousand copies printed, an increase of three hundred over the previous year. This committee congratulates the Association on the success it has attained, as is exhibited by the increase in volume, substance, demand, and therefore numbers of the last report; and in order to reduce the expence of publishing, we beg to suggest that it would be advisable to omit the constitution and by-laws as well as other matter that may not be considered absolutely necessary.

The outlay for the last report has been very heavy, but it was felt that an extra effort had to be made to place the Association among those of first-class standing, and we feel satisfied that the object desired

has been accomplished and that it will produce a beneficial result to this Association.

We are pleased to note that seven members of the Association have taken advantage of the splendid opportunity afforded them of adopting the Annual Reports as an advertising medium by inserting their professional cards at $1.00 for one-third of a page, and we would urge every member interested in this Association to take this means of assisting it, feeling assured that mutual benefit will be the result.

We congratulate the Secretary-Treasurer on the creditable and handsome design he has adopted for the heading of our letter paper as we believe that it tends to advertise the good standing of this Association.

In conclusion, we beg to remind you of the many interesting features and profitable results that must be attained by keeping a "Member's Record," and hope that you will favorably consider the suggestion of the same as published in the last Annual Report.

Signed on behalf of the Committee,

T. D. GREEN,
Chairman.

DISCUSSION.

O. J. KLOTZ.—"I think that the Constitution and By-Laws should not be omitted. They are very often handy for reference purposes."

SEC.-TREASURER.—"I beg to draw attention to the fact that our best exchanges do not print them every year."

On motion it was resolved that the report of the Committee be received and adopted, and that the matter of printing the Constitution and By-Laws be left in the hands of the Publication Committee for 1890.

REPORT OF STANDING COMMITTEE ON TOPOGRAPHICAL SURVEYING.

To the President and Members of the Association of Dominion Land Surveyors.

Gentlemen,—

As Chairman of your Committee on Topographical Surveying it becomes my duty to report to you on that subject.

Topographical refers to topography, the latter word having been taken almost bodily from the Greek language in which it is τοπογράφια, this word is in turn derived from the two Greek words τόπαο a place, and γράφειν to write or describe.

You will observe that topographical is used in distinction from geographical, the former meaning the description of a particular place and the latter referring broadly to the whole earth.

Webster's unabridged dictionary defines the English word topography as meaning: "The description of a particular place, city, town, "manor, parish, or tract of land; especially, the exact and scientific "delineation and description in minute detail of any place or region; "the science or art of exact delineation or description."

Worcester's dictionary defines the word as meaning: "A descrip- "tion of the form of the surface of a limited portion of the earth's "surface, whether made verbally or by a graphic delineation, or a "description of the natural objects found upon it, such as rocks, trees, "streams, etc., together with all constructions, as roads, bridges, towns, "etc."

The prime object of a topographical survey is to permit the construction of a map shewing the topography of the tract of country surveyed.

From the definitions of the word given above and the works of the highest authorities, we arrive at the conclusion that a topographical map shows not only the natural or physical features of the country, but also all structures such as bridges, roads, buildings, etc.

Maps are sometimes incorrectly spoken of as topographical, as for example, the map of Manitoba and the North-West Territories. This map, although showing some topographical features, may be properly

denominated geographical, since the scale is too small to shew other than very prominent topographical features. A map to be correctly denominated topographic must be on a sufficient scale and show accurately *all* topographical features.

In short, a milkman may put a little milk into water but that does not entitle him to call the whole mixture milk.

As before stated the base of a topographical map is a topograhical survey.

Prof. Johnson's definition as set forth in his "Theory and Practice of Surveying" is as follows: "A topograghical survey is such a one as "gives not only the geographical positions of points and objects on the "surface of the ground, but also furnishes data from which the character "of the surface may be delineated with respect to the relative elevations "or depressions."

When such a work is extended over any considerable area, it is based on a trigonometrical survey of a high order of precision and the geographical position of at least one of the initial points must be accurately determined by astronomical observation. Otherwise the geographical position is not known. To illustrate this we may say that Toronto is in Canada, but this does not define its geographical position: that can only be done by stating its latitude and longitude, or its exact position in reference to some point whose latitude and longitude are known.

The only topographical surveying, of which we have knowledge, carried on in Canada, is the photo-topographical survey of the Rocky Mountains, now in progress. Its initial point is the astronomical station at Calgary, whose latitude and longitude have been ascertained by Messrs. King and Klotz of this Association. The trigonometrical survey on which the detailed topographic work is based has been carried on by the writer and is precise, although not of the highest order of precision. For the purposes now aimed at, it is not necessary at present to make this work in the Rocky Mountains of the highest order as the extra cost might not be compensated by the immediate increased economic value.

When speaking of the highest order of precision it is meant that a base line is measured with a probable error of not more than 1 in 1,000,000, the angles measured with an instrument reading to single seconds or less, all possible precautions taken and all known refinements used in the reduction.

In our trigonometrical work the length of base adopted was the mean of two measurements, each of which differed from the mean .018 of a foot. Taking the mean of the two measurements as the correct length, the precision of either one will be measured by the ratio of .018 to 8118 or 1 to 451000, and the probable error of the mean will be 1 in 676500.

Owing to inability to obtain an instrument such as was desired in time for the work, part of the triangulation has been executed with a three vernier six inch alt-azimuth reading to .004 of a degree but which could be readily estimated to half that amount.

The instrument which it is proposed to use has a six-inch limb and reads to 2 seconds by means of filar micrometers. There will be quite sufficient difficulty in carrying an instrument of even this size to the tops of mountains from ten to eleven thousand feet high.

The subsidiary or secondary triangulation has been made with a 3½ inch prismatic transit reading to single minutes. The photographs, from which the topography is laid down on the plan, are taken from the various triangulation stations and auxiliary points called camera stations. The position of the latter is fixed by setting up the transit at the point and reading on three or more triangulation stations : it is advisable to also read on the camera station from one or more triangulation stations if possible. Azimuths and zenith distances are taken to two or more peaks appearing in each view.

In my report of last year will be found a description of some of the methods used in applying the photographs to plan making.

Mr. McArthur who has been carrying on the secondary triangulation and photographic work during the past year, is a member of this Committee and has been repeatedly asked to write something on the subject of this report, but has steadily refused to do so. You will therefore understand the want of matter on this subject.

The work now being carried on in the mountains has for its object not only the construction of a map, but is also intended to furnish points of departure for the survey of mining claims, timber limits and lands.

In the mountains, it is impossible to run a system of base and meridian line as on the prairie, and a triangulation probably affords the most accurate and economical base from which to operate.

A cairn is built at each triangulation station and it will be no excessive amount of work to determine and tabulate the position of each cairn with reference to the nearest theoretical section corner.

This being done a simple triangulation and an azimuth observation will serve to fix the position of the instrument; or, as will often be the case, three or more cairns will be visible and by reading the angles and using the problem of the three points, the position can be found.

For rough work, compass bearings would probably serve.

In the portion of British Columbia where the lands are not laid out in regular townships and sections, I believe the system of triangulation above mentioned would offer special advantages. But a few weeks ago it was noticed in the newspapers that our citizens on the Pacific slope were agitating the making of extensive surveys. Now, if we can show that the carrying out of the system mentioned above would result in a complete map of the country and an accurate basis for future surveys at a less cost than any other method, it should be to our advantage.

From the experience we have had in the mountains, we believe that a sufficiently exact triangulation can be carried over the greater part of that Province and a topographical map made by photo-topography at a cost of from two and one-half to four cents per acre.

The men undertaking that work would require a slight knowledge of photography and the methods used in making a map from photographs. The latter knowledge can be had from a book written by our Honorary President, E. Deville, Surveyor-General of Dominion Lands. In addition to the involved problems in descriptive geometry, the book deals with perpective and its application to the making of plans from photographs, also the instruments used in the work and the method of carrying on the subsidiary triangulation necessary for the determination of the geographical position and elevation of the points from which the photographs are taken. It may be said that it would be a great benefit to the members of this Association and to surveyors generally if the Surveyor-General could be persuaded to publish his book so that it would be available to every one.

Trusting that all herein contained may meet with your approval, and that next year's chairman will be able to report a large increase in topographical surveying, this report must be drawn to a close.

W. S. DREWRY, *Chairman.*

DISCUSSION.

A. O. WHEELER: "I think that Mr. Drewry's suggestion 'that it would be a great benefit to members of this Association and to surveyors generally if the Surveyor-General could be persuaded to publish his book so that it would be available to everyone,' should be put in the shape of a resolution and be transmitted to Mr. Deville."

W. S. DREWEY: "I may explain that Mr. Deville's work on this subject is the only complete work in existence suitable to the application of Photo-topography in Canada."

A resolution for transmission to Mr. Deville was then passed, expressing the hope that he would see his way to carry out the publication referred to.

On motion the report of the Committee was received and adopted.

REPORT OF STANDING COMMITTEE ON PERMANENT MARKING OF SURVEYS.

[This Report, although published in the Sixth Annual Report of the Association, was not presented at the Sixth Annual Meeting, owing to the unavoidable absence of the Secretary-Treasurer, in whose hands the same had been placed. It was laid before the general meeting in February last, and is now reproduced together with the discussion thereon.—*Sec-Treas.*]

Man's life is but a surveying bout,
And he's best engineer
Whose perfect transit ne'er is out,
Whose plan and lines are clear.

OLD POEM.

With regard to carrying out the suggestions in the paper "on the permanent marking of public Surveys in the field," published in the Report of the D. L. S. Association, in March of the year 1888, the undersigned would observe:

That there are two points which seem to demand special consideration: 1st. By what means can Surveys be marked in the field, so as to perpetuate them; 2nd. How can the results of those Surveys be published in a concise and convenient form, so as easily to give whatever information can be derived from them.

The plough in the field, fire in the bush, are powerful agents for the destruction of timber posts. Trees are becoming too scarce to be spared for landmarks, and but for hard fighting with the fire every season, they would be even scarcer. Maps, to give accurate information, must be on a scale so large as to forbid their being published. Field notes are also difficult and expensive to publish, and occupy a good deal of space. If then Surveys are to be made permanent, and the information they furnish is to be given in such shape as to be easily packed away for future use, and yet to be always at hand, available for whoever wants it, there will have to be a departure from the wooden post and inscribed tree, and there must be some additional record of the work besides the usual plan and the report accompanying it. What then is to be substituted for the discarded landmarks, and what better method of recording shall we adopt?

It is hoped the accompanying table of co-ordinates, illustrated by a diagram of an imaginary Survey, will afford a satisfactory answer. Such a table is easily published, one page of a "blue book" would give enough for an extent of many miles. The diagram is nicely illustrative. A township plan showing the transit line of a Railway Survey being at hand, was taken advantage of, and a few hypothetical notes were added. A writer in one of the "exchanges" says: "if you leave plenty of marks, you have the Contractor (or whoever comes to disturb the survey lines) by the throat, the lines can be restored if necessary." It is presumed the *modus operandi* is obvious. Lot corners, creeks, houses, intersections of roads, serve for points of reference, and though some may be lost, enough will remain to make the survey permanent.

In an extensive exploratory Survey like that of the Ottawa Ship Canal, it would be difficult to give precise rules—the Surveyor would have to do the best he could. Rocks in remarkable places, as for instance at the head of an island, might be marked. Iron posts such as are used in the North-West would serve well for mile posts. They are light, imperishable, and useless for any other purpose, "Lo, the poor Indian" lets them alone, so the chances in favor of their permanency are good.

It is unfortunate that the services of Messrs. Webb and Dumais, who were appointed with the undersigned to act as a Committee, could not be obtained. This unaided effort to meet the wishes of the Association necessarily falls very far short of what might be expected from

the better judgment and experience of those gentlemen; but it must be either this or nothing, and it is hoped its defects will be viewed with leniency. The endeavor is to show that Surveys may be made permanent at a trifling additional expense, and that the information forthcoming from them can be conveniently and concisely given, in a great measure if not entirely, independent of a map.

Submitted with deference by

S. L. BRABAZON,

PORTAGE DU FORT, 1st Dec., 1888. *Chairman.*

P. S.—Since the above was written, the courses and distances of the transit line and the co-ordinates of the initial point of each course have been added to the table before mentioned. It is scarcely necessary to say that as long as one recorded mark can be found, any other can be established by means of it. Corners of lots, in a settled country, may be regarded as permanent marks, conflicting interests tending to preserve them. The data are more than sufficient for the utilization and permanency of the Survey, but the work would be more complete and valuable if permanent bench marks had been made and were recorded.

TABLE of co-ordinates of certain points in the Township of Eardley, County of Ottawa, Que., determined by the survey of the Montreal Northern Colonization Railway, the axis of X being the meridian, and that of Y a line perpendicular thereto.

		Co-ordinates. X.	Y.
	Origin of co-ordinates on E outline of Eardley 19.5 chs. from S. E. boundary of Township on the bank of the River Ottawa	0.00	0.00
	S. Boundary post between Eardley and Hull	—19.50	+ 2.00
1	S. W. corner of Lot 2, R. II	55.00	—58.50
2	S. W. corner of 3, R. III, 9 chs. W. of Aylmer Road	131.50	94.50
3	S. E. corner of 5, IV, 4 chs W. of Aylmer Road	208.50	128.40
4	S. W. corner of stone foundation of M. N's dwelling house on Aylmer Road	243.75	150.00
6	S W. corner of 8, VI	283.00	191.00
7	S. E. corner of 13, VII	427.00	361.00
8	S E. corner of 17, VIII	484.00	474.00
9	S. E. corner of 20, IX	553.00	564.50
10	S. W. corner of 23, X	613.50	676.50
11	Intersection of transit line with E. fence of road 33 50 chs southerly from Aylmer Road	650.00	723.50
12	Rock marked with a cross thus +	670.00	755.50
13	Intersection of transit line with W. outline, 62 chs. from S. W. corner	654.60	873.30
14	S. W. corner of Eardley, Latitude 45° 31′, 36″.6 as determined by Deville	593.50	806.35

No. of Line	Transit Line. Course.		Distance chains.	Initial Point. X.	Y.
1	315°	00′	115 75	0.00	0.00
2	336	30	54 50	81.50	83.00
3	359	00	41 00	130.00	105.60
4	329	00	85 50	171.00	107.50
5	300	30	37 95	243.50	155.50
6	328	00	26 00	261.50	187.50
7	340	00	61 50	283.00	202.00
8	305	30	623 50	340.00	226.00
9	258	30	60 00	670.00	755.00

Convergence of Meridians say 1′ 4″ p. 100 chains.

(Note.—The diagram referred to in the above Report may be found in the 6th Annual Report of the Association.—*Sec.-Treas.*)

DISCUSSION.

The President: "Sufficient prominence is not given to the marking of surveys. One of our members—Mr. McLatchie—during the past season, has made a suggestion in this connection. He proposes that iron posts and mounds shall be placed at all section corners in timbered country, instead of marking the corner with post and bearing tree as is now the custom. I am in favor of his suggestion and have done what I can to forward it.

Mr. Brabazon's report refers to settled country and is more appropriate to Railway Surveys than to those made by Dominion Land Surveyors."

Wm. Crawford: "During the last six years I have spent a great part of the time tracing old lines. This year I have had more experience than in any previous one. I consider that the ploughing up of mounds is an act of vandalism. I have come across an instance of one man who had ploughed up seven mounds, and in my report I referred to that man as perpetrating an act of vandalism."

The President: "That was an act of carelessness, and the matter at present under consideration is the perpetuating of marks."

Wm. Crawford: "I think such men ought to be prosecuted."

The President: "During the last year, one man was arrested for moving survey marks. He was tried, convicted of felony and sentence now hangs over him."

WM. CRAWFORD : "I just mentioned this to show the inconvenience surveyors were at."

A. O. WHEELER : "Were a triangulation survey of the country once instituted, the usefulness of Mr. Brabazon's suggestions would in a very large measure be done away with"

J. F. SNOW : "The boundaries of lots are established by law, and therefore Mr. Brabazon's methods could not be adopted."

On motion the report was received and adopted with the understanding that the matter should be left in the hands of the Committee on Permanent Marking of Surveys for the ensuing year.

REPORT OF STANDING COMMITTEE ON NATURAL HISTORY AND GEOLOGY.

February 18th, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

After carefully reading and re-reading Mr. Drummond's "Suggestions for Surveyors Repots" I am more than confirmed in the opinion that his suggestions are of the utmost value, not only to Surveyors, but to all explorers who describe a tract of country which may be practically unknown to others than themselves. It *is* necessary for a surveyor to give all the topographical features of the country traversed, but is it not as necessary that he should indicate the timber with which it is covered, if a forest district, and if on the prairie the leading grasses? How much more valuable is such a report than one giving only the surface features?

It is not merely the vegetation but the birds, mammals and even insects that should be noticed, and if you choose, above all, the rocks, because these indicate the soil and the soil the productions; for we all know quite well that a region of sand is quite distinct in all its features from one where limestone predominates.

Although not asked to suggest a means by which Mr. Drummond's suggestions can be easily carried out I would say, nevertheless, that my Catologue of Canadian Plants indicates the range of all our trees, gives the common and scientific names, and a very slight acquaintance with it

would enable any one to tell what trees he saw in the district where his work might lie. Regarding the general geology, I may say, a few sentences descriptive of the work, written on the scene, and a few specimens brought away would enable any practical geologist to tell the horizon of the district in question.

A still more important matter is one that I have long felt should be adopted by our Department.

In no case should a topograpical survey party of any magnitude be sent out without a geologist and a naturalist being of the party. By not doing this many opportunities of acquiring very valuable information at a nominal cost have been lost and many years may elapse before another chance may occur.

When the Americans were surveying their interior they always did this and to-day their Survey Reports of nearly 40 years ago are models of thoroughnesss and have never been set aside. Were I in a position to make my voice heard I would have the complete survey of a district done at one and the same time so that a complete synopsis of the topography, natural history and geology of a district could be published simultaneously and in such a form as to be useful for all time. I know I am talking to men who have different views from myself in many matters, but we all know there is a right way and a wrong one, and dispassionate examination will show that to make a valuable and exhaustive report on any district the three branches spoken of above must be combined in either a greater or lesser degree. It follows then that Mr. Drummond's "suggestions" are timely and well worthy of more than a passing thought.

JOHN MACOUN,
Chairman.

DISCUSSION.

PROF. MACOUN—"If any gentleman will ask me a question I will show him the usefulness of my Botanical Catalogues."

J. J. MCARTHUR—"Professor, you have been in the neighborhood of Lake Winnipeg. What would you call the jack pine in that district?"

PROF. MACOUN—"*Pinus Banksiana*, or northern scrub pine, so called after Sir Joseph Banks, the discoverer."

WM. OGILVIE—"I have heard it called pitch pine in the neighborhood of Edmonton."

PROF. MACOUN—"This is the same species if found east of the Rocky Mountains."

J. J. MCARTHUR—"Some of the trees I refer to were eighteen inches in diameter."

WM. OGILVIE—"The ones I have seen were only small."

PROF. MACOUN to Mr. Ogilvie—"Were you ever on the Clearwater River? There you will see the same kind of large size. There are three species of pine closely related. East of the Rocky Mountains, *Pinus Banksiana*; in the Rocky Mountains and westward, *Pinus Murrayana*; and on the Pacific Coast, *Pinus contorta.* To a casual observer these are all the same, but the locality where found would show the species on referring to my catalogue."

WM. OGILVIE—"What is the difference between black spruce and white spruce?"

PROF. MACOUN—"The chief distinctions to a common observer are the cones and the trunks. The cones of the white spruce are long and finger shaped and the trunk is light coloured. In the black spruce the cones are quite short and dark brown or purplish, while the bark is black. There is still another species, viz: the Rocky Mountain spruce, which is distinguished from the white spruce by its cones being much thicker and the scales being undulated, not smooth."

JOHN VICARS—"What are the big pine trees you see in British Columbia?"

PROF. MACOUN—"The Rocky Mountain pine is a white pine like our eastern pine but named *Pinus monticola* (Douglas or western white pine). Another pine is found in the dry parts of British Columbia which is a fine stately tree and named *Pinus ponderosa*, on account of the height of the wood."

J. J. MCARTHUR—"Is there not a close affinity between hemlock and Douglas fir."

PROF. MACOUN—"In general appearance they look much alike, but the cones of the Douglas fir are quite large and with spinose scales, while the cones of the hemlock are very small and without spines."

JOHN VICARS—"We found a tree looking like cypress last year, near Coquitlam Lake. What was that?"

PROF. MACOUN—"That is yellow cedar and extends all the way to

Alaska, and from it the Coast Indians build their large canoes. Where you saw it, it would be at least 1000 feet above the sea as it does not come to the sea level in that latitude."

JOHN VICARS—"We found it about two miles from the sea coast, high up. We got another tree up there called a larch. It looked like a balsam."

PROF. MACOUN—"The larch is the ordinary tamarack, and no larch grows in that region."

JOHN VICARS—"It looked much like balsam."

PROF. MACOUN—"In that case it was what is called *Abies grandis* or giant balsam. It is a fine, tall, large growing tree with white bark and may be seen rising from the woods like stately columns."

WM. OGILVIE—"Is not the common tamarack the larch."

PROF. MACOUN—"Certainly it is."

JOHN VICARS—"Some years ago in Algoma we came across a little fern that had a sweet scent like a geranium."

PROF. MACOUN—"That was the *Aspedium fragrens* or sweet-scented fern and is the only fern with a perfume. It is quite common around Lake Superior."

THE PRESIDENT—"Gentlemen I consider that this is one more kindness on the part of Prof. Macoun, and I think that the members should try and carry out Mr. Drummond's suggestions in accordance with the Professor's ideas."

PROF. MACOUN—"When Dr. Dawson goes out into any part of the country, he brings in botanical specimens and states where he found them; then I name them, and thus he gets the correct name in his reports."

THE PRESIDENT, to Prof. Macoun—"What steps would we have to take to obtain your Botanical Catalogues?"

PROF. MACOUN—"I should think that an application should be made direct to the Minister of the Interior."

WM. OGILVIE—"I shall always be pleased to do anything I can to forward the Professor's views. Anything I have already done in that direction is due to the Professor. The suggestions made are very valuable and we should go to work to carry them out. Too much, however, must not be expected of surveyors. I have often seen specimens I would like to have carried away but my duties as a surveyor absorbed all my attention, and it was only occasionally I could get the opportunity to do as I would wish in this direction."

PROF. MACOUN—"Mr. Ogilvie is correct. The Surveyor has not the time to attend to other than his own business. Topography, natural history and geology should be worked together. A naturalist and a geologist should be sent in connection with the topographical survey. If you want natural history, send a naturalist. If you want geology, send a geologist. The naturalist learns from the surveyor and the surveyor gets the practical knowledge of the naturalist."

On motion the Report of the Committee was received and adopted.

THE PRESIDENT—"I have much pleasure in conveying the thanks of the meeting to Prof. Macoun and I heartily concur in his remarks and suggestions."

PROF. MACOUN—"I will write to the Minister of the Interior and urge upon him the benefits of Members of the Association being in possession of my Botanical Catalogues."

WM. OGILVIE—"Professor, have you seen Mrs. C. P. Traill's 'Plant Life of Canada'?"

PROF. MACOUN—"Yes, I consider it an excellent work."

REPORT OF STANDING COMMITTEE ON LAND SURVEYING.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

The solution of the "Subdivision of a Quadrilateral Figure," which was submitted at the last Annual Meeting of the Association, by Mr. H. Irwin, D.L.S., of Montreal, and a paper entitled "A Standard of Precision," which was submitted at the same time by Mr. J. A. Kirk, D.L.S., of Stratford, having been referred to the Committee on Land Surveying, they beg to report thereon as follows:

1st. The "Subdivision of a Quadrilateral Figure."

The Committee have examined the solution of this problem. It is a very valuable addition to problems in surveying, but as a practical question will seldom come into requisition.

2nd. "A Standard of Precision."

Attention has been directed, by the writer of this paper, to the re-

sults which have been obtained from using a check chain on a survey. We will therefore introduce our remarks on it, by referring to the differences occuring in chaining with and without a check chain.

To make any experiments in chaining, it is necessary to have good, careful chainers. Experience with very careful chaining shows that chaining on level prairie is about two links to a mile longer than over hilly and broken prairie, or over windfall and brush in the woods.

To remedy this defect, it is easy to add to the chaining over rough country the amount of error determined from experimenting. On all measurements made, even by experts in chaining, the distance has been found short wherever there was much plumbing to do. When a check chain of one hundred feet in length was used on surveys of standard meridians and parallels, the difference in measurement was very slight on prairie. When chaining over uneven and broken country, the long chain gave the most accurate measurement; the reason of this being that it was often necessary to break the short chain in crossing a deep ravine, while the long chain passed over it without necessitating a break. When the surface was uneven and broken, the difference was usually from one to two links to a mile, the average being about one and a half links to a mile. On level ground the chain, one hundred feet in length, gave shorter, and over uneven and broken country, longer measurement than the one sixty-six feet in length.

The conclusion arrived at, would therefore be, that with ordinary care in chaining the limit of error would not be more than one and a half links to a mile. This might be called the standard of lineal precision. But it must be remembered that in those measurements the chains were compared with the same standard, and the same allowance was made for temperature. Different chainers were employed, but they had equal experience in chaining and had received the same instructions and training.

If all chains could be compared with the same standard, or were of equal length; if the temperature remained always the same, or the correction to apply was constant; if there was always true alignments in chaining; the same pull on the chain and correct plumbing; if all the chainers employed on surveys were equally experienced and careful; if all surveys required the same degree of accuracy and precision, then there would be no difficulty in formulating a standard of lineal precision.

In making a traverse survey of a lake, when eight or ten courses are run, the closing angle should be found not to exceed one minute in error. In making a traverse survey of a river, which runs across a township, the angle at the intersection of each section line should not exceed one minute in error. The above remarks refer entirely to an ordinary traverse of a lake or river, where the object in view is merely to locate the lake or river, for the purpose of obtaining the area of the broken sections in which they are situated. In such a traverse survey of a lake or river, where the angles are only noted to minutes, if the angle measured to the forward picket does not give an exact minute, note the nearest one, making an allowance by offsetting at the forward picket for the difference between the reading and the angle noted. The distance to offset is easily deduced from the length of the course. In a hurried lake or river traverse, should this be attended to, there will oftener be no closing error, than one of one minute.

In making a traverse survey, such as that of the Canadian Pacific Railway, which was to be used as a base line, and where angles were required to be measured as exact and precise as possible, no such errors as given in this lake or river traverse would be admissable.

Many instances could be given on the survey of Standard Meridians and Parallels, which when checked by other surveyors, were found not to differ over ten seconds in bearing. On block suveys, lines run by different surveyors on opposite sides of the correction line road allowance, one chain and fifty links apart, and which were started from independent astronomical observations, have been found at the width of a township not to vary more than ten seconds in bearing. When the work was at all carefully done, the errors hardly ever reached thirty seconds in bearing, and this was owing to error in the production of the lines caused by high wind, refraction, or a smoky atmosphere. Under ordinary circumstances, a line started from an observation should not be found over thirty seconds in error in bearing when run the depth of a township. This might be called the standard of angular precision.

If all surveyors were alike careful in their operations; if all instruments were of equal stability and as perfect in construction; if good light was always available; if pickets could always be set at equal distances; if there were no high winds, refraction or smoky atmosphere, there would then be no difficulty in formulating a standard of angular precision.

A low standard of precision would only produce careless work. An example of which is found in the limit of error given for closings in sub-division surveys. A high standard of precision should have an opposite tendency, so long as it is not unattainable.

A difficulty which presents itself is this, that a number of standards would be necessary, according to the degree of accuracy and precision required for different surveys.

With or without a standard of precision, it is the duty of each surveyor to take advantage of every opportunity to check his surveys so as to locate and correct an error, if any, before leaving the ground. Besides this each surveyor should have a standard of precision of his own. If he makes it high, more care will have to be exercised on his part to attain it.

In the event of a survey being disputed, the party disputing its correctness, would in all likelihood employ another surveyor to check it, and thereby entirely ignore any standard of precision adopted by the Association.

In attempting to make a survey even approximately correct, the surveyor is beset on all sides with many difficulties.

It would therefore appear from the difficulties which present themselves, that the Association is not warranted in formulating or adopting any standard of precision.

JOHN McLATCHIE,
Chairman.

On motion the Report of the Committee was received and adopted.

REPORT OF SCRUTINEERS OF BALLOTS.

FEB. 19th, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIAOTIN OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

We the undersigned scrutineers appointed to examine and count the ballots sent in for the election of officers for this Association for the current year, beg to report that we have performed that duty, and find the following gentlemen to have received the highest number of votes.

For PRESIDENT - - - - - - -	Wm. Ogilvie.
" VICE-PRESIDENT - - - - -	Samuel Bray.
" SECRETARY-TREASURER - -	A. O. Wheeler.
" EXECUTIVE COMMITTEE - - -	O. J. Klotz. J. S. Dennis. John McLatchie.
" AUDITORS - - - - - - - -	J. F. Snow. F. Driscoll.

JOHN McLATCHIE,
J. E. SIROIS,
J. J. McARTHUR.

On motion the Report was received and adopted.

Notices.

EIGHTH ANNUAL MEETING.

The Eighth Annual General Meeting of the Association will be held at Ottawa, commencing on the Third Tuesday in February, 1891.

All members who read these pages, will clearly see that the principal aim of the late Executive Committee has been to make the Association of some practical use to the Profession. If not successful it cannot be said that the effort has not been made, and I think that a glance at the President's Address will show that some results have been attained.

The object of this notice is to call upon all members to lend their assistance toward the success of the coming Eighth Annual Meeting. In order to make this meeting a success, there *must* be a good programme. You are therefore requested to furnish a paper suitable to this occasion.

If you cannot furnish a professional paper, prevail upon some one who can to do so. Surely in the course of your professional career you have met with some matter that has raised a question or is of special interest from a professional point of view and which, it would benefit you to have discussed by the General Meeting. Then why not put it in shape and submit it to the said meeting?

Later in the year, you will be specially invited to interest yourself in this direction and lend your assistance to the Executive Committee on behalf of the programme for the Eighth Annual Meeting; *then*, bear this notice in mind and although it may cause you a little personal inconvenience, you will feel the better for having contributed your quota to the general good.

Secretary-Treasurer.

ANNUAL DINNER.

The first Annual Dinner of the Association was an unqualified success. Thirty-six tickets were sold and eight invited guests were pres-

ent. The dinner was served in the dinning-room of the House of Commons, special permission having been obtained from the Speaker. Among the guests present were the Deputy Minister of the Interior, Dr. Selwyn, Dr. Dawson, Prof. Macoun, the Surveyor-General, Dr. Bell, Mr. A. T. Drummond and Mr. W. F. King. The dinner was followed by an adjournment to a smoking room, supplied with a good piano, and the balance of the evening was spent most enjoyably, excellent entertainment being kindly furnished by Messrs. O. J. Klotz in English and German songs; Wm. Ogilvie, recitations; D. C. Morency French songs; P. D. G. Dumais, Italian song; D. W. Davis, M. P., Indian dance; J. C. Nelson, song, and J. F. Snow, first-class music. The gathering broke up during the small hours next morning, all vowing that a more enjoyable evening had never been spent.

Members are strongly advised to spare no effort to be present at the Dinner to be held at the close of the Eighth Annual Meeting in February next.

Secretary-Treasurer.

Obituary.

Since our Annual Meeting we have to record the death of one of our members in the person of Mr. John Frederick Snow, D.L.S., who died very suddenly of heart disease, in the City of Ottawa, on the morning of April the 11th, 1890.

Mr. Snow was born in the Township of Hull, in 1852, and after completing his early studies he, in 1868, went to Victoria College, where he remained for a year, and then accompanied the Hon. Wm. McDougall, in 1869, to Red River. Returning home after a few months absence he began his service in the Profession under articles to his father, also serving some time with Bolton Magrath, Esq., and Robert Sparks, Esq.

In 1874 he became a P. L. S., for Ontario, and during the same year was admitted to practice in Quebec. In both of these Provinces he had a wide experience in surveys, both in conjunction with his father and by himself.

He received his commission as a D. L. S. in 1880, and during the seasons of 1883 and 1884, he worked for the Government on sub-division surveys in the North West Territories.

He was among those who were present at our first Association Dinner, and being an excellent musician, he contributed largely to the success on that occasion.

Mr. Snow was widely known among the Profession and was universally liked.

Ottawa, May 7th., 1890.

Questions Submitted.

"MORE OR LESS."

FEBRUARY 1st, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

I beg, to lay the following question before you for consideration :

Should a surveyor, when preparing, for insertion in a deed or patent, the description of a block, lot or parcel of land surveyed by him, apply the words "more or less," either actually or in effect to the length of any course or every course, the terminal points of which have been located by any of the following methods :—

1. By a wooden, iron or stone post, perpetuated by a bearing tree, witness mound or other mark.

2. By a wooden, iron or stone post in a stone or earthen mound.

3. By a wooden, iron or stone post only.

My reason for bringing this matter before you, is that during the past two years in my official work, the above question has frequently been raised, and contentions have been advanced both for and against the use of the words "more or less" as applied to any but the closing course of the block, lot or parcel of land which has been encompassed.

Let me state the following case as an example, and ask for your ruling in the instance cited.

The surveyor has been employed to lay out a certain parcel of land as a mining location, and with his returns of survey he sends the following description for insertion in patent.

"All and singular, etc.,.....commencing where a post has been planted on the water's edge of Lake Superior to mark the N. W. corner of said mining location, said post being distant one hundred and sixty-four $\frac{41}{100}$ (164.41) chains east ast. and eight (8) chains north ast. from the N. E. corner of the N. E. quarter, Sec. 12.

20.15 W. of the 91st meridian, thence east ast. twenty (20) chains, thence south ast. twenty (20) chains, thence west ast. twenty (20) chains to the water's edge of Lake Superior, thence northerly along the said water's edge twenty (20) chains more or less to the place of beginning."

On referring to the field-notes of survey it is found that at the south west corner of the location has been planted an "oak post in stone mound," at the south-east corner has been planted a "poplar post with bearing tree," at the north-east corner a "poplar post with bearing tree" and at the north-west corner, an "oak post in stone mound."

On the above grounds the surveyor's description is challenged and it is required that the distance to posts should be given as "more or less."

In his defence the surveyor claims that were his description so amended it would be erroneous and entirely at variance with his own custom or the custom of any surveyor whose practice he is acquainted with. He states that the closing distance is given as "more or less," but that if the others were so given, how would it be possible to retrace the lines were some of the posts missing.

In conclusion I beg to state that it is my intention that the question submitted should apply only to original surveys and not to subdivision of an original survey. In the first case the description is dependent upon the survey, in the second the survey upon the description.

Trusting that I shall receive a definite answer to my question and a distinct ruling in the case cited.

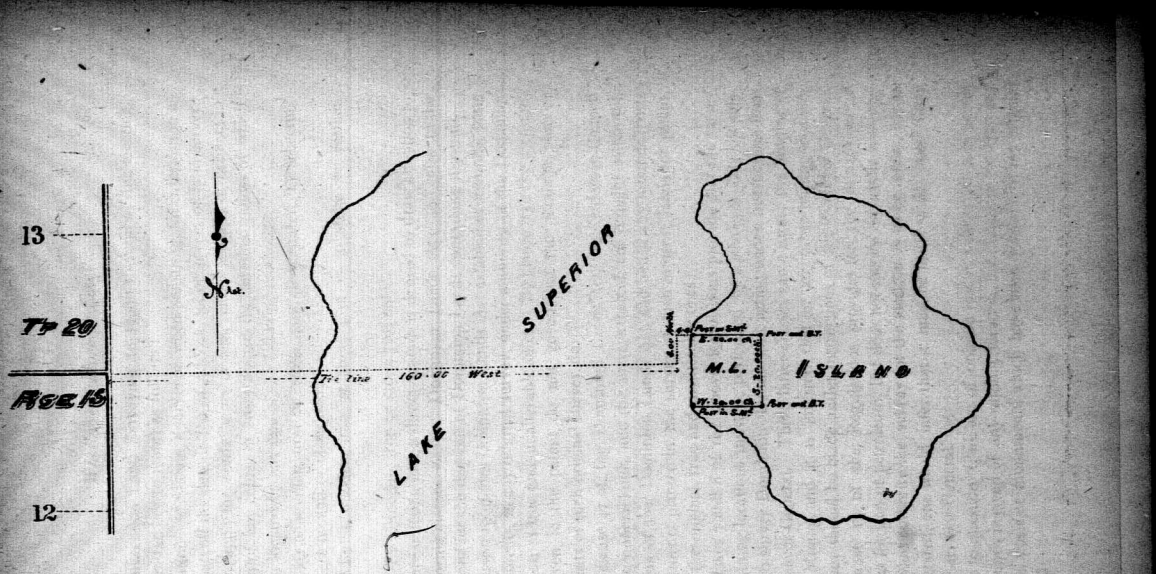
I have the honor to be,
Gentlemen,
Your obedient servant,
ARTHUR O. WHEELER.

REPORT OF COMMITTEE ON LAND SURVEYING ON THE ABOVE QUESTION.

To the President and Members of the Association of Dominion Land Surveyors.

Gentlemen,—

In reply to the subjoined questions, submitted at the present meeting of the Association, by Mr. A. O. Wheeler, D.L.S., and referred to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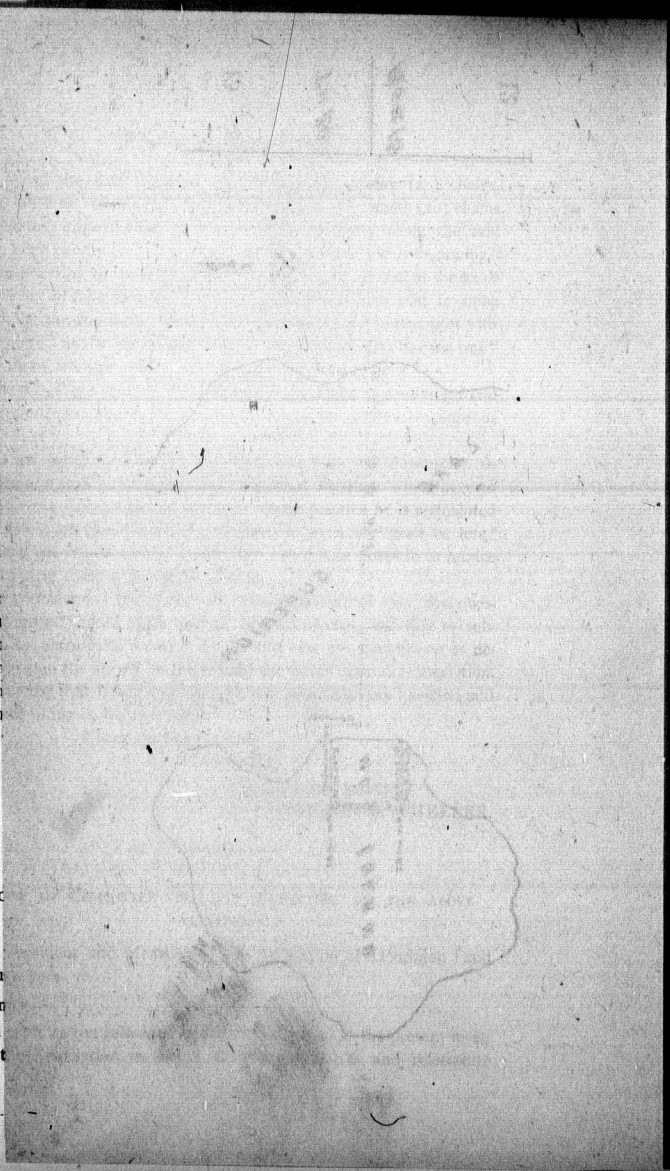

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the Committee on Land Surveying to report thereon at this meeting, the Committee beg to report as follows :

Question :—"Should a surveyor when preparing, for insertion in a deed or patent, the description of a block, lot or parcel of land surveyed by him, apply the words "more or less," either actually or in effect to the length of any course or every course, the terminal points of which have been located by any one of the following methods:

1. "By a wooden, iron or stone post, perpetuated by a bearing tree, witness mound or other mark."

2. "By a wooden, iron or stone post in a stone or earthen mound."

3. "By a wooden, iron or stone post only."

Before entering into a direct reply it is desired to draw attention to the following clauses of the Dominion Lands Act, and also to the Regulations for the disposal of Dominion Lands containing minerals.

Clause 129 of the Dominion Lands Act establishes mounds, posts or monuments, in any original survey, under authority of the Dominion Lands Act, as true and unalterable ones. By clause 130 the measurements given in the patent do not govern, but the mounds, posts or monuments of such original survey do.

By clause 47 of the Dominion Lands Act, the Orders-in-Council regarding mineral lands, and the surveys thereof, are brought within the operations of the Dominion Lands Act, and hence any mounds, posts or monuments planted in the survey of such mineral lands for patent, become the original, true and unalterable ones.

Clauses 7 and 8 of the above Regulations provide that the survey of all mining locations must be performed by a surveyor duly commissioned to survey Dominion Lands, and acting under instructions from the Surveyor General. These latter clauses came under the heading of Quartz Mining, and it is inferred that for any other mining location, the survey should be made under instructions of the Surveyor General.

Clause 13 of the Regulations provides for the dimensions of locations for iron or petroleum, but does not specify especially how, and under what authority the survey for the location is to be made, but as before stated, one would infer that it must be made under instructions of the Surveyor General.

As to question 1, we are of opinion that if a description by metes and bounds is given of any mining location, the distances between any mounds, posts or monuments which have been planted, in the original

survey, must be qualified by the words "more or less" as such mounds, posts or monuments are, as we have seen by clause 129 of the Dominion Lands Act, the true and unalterable ones.

A Bearing Tree only becomes a factor when it is necessary to re-establish a lost corner; a Witness Mound for determining the corner to which it refers; neither a Bearing Tree nor a Witness Mound having anything to do with the description for a patent.

Question 2. In case the post (of whatever material) has been planted in a mound (of whatever material) and so designated in the original plan, then in the description the post should be referred to as being in a mound, stating the material. The distance to such post being as above "more or less."

Question 3. The answer is the same as for No. 1, being so many chains "more or less" to the post.

In short, the distance between any two mounds, posts or monuments in an original survey, must always be given as "more or less" for a patent.

Discussion of the description submitted in the example cited by Mr. Wheeler.

"Commencing where a post has been planted at the water's edge of Lake Superior, to mark the north-west corner of said mining location, said post being distant 164.41 chains, east astronomically, and 8 chains north astronomically, from the north-east corner of the north-east quarter of Section 12, Township 20, Range 15 west of the 91st Meridian." Now this point of commencement is relegated to two points and one line; the two points not only, do not necessarily coincide, but very probably do not do so, nor do either of them necessarily fall or come for all time in the water's edge. In short, highly improbable, if not impossible, conditions are placed upon the point of commencement. The question arises, what should govern the post planted on the original survey: the water's edge or the distance from some peviously established point? As we have seen that the post in an original survey is the true and unalterable one, therefore it must govern, and the point of commencement must be at the post (in mound in this case).

Hence the following is suggested: "Commencing where a post in stone mound has been planted adjoining the water's edge of Lake Superior, and distant, according to the measurement of John Smith, D. L. S., 164.41 chains east astronomically, and 8 chains north astrono-

mically from the north-east corner of the north-east quarter of Section 12, Township 20, Range 15 west of the 91st Meridian."

Then, continuing, the description should read: "thence east astronomically, twenty chains, more or less, to a post; thence south astronomically, twenty chains, more or less, to a post; thence west astronomically, twenty chains, more or less, to a post in a stone mound; thence north astronomically, twenty chains, more or less, to the place of beginning."

According to clause 13 of the Regulations quoted, the location "shall be bounded by due north and south, and east and west lines, and its breath and length shall be equal." It therefore follows, that in a description for a patent, the irregular line of the water's edge cannot be made a boundary line, although practically, it may become so by making the north and south, and east and west lines project into the lake.

In reply to the assertion, "that the closing distance is given as 'more or less,' but that if the others were so given, how could it be possible to retrace the lines were some of the posts missing?"

From the tenor of the latter part of the above, one would infer that "more or less" is of such broad meaning as to include any measurement whatever; far from such is its meaning. When we say "twenty chains more or less to a post," it means that the line is to terminate at the post, not at twenty chains, and the fact that a measurement has been given shows that there is some authority for giving such measurement; but as no measurement is absolute, it follows that the distance to a fixed point must be "more or less," which words "more or less" are equivalent to saying "that the distance to the post is, according to the measurement of John Smith, D.L.S., twenty chains (no more or less)."

In retracing any line, where some of the original posts have been lost, evidence precedes measurement, and where evidence is wanting the measurements govern as provided by statute.

JOHN MCLATCHIE,
Chairman.

DISCUSSION.

JOHN VICARS—"Why use 'more or less' when you have a fixed point, as no distance is absolute?"

J. J. McARTHUR—"I do not see why."

PROF. MACOUN—"I think the use of the words 'more or less' is scarcely wise. John Smith's survey is disputed and is rechained on each side. The lawyer now comes in with absolute distance."

JOHN McLATCHIE—"All original survey posts are fixed points, and the distance to same must be more or less."

D. C. MORENCY—"Theoretically no block of land, of which the limits are north and south and east and west lines can be laid out in a square. It would be better to insert the words 'more or less' when applied to a fixed point."

WM. OGILVIE—"Taking the view that no measurement is absolute the words 'more or less' should apply. No limit of absolute measurement has yet been laid down."

J. J. McARTHUR—"In other countries a limit has been laid down."

WM. OGILVIE—"Well, none in Canada. Too much importance is attached to the words 'more or less.'"

D. C. MORENCY—"The question should be settled. There should be a way of adding something to these words that would make them apply more definitely and therefore cover the question from a lawyer's point of view.

On motion the Report of the Committee was received and adopted.

Lectures.

SYNOPSIS

OF A LECTURE ON ASTRONOMY, BY W. F. KING, CHIEF ASTRONOMER TO THE DEPARTMENT OF THE INTERIOR OF CANADA.

The lecturer began by saying that having had the good fortune to happen upon a number of views illustrating astronomical facts and theories, and Mr. Topley having kindly consented to exhibit them with the sciopticon, he would confine himself this evening to saying a few words in explanation of each view as it appeared on the screen.

The first four views showed the solar system, illustrating different theories which had been proposed to explain the apparent motions of the sun and planets.

The first view exhibited the earliest motion of the solar system. The Earth is fixed in the centre, about it circle the Moon, Venus, Mercury, the Sun, Mars, Jupiter and Saturn, in the order named. Beyond all these planets revolves the celestial sphere carrying with it the fixed stars. The earth is the centre of the universe. This theory not being sufficient to account for the observed movements of the planets, a later theory makes the Earth the centre as before, with the Moon revolving about it. Beyond the orbit of the Moon revolves the Sun, the Sun carrying with it, and revolving about it, Mercury and Venus. Beyond the Sun's orbit lie Mars, Jupiter and Saturn, revolving, not about the Sun, but about the Earth.

In the third theory the Earth is still in the centre with the Moon revolving about it. Beyond circles the Sun, about which all the planets, superior as well as inferior, revolve, and are carried with it around the Earth. The fixed stars also revolve about the Earth.

Finally the fourth view gives the correct theory of the solar system. Here the Earth loses its primacy; it is only one among the planets, controlling no other body than its own Moon. The Sun stands in the centre, and the planets revolve about it.

The next views showed the relative sizes and distances of the planets

together with their astrological symbols, a reminder of the time when the planets were supposed to have an intimate connection with affairs on the earth. These symbols are still used in astronomical publications, for the sake of brevity, instead of the names of the planets.

Some forms of nebulous matter were shown, indicating the manner in which stars are formed, if the nebular hypothesis is true. A view was also shown of the milky way, as an elongated cluster of stars, of which our sun, with its attendant planets, is a rather insignificant member.

Several views were now shown of the planets as seen through a powerful telescope: the crescent Venus—the markings on Mars—Jupiter's belts—Saturn's rings.

Then came the Earth divided up by meridians and parallels, and showing the different zones. An explanation was given of the relation of the arctic and antarctic circles, and the tropics to the seasons.

Some views followed, illustrating the phases of the moon, and lunar and solar eclipses. The obliquity to the ecliptic of the moon's orbit was shown to result in the fact that an eclipse dose not take place at every new or full moon; the moon has to be within a certain distance of one of the "nodes" of its orbit for an eclipse to occur. The action of the moon in causing tides was also illustrated. Also the illumination of different parts of the earth at the solstices and equinoxes, showing the variation in the length of day and night, and the seasons, as accounted for by the obliquity of the earth's equator to the plane of its orbit.

Another diagram showed the relative orbital motions of the earth and the inferior planets, Mercury and Venus, and an explanation was given of the "direct" and "retrograde" movements of these planets, the "stationary points," &c.

Next followed a diagram of the signs of the zodiac, showing the fanciful figures devised by the astrologers to represent these constellations, viz.:

> "The Ram, the Bull, the Heavenly Twins,
> And next the Crab, the Lion shines,
> The Virgin and the Scales,
> The Scorpion, Archer, and He-goat,
> The Man that holds the watering pot,
> The Fish with glittering tails."

The lecturer concluded by exhibiting (with the lantern) diagrams

of several well known constellations, Taurus, Ursa Major, Orion, Cepheus, Cassiopeia, Sagittarius, Aquarius, Perseus, showing the stars in each as they appear in the heavens, together with the outlines of the objects they were supposed to represent. The fanciful and arbitrary nature of the constellations was apparent in these views, although this classification is commonly used advantageously in naming and identifying the brighter stars.

SYNOPSIS

OF A LECTURE GIVEN BY H. N. TOPLEY, ENTITLED "A PRACTICAL CHEMICAL DEMONSTRATION OF THE BROMIDE PROCESS."

The lecturer began by stating that he would give a simple but practical demonstration of the Bromide process without entering into the difficulties which arise from using impure chemicals. Placing before his audience a glass containing some gelatine, and after dissolving and cooling to the proper temperature, he added some bromide of potassium and dissolved it. The next important step was to add the nitrate of silver, which was done; these solutions being heated to about 150 degrees Far. the silver was then added to the bromide in a fine stream (in the darkroom). Three different ways of mixing were then explained. First, two funnels are joined at their outlets; then filtering cotton being placed in the funnels, the two solutions are poured and the fine streams uniting and falling into the beaker, produce an emulsion in a very fine state of division. The second mode is by inserting a funnel into the glass beaker, and filtering the nitrate of silver through absorbent cotton, drop by drop, until one-third of the solution is emulsified; then the liquid is allowed to run through in a fine stream, both solutions being heated to about 150 degrees Far. The third way is considered the most simple and best suited for amateurs. Mix gelatine and bromide of potassium with the proper amount of water and a few drops of nitric acid. Heat the solution to 120 degrees Far., just enough to dissolve the gelatine. Take the crystals of nitrate of silver and drop a few of the smaller pieces into the bromide solution; keep it well stirred with a glass rod until the last trace of silver is disolved. To test whether an emulsion has been properly mixed proceed in this manner: take a piece of plain glass, then with the stirring rod spread some of the

emulsion on the surface of the glass and hold it toward the light, it will now appear a deep ruby color by transmitted light, and a straw yellow by reflected light. When satisfied that the emulsion has been carefully mixed, the glass containing the emulsion is now placed in a water bath and the water is brought to the boiling point as soon as possible and allowed to remain boiling for half an hour, the emulsion in the meantime being stirred every ten minutes during the time it has been cooking; now take a small portion of the cooked emulsion and proceed to test as before, this time you will notice that your emulsion is no longer a deep ruby, but a pale blue by transmitted light. The emulsion is now set aside to cool. The gelatine is weighed out and soaked in water for a few minutes and then added to your emulsion at about 150 degrees Far. until dissolved; it is then placed in a cool room to set. When cool it has the appearence of very stiff blanc mange.

The emulsion is now squeezed through coarse linen into a vessel covered over with cheese cloth, tied over in such manner as to sink down in the middle. The emulsion is washed until all the soluble bromides are eliminated. If this is not properly done the result will be that the finished plates will appear foggy, and develop very slowly. Next take the emulsion and put it into the melting pot; while this is being dissolved place the last of the gelatine (this should be Heinrich's Hard or Siemon's Hard Swiss gelatine) to soak. Then add it with the proper quantity of water to make up the amount. After dissolving the emulsion it is now ready for filtering, this is done in a warm room. If the emulsion does not measure 128 oz. add water; use filtering cotton; fill the cotton with hot water and put it into the neck of the funnel, not too tight. If the emulsion passes through too fast press down the cotton until it runs in a fine stream or very frequent drops. Before coating the plates it is as well to test the molecular deposits. Should the particles appear coarse and uneven through a magnifying glass the operation of mixing and cooking has been carelessly performed. It will be noticed that there is a large deposit of a coarse bromide of silver remaining in the filtering cotton, thus depriving the finished emulsion of its full amount of sensitive bromide of silver, making plates with less body, and without latitude both in exposure or development. The coating is done by pouring the emulsion into the coating pot. This is a small tea-pot with a spout from the bottom. The excess is poured back into the pot to be used over again. After the plates are coated they are placed on a marble slab to set. When enough have been

coated to cover the slab the first ones are picked up and put in racks to dry, which generally takes about six hours.

Successful platemaking is due more to the practical details and chemical changes (photographically speaking) than anything else. The following is a formula for the emulsion :

No. 1.

Water distilled	36 oz.
Alcohol	4 oz.
Glacial Acetic Acid, enough to redden litmus paper.	
Bromide of potassium	3 oz, 6 drachms.
Iodide "	80 grains.
Gelatine (Henrich's soft)	480 grains.

Place all the above in a one gallon flask and put the vessel in water and raise to 160 degrees Fahr.

No. 2.

Water	36 oz.
Alcohol	4 oz.
Nitrate of silver	5 oz., 2400 grains.

Place all of No. 2 in another flask and heat to 160 deg. Far. No. 1 and No. 2 being now at 160 degrees, mix the solutions in a fine stream in the dark room. Everything prior to this can be done in daylight.

Mr. Topley next developed two negatives, one having received about the correct time, the other one double the exposure. The first proved fairly good, but over exposed. The second also a good negative. This was to demonstrate the restraining power or control one has in developing, when given the time of exposure and circumstances under which they were taken. Afterwards two dried negatives were exhibited to the audience made by the above process and developed with the following formula :

No. 1.

Pyrogallic acid	1 oz.
Sulphite of soda	1 oz.
Citric acid	30 grains.
Water	8 oz.

No. 2.

Water	7 oz.
Sulphite of soda	1 oz.
Bromide of potassium	300 grains.
Liquid ammonia	1 oz.

To use take one drachm of each to 3 oz. of water.

The gelatine bromide printing process was next explained. A

large negative had been taken for this purpose, that all present might observe the gradual appearance of the image during the process of development. Next a piece of bromide paper having been adjusted on negative and placed in the printing frame, a small hand lamp lit to make the exposure. The frame containing bromide paper was turned face down on the table until all explanations were given, then placed at about three feet from the light and an exposure of 90 seconds given. It was developed with the following developers:

Saturated solution of neutral oxalate of potass. 6 dr.
Saturated solution of poto-sulphate of iron.... 1 dr.

Both solutions made acid with citric acid just enough to turn litmus paper red, and used in the above proportions, the picture came out slowly, clean and brilliant, and to the astonishment of all present it proved to be a portrait of a man with a large—yes, very large, open mouth, labeled with large letters "the Department of the Interior, Technical Branch." Some thought it was a portrait of McGinty. Afterwards the picture was fixed in a solution of

Hyposulpite of soda.... .....1 oz.
Water..... .....4 oz.

REMARKS

ON NATURAL HISTORY, WITH SPECIAL REFERENCE TO CANADIAN FISH, BY PROF. JOHN MACOUN, BOTANIST AND NATURALIST TO THE DEPARTMENT OF THE INTERIOR OF CANADA.

Prof. Macoun said that he would give an account of the standing of Natural History in this country, in order to obtain the assistance of Dominion Land Surveyors.

The natural history of the country was not on the proper footing. It was not as well known in some respects as it should be. Little or nothing was known about the fish. No other country on God's earth to-day has such valuable fisheries in the waters around its coasts; and neither did the people know it nor seem to care to know it. It was a pretty serious charge to make, but that was just how the matter stood at present. Preachers said that to spread the Gospel they must talk in season and out of season; he believed in spreading his own particular

fad (natural history) in season and out of season. He hoped to get assistance from land surveyors. Everybody going out to explore should have some knowledge of natural history. Before 1872 he had studied botany for a number of years, and he would show conclusively that it was only by a knowledge of botany and natural history that he had been able to substantiate the statements he had made in connection with the North-West years ago. What had he seen? He had seen the same plants and grasses growing in the Peace River district as grew in Ontario. He had reasoned that if grasses and plants ripened in the two localities at the same time the climate must be similar. The statements had been founded upon fact and they remained good until to-day.

As far as the botany of Canada was concerned, all known plants were now classified and catalogued, and he had published four volumes of the same under the auspices of the Geological and Natural History Survey of Canada, and was now working at the fifth.

A complete catalogue of Canadian birds was ready for the printer. Over six hundred different kinds of birds had been catalogued; their ranges, breeding places and so forth.

Mammals also were pretty well catalogued.

Surveyors could not be of much assistance as far as birds were concerned. Birds fly and might be found in three or four different localities in the same year. What was wanted were small mammals.

Small mammals bred and died within a small area and might be considered as representatives of that locality. They required the skin and the skull. To skin the animal, just split down the centre of the stomach and pull the skin over the head. Each skin and skull should have a tag with a number to correspond upon it, and the tag should also show the date and place where killed. All kinds of mammals were necessary. Why? Because twenty, thirty, forty years might elapse before we would get the same opportunities of acquiring the knowledge. Last year he collected a large number.

Very little was known about reptiles and less about fish. No man to-day could give a complete list of the Canadian fish; so it might be seen how little was known.

It was true that very few fish were to be found in the Ottawa River owing to the sawdust infamy; but in the Rideau Canal how many knew what species were to be found? As far north as he knew, people lived on white fish. Who could say how many kinds there were? There are

a dozen different kinds of suckers; twenty or thirty different kinds of trout; what do we know more than this? Sir John Richardson had studied our fish before most of us were born, and they have never been studied since.

The Senate Committee had asked him if he could put the matter straight and get up a full list of the fish, and when he told them that we knew as much sixty years ago as now, Senator Schultz was surprised. "What!" said he, "can this be so?" One man called it a trout—another a greyling—a third, a char. What did we know, who was right? They knew nothing, nor did we.

There are shoals of fish on the West Coast, cod and halibut, and their value is neither known nor cared for. He had seen shoals of them twelve to fourteen feet below the surface and a dogfish would dash in amongst them and scatter them right and left. Only Indians fished for them, and they caught all the big halibut. What are they?—only fish. The Minister of Marine had been in correspondence with Dr. Selwyn to see if something could not be done towards increasing our collection, and he was happy to say that he would be authorized to pay more attention to them during the coming season, and he desired to enlist the gentlemen of the Association in the same good work. We had a fine collection as far as it went; were all named, and what was wanted was to supplement this collection. We wanted in the same museum a complete series of food fishes and also the smaller fishes that were food for the larger ones, so that scientific visitors from either Europe or the United States could see at a glance what the waters of Canada produced. If we could show what fish there were and had them properly catalogued, visitors would say, "Why! these people are awake." Could it be said now? No, sir! Only that we had the grandest fisheries in the world. Where was the proof? Americans had men going into Hudson's Bay for fifty years and we did not know what they take out of it, and what is more, did not seem to care. Within the past week he had had some correspondence with Mr. Wilmot, who had charge of the fish propagating establishment of the Department of Marine and Fisheries, and he (Mr. Wilmot) had told him that the proper way to preserve fish skins was a very simple one. All that was necessary was to skin the fish, but not to be particular about taking all the flesh off the skin; then keep the skin in a strong brine for a few days, and after that it would be an improvement to throw that out and put on fresh brine. Leave it in it for a week or two. If you should catch any big fish this

summer, let the cook take off the skin, no matter about flesh being on it, and treat it as he had already said, and then pack and address to Mr. Wilmot, Dept. of Marine and Fisheries, Ottawa, and you will have done something for your country. The place where caught and the length and weight of the fish should also be sent, as this information was necessary. It was every man's duty to obtain and spread knowledge of his country. He wanted to see Canada in her proper place. These were the co-efficients. What we wanted were the facts. Send the articles and they would soon be put in the proper shape. He would see that the natural history of the country was in as good shape as the botany. Americans said that for fifty years no botanical work as good as his had been published and they were now going to get something in the same style.

The Professor concluded by saying that the meeting must excuse his selfishness, for when a man talked of himself he was selfish.

DISCUSSION.

THE PRESIDENT—Nothing is selfish that is for the public good. The Professor has time and again asked us to assist him. I would like to say to the members that they should try and do somewhat to meet the Professor's views. I have myself done nothing and have not made use of my opportunities, but will try and do so in the future. If all surveyors who go out would bear in mind and when possible would meet the Professor's views, it would only be paying him for his trouble in bringing the matter so ably before us. I agree with Prof. Macoun that we know almost nothing about fish. In the western part of the Territories you may catch half-a-dozen different kinds of fish with half-a-dozen different names; and which of these names are correct? I hope you will all try and carry out the wishes of Prof. Macoun."

W. S. DREWEY—"Professor, did you ever, on the West Coast, catch a salmon with a fly?"

PROF. MACOUN—"I never caught a fish with a fly in my life, and what is more, I think it is waste of time."

Papers.

WANT OF PRECISION IN SURVEYS.

The members of this Association are doubtless quite familiar, from their own experience, with the want of precision in surveys.

In the early surveys of the older provinces of the Dominion, the surveyor was obliged to use the magnetic compass. Subject as it is to so many variations and to local attraction, it is not to be wondered at, if the original surveys were not precise. Add to the use of the compass, the link chain, which was liable to *stretch*, and which was probably never checked on surveys of long duration, and you have a sufficient reason to account for the long measurements made.

The use of the compass is now almost abandoned, especially on surveys where precision is required. In Ontario and Quebec it is used for tracing out and determining the boundaries of timber berths, which are defined by lines run magnetically. The compass is also used to a certain extent, in defining such boundaries. The declination of the needle is determined from an astronomical observation, and the line is then run with the compass, allowance being made from the astronomical bearing of the line equal to the declination of the needle. This line is called an astronomical line, and is returned as such to the Crown Timber Office. The same method has been followed to some extent, in the survey of timber berths in Keewatin and the North-west Territories; and is also followed in the determination of astronomical lines in the public surveys of the Province of British Columbia. Lines run in this manner, with a compass in the hands of a careful operator, would not be very far wrong, still there is no certainty in the work. The compass has had its day; its usefulness is gone, and it must go. It is only to be regretted that it was used so long; still it was easily and conveniently carried in rough and mountainous country, although uncertain in use. It has been truly said that "although never precise, and seldom accurate, it was generally not very far wrong."

With instruments almost perfect in construction, and capable of being easily adjusted, and with the use of the steel band chain, which does not *stretch*, the surveyor is now placed in such a position, that his work should be practically correct. This is not the case, however, as in some instances improved instruments and chains have not produced correspondingly improved surveys. This can be easily verified by an examination of some of the surveys made with them. An error of a minute in bearing produces a deviation of only about two and one half links to a mile; errors in chaining should not exceed that amount. When errors in bearing exceed one minute, and in chaining two and a half links to the mile, the question naturally arises, what is the cause of this want of precision. In answer, I say the want of precision in surveys may be attributed principally to carelessness, on the part of the surveyor. Carelessness on his part in not being exact and precise in in his own work, such as taking astronomical observations, measuring angles, producing lines, making calculations and triangulations, and in giving proper instructions to the chainers, picket man and other employees. If the surveyor is careless in his own operations, the members of his party will be careless in theirs also. There is a great deal in example, more than is generally supposed, and I may say, as a rule, that the members of a survey party will be governed by the example set by the chief of the party. If he finds it too much trouble to go half a mile to offset a post at the commencement of the survey, they will find it too much trouble to do so, before the survey is completed. He must insist on accuracy and precision, and have it understood that nothing else is admissable.

I would gladly omit another cause of want of precision, but as all the trouble does not arise from carelessness, I will mention ignorance, and in some instances ignorance of the first principles of surveying. That such is the case, however, cannot be denied, and I don't mention it by chance, but because I know it to be a fact. I can point out several townships, amongst the early surveys in Manitoba, that have been surveyed by men who were totally incapable of doing the work they had undertaken. One, however, will suffice for the object I have in view. If you should stop at a particular section corner in this township, you will see three mounds, and although the posts have been moved from one mound to the other in turn until placed in the third mound erected, the rejected mounds have not been destroyed. If you can determine the third mound erected by finding a portion of the

remains of the old post in it, you are then in a position to check the survey. Measure east, west, north and south from this mound and you will not find the quarter section posts placed on the lines connecting the section corners; some are one, some are two and some are five chains off line, while none of them are placed midway between the section corners. If you go all over the township, you will see two or three mounds at each section corner, while the quarter section posts are invariably out of position. The number of mounds erected at the section corners give evidence that the surveyor had made several attempts to correct the survey. That it was executed to the best of his ability, I have no doubt; at the same time it gives ample evidence of his incompetence and ignorance in conducting a survey. Happily not many surveyors were employed on subsequent surveys, who through incompetence and ignorance produced such blunders, as are to be found in this survey.

Again many surveyors undertake surveys, which from the scientific knowledge they possess, and from practical experience, they are not fitted to execute. In surveys where consummate skill is required in the manipulation of instruments and in making abstruse calculations, it is absurd to suppose that they would be undertaken by those who have no practical experience, or are not possessed of the necessary scientific knowledge. In the same manner, no surveyor should undertake to determine the azimuth of a line, even by the simplest methods, who has no practical experience with the use of the transit, or knowledge of the calculation required.

As coming under this class, I may mention those who are constantly giving an exhibition of their knowledge of surveying by talking about the adjustments and use of instruments, interspersed with astronomical problems, but who have never adjusted an instrument properly, or taken an astronomical observation correctly. In fact, who could not be relied on to measure a distance with any degree of accuracy with the chain, to make a calculation in plane trigonometry or determine a distance accurately by triangulation.

Another cause of want of precision is the desire to make money in a hurry, apparently forgetting that "he that maketh haste to be rich is not wise." Many surveyors on contract surveys, instead of trying to close the lines on the section corners, are quite satisfied if they come within the fifty link limit, allowed by the Manual of Surveys; and

indeed it is not surprising, if some of the lines are found beyond that limit. A rigid inspection of contract surveys, with a reduced limit of error, necessitating the re-survey of lines in the woods, when they are beyond the limit allowed, would have a healthy effect in procuring a greater degree of precision.

The public demand for cheap surveys is put forward, in private practice, as an excuse for want of precision. The surveyor cannot afford to pay the expenses of an assistant, competent to superintend the chaining, and it is not always convenient for the surveyor to do so himself. The employer considers that the expenses of the surveyor are quite enough for him to pay, making no provision for correct measurements with the chain, on which the surveyor's work is based. In private practice, when I have suggested that it was necessary to take at least one experienced chainer with me, I have been told that competent men could be procured to carry the chain where I was going, and so save the expense of bringing one with me. On short surveys it is not possible for a surveyor, without great loss of time, to properly train the chainers. I have found it necessary in my private practice, to take one end of the chain myself, and even then the chaining has not always been as carefully done as it should have been. I always sympathize with a surveyor employed on private surveys, whose practice does not warrant him in securing (and at his own expense if necessary) a trained and reliable assistant who could look after the chaining. The want of such an assistant has often led to errors in measurement of considerable magnitude, and the surveyor employed is held responsible for the error, instead of his employer. It is not to be wondered at, if the surveyor who is employed on work of this kind, year after year, should become careless in the performance of his own duties.

I will just mention one instance that occurred in private practice, my informant being one of the chainers employed on a survey of a side line between two lots in a township in the Province of Quebec. When the line had been opened out in the woods, over a rocky and mountainous country, about half the depth of the concession, the surveyor chose two of the axemen, who never had had any experience in chaining, to go to the front of the concession, to chain the line. They were duly sworn, and without receiving any instructions were sent back to chain. They made ten wooden pins, and commenced chaining along the line without any regard to the uneven surface over which they were passing.

On reaching the working party, the surveyor wanted to know how many chains they had measured; neither of them knew, and in fact, were quite astonished at the question asked by the surveyor. If they had lost a pin on the way, they would likely have replaced the lost pin with another, and still would have been chaining to the best of their knowledge. This may be an extreme case, but the same thing is going on from day to day, in a greater or less degree. In defence of the surveyor employed, I may state, that the line, being a trial line, was not chained for the purpose of dividing the distance between the concession lines, but merely for offsetting, so as to give the position of the true line, between the posts at the front and rear of the concession, so that for the purpose intended the chaining might have been a little carelessly done without affecting the survey to any great extent.

I have been asked the question, "Why do not surveyors furnish their own chainers on private surveys?" I have answered, "Simply because the employer will not pay the additional expense incurred in taking chainers, as he wants a cheap survey; and the surveyor goes without them, because he cannot afford to remain idle on account of an empty purse."

The chainers being an important element, on all surveys, whether public or private, as regards precision, none should be chosen to chain excepting those who are careful and conscientious. Careful and conscientious because they have to be sworn, and if they are not both careful and conscientious, the fact of their being sworn does not make the chaining correct. The chainers being sworn, complies with the law, and legalises the survey, which is as much as can be said in its favor. I would prefer to judge of the accuracy of the chaining, from the closings, rather than to depend upon correctness, based on the fact that they were sworn.

The surveyor cannot be too careful in his choice of chainers (if he is allowed the choice). Even then he will find some men, otherwise intelligent, who will never become experts in chaining. The fault, however, often lies with the surveyor himself in not training the chainers to do their work properly. No matter how accurately the surveyor may perform his share of the work, either in the measurement of angles, or the production of lines, the closings will never be satisfactory if he has to depend on careless chaining.

He ought therefore to keep a constant watch over the chainers so as to prevent them from adopting and practising careless methods. This

is especially desirable at the commencement of the season's work and until they have been taught to chain correctly. If a pin is lost, don't admit of any guess work, but have them chain again from the last tally. If an error has occurred in the measurement of a line, or if there is a difference in measurement of two lines, that should be of even length, have them chained over again to ascertain where the error has been made. If the second chaining of the lines is not satisfactory, have them repeat the operation until they chain correctly; and it will do no harm for the surveyor to take a hand at the chaining himself, as it will show them the importance he attaches to their part of the work. There is nothing, that I am aware of, has a more salutary effect, or is more conducive in producing good chaining, than to give the chainers extra work to do in correcting their own errors. Have it distinctly understood that at every closing that is in error, the same course will be pursued, and I venture to say that it will not occur very often.

There is another difficulty in connection with chaining, which may be worth mentioning, that is, carelessness produced by over confidence. When the chainers have learned to chain correctly and have been doing good, careful work for a time, they become over confident and consequently careless, because they imagine they cannot chain wrong. Being unexpected, errors in chaining, occuring in this way, are very annoying to the surveyor. On this account, I have usually found it necessary to waken up the chainers, once or twice during the season.

The surveyor should be careful with his own work, so as to be in a position to check the chaining; as he should be able to tell from it what the closing ought to be, or within what limit it ought to be. If his own work has been carefully done, he is in a position to attribute the closing error, if any, to the chaining. If he cannot depend on his own work, because it has been carelessly done, it would be unwise to attribute the error to the chaining. My experience warrants me in saying, that there must be carelessness on the part of the surveyor himself, if his work produces a greater error in closing than a link or two to the mile.

When rapidity of work, as well as precision is desired, much depends on the picketman. The surveyor should, therefore, select the most active and intelligent man of his party as picketman. He should be a man of good judgment, and should be able, with a little practice, to choose the best points for the production of the line. In crossing valleys in the woods, he should keep the line clear overhead, and

direct the axemen so as to avoid unnecessary chopping; and should be able to select the best base line obtainable for the triangulation of a stream or lake. In a wooded country, where it is necessary to make pickets for producing the line, he should be competent to make them straight and of uniform size and length. In fact he should be ready and willing to do anything and everything necessary to further the work, and thereby save the surveyor much trouble and annoyance. Those who have had experience with a slow, stupid picketman, can readily appreciate one who is active and intelligent.

The choice of an instrument is of considerable importance, and depends upon the degree of precision required on the survey. If the surveyor is going to run Standard Meridians and Parallels, he ought to have a six inch transit, of good workmanship, reading to ten seconds. On township lines a five inch transit reading to twenty or thirty seconds; while on subdivision surveys a four or five inch transit reading to one minute will do. It would be just as unwise to undertake a survey of Standard Meridians and Parallels with a four inch transit reading to one minute, as it would be to undertake the same work without the necessary qualifications to perform it. I am not in accord with the surveyor who made a hobby of buying old instruments that had been thrown aside as worn out and useless by other surveyors; just because he wanted to show how accurately he could perform a survey with them. It would be well enough to experiment with them at home; they are not desirable, however, as a part of a surveyor's outfit for prosecuting surveys. The cost of instruments, of good make, is now so moderate, and they are so easily procured, that the use of anything but a good one should not be entertained. I believe that a surveyor commencing practice should have the best instrument, of the kind he wants, that can be procured, one perfect in construction and that can be readily adjusted. I do not believe in using an instrument that requires to be adjusted every day. It ought to be so well made that, with careful handling, it would not require to be adjusted during a whole season's work. The surveyor, having supplied himself with a good instrument, and having placed it in proper adjustment, is supposed from practical experience to be competent to lay down a meridian line from an astronomical observation.

In running Standard Meridians and Parallels great care is required, because the work should be exact and precise, and there is no check until the block is closed. We will suppose that the surveyor has been careful in determining the azimuth, and producing the lines run; that

the chainers have been careful in their measurements, and in making due allowance for temperature; that the picketman at each station chosen has been careful in plumbing the pickets, and in noting the points given for the production of the line; and that the closing of the block has been satisfactory and creditable to all concerned. There has, however, been something forgotten on this survey: the pickets set on the lines will not last forever, and there is nothing else to mark the lines run, as the posts have not been placed on them. The surveyor has evidently left this part of his duties for the chainers to do, but as the pickets have been set far apart, they have done the best they could, under the circumstances, by placing the posts on their chaining line. Sometimes, they are set in a curve to one side, and sometimes to the other, while in the valleys and ravines they are farther off line than on level land. It will be difficult to define those lines when the pickets are gone, while the surveyor could have placed the posts on the lines with the instrument, when producing them, and saved this evidence of want of precision through carelessness. I have attempted to determine the bearing of a line posted in a manner similar to this one, and before I could do so, I found it necessary to run a line the full depth of the township. Even then I was not certain that I had obtained the true bearing, because the township corners may not have been placed in their true position. How easily the posts could have been placed on the lines when the survey was in progress; and how much more conveniently could the lines have been retraced when necessary to do so! I have often been surprised to find the posts placed in all conceivable positions off the lines, when they were carefully and well run, and the closings good. Usually the posts do not stand more than two or three links from the lines, but in valleys and ravines they have been found over fifty links distant from them.

In the survey of township outlines, in many instances, there is ample evidence of carelessness. Why rapidity of work was preferred to extreme accuracy has always been a puzzle to me. Evidences of rapidity of work, which engendered carelessness, are found in variable chaining; errors in measurement; errors in calculations, and triangulations; crooked lines; posts not set on the lines run; posts set on the wrong side of the road allowance, while on some trial lines the posts are off-setted; and on others, some are off-setted and some are not.

In the subdivision of a township into sections, we have an example

of a survey where extreme accuracy is not required, and where the standard of precision is low.

While it is not desirable to expend too much time and labor in the prosecution of a subdivision survey, still the surveyor should, without loss of time, be able to run a line within one minute of the bearing required and the chainers should be able to chain a mile within two or three links of the true distance.

The work done would be more precise, if the surveyor were to spend a little time in opening out and measuring the north or south boundary of the township to be subdivided. This boundary could be used as a base line to project the Meridians from, after the inner angles of the township, adjoining this boundary, have been determined. It would also be necessary to measure carefully part of the east and west outlines, so as to be able to compare your chaining with the chaining of the outlines, and to modify it so as to agree with the same. If there are no errors in the township outlines, you are now prepared to go on with the survey intelligently. Time spent in getting a good start, will be found to be time saved. If all your work has been carefully performed, there will be no lost time afterwards.

Great difficulty is experienced in producing lines on the prairie, during the months of July, August and September, on account of refraction and smoky and hazy atmosphere. Instead of using a cross stick on the back picket, which is difficult to see, under the above conditions of the atmosphere, a sod placed on it is a great advantage and is now generally used. During my first season's work in Manitoba, on open prairie, I had frequently to get the moundman to stand behind the back picket, so as to enable me to see it. The next season instead of getting the moundman to stand behind the picket, I had him place his hat on it. Being desirous of going early to camp one evening, the moundman placed a sod on top of the picket in place of his hat. The next day I placed sods on every picket set, making them of a size proportionate to the distance to the forward picket. I found them of so great advantage, that after a short time I used the sod to sight on, paying very little attention to the picket. In smoky or hazy atmosphere, I have been able to see sod distinctly, when only the dim outline of the picket was visible. Before using the sod I found that all east and west lines run curved slightly towards the north, because the point taken on the back picket was not its centre, the south side being bright and the north side shaded. In running westward this was easily

verified by sighting on the back pickets four or five miles when the sun was shining directly on them. With the sod on the picket it is just the same whether you are running north and south or east and west. In taking a back sight it is not always necessary to sight on the sod, in fact, sometimes it is better not to do so, especially when there is much refraction. If you are using an instrument with two hairs crossing the horizontal one at a small angle, it is better to direct the telescope, so that the sod in its lateral motion will just touch the cross hairs above or below their intersection. If the sod in its lateral motion should overlap the cross hairs, move the telescope so that the sod will be farther from their intersection, and adjust the line of sight until it lies evenly between them. With the line of collimation almost true; I have found it a great advantage to place a sod on the forward picket also. I think it preferable to use a sod on the forward picket when there is much refraction, than to take the mean of two points when both are uncertain.

With a little care, in open, level and undulating country, there cannot be much error in the production of a line. This is also true, when long sights are taken in the woods, but this usually requires an enormus amount of time and labor to be expended in opening out the line, especially when pickets have been set from hill to hill. In crossing valleys, to avoid this loss of time and labor, the alternative is resorted to of setting pickets at short distances.

In producing lines in wooded country, where the surface is hilly and broken, I dispense with the use of a flag picket, having the picket man make the pickets as they are required. The method I have adopted for the production of a line where the pickets have to be set at short distances, and which I have found very convenient in British Columbia is as follows, viz:—

Adjust the line of collimation so that a sight taken direct and reversed will fall on the forward picket at a distance of ten chains. As soon as the first picket giving the direction of the line is carefully set, look for a reference object ahead on line, such as a dead tree, a white stone or anything that is definitely outlined. If nothing else is seen, the top of a tree on some distant hill or mountain will do. If there is nothing definite to note in sighting forward, then revolve the telescope and take a sight backwards and fix, if possible, a reference point in that direction, due allowance having been made for collimation. Then place the telescope in a vertical position, and set the back picket be-

hind the instrument, with the eye, by placing it in line with the telescope and forward picket. If the picket can be set twenty or thirty feet back from the instrument, all the better. A picket of bright green wood, in fair light can easily be distinguished at a distance of fifteen chains, and in wooded country where it is hilly and broken, they are not often required to be set at a greater distance. The picketman is supposed to have left space enough in front of the forward picket to set the instrument, say from five to thirty feet, according to the nature of of the ground. Proceed now to the forward picket and pass to the front of it. A glance ahead is all that is required to decide if it is necessary to set a guide picket, to give the axemen the direction of the line, and save unnecessary chopping. If a guide picket is required, place the instrument so that the line of sight to the back picket will pass one side or the other of the front picket, you can then set the guide picket and if it is not exactly true, it is near enough for the purpose intended. Then proceed at your leisure to set the instrument in line by moving it to which ever side is required: level it, point the telescope towards the picket, and place it in a vertical position. If the telescope is not in line with the two pickets, repeat the operation until it is in line. Push the front picket to one side, set the telescope on the back picket, revolve, it and you are ready to set the forward picket. Practice makes this the work of only a few minutes, as you will sometimes hit it at the first, or at the most the second setting.

In this manner, I have set ten or twelve pickets in succession crossing a valley, which did not average over three chains apart, and by sighting on a reference object or back picket, have frequently found that the direction of the line had not changed more than two or three inches to the mile.

The advantages of this method are that it relieves the picketman from carrying a flag picket, which, to him at least, in a hilly, broken and mountainous country covered with timber, is a nuisance. It relieves the picketman also from placing a hub at each station.

It gives the surveyor the advantage of setting his instrument at the best point for producing the line, and therefore he has not to depend entirely on the point chosen by the picketman.

After the picket is set, it often occurs in wooded country, that a knoll or ridge intervenes between the point taken by the picketman, and the place best suited for the next station, which was not visible until the line was opened out. It, therefore, gives the surveyor an opportunity

before setting up the instrument at the point intended, to move forward to the ridge or knoll, and line in from there.

Some surveyors, in taking short sights, use a chain pin set on a hub, instead of a picket. A surveyor, employed on the survey of the Railway Belt in British Columbia, told me that he was often surprised at the correctness of his own work, when producing a line up and over a mountain, where he had to take a number of short sights in succession on a chain pin, as above described. But to see a chain pin distinctly it is necessary to change the focus, which I never do, because in changing the focus you are very liable to change the line of collimation also, if the focussing tube has not been properly made, and does not move parallel to the line of collimation. It would never do to be constantly adjusting for focus and collimation. When the difference between the back and foresight is great, if you cannot centre the line of sight by having your eye close to the eye piece, move further away; by paying attention to this, the difference with or without focussing is hardly perceptible.

One disadvantage of this method is that the forward picket may be moved before the instrument is again set in line. This may be caused by the picketman when moving away from it, or by the surveyor himself when passing it, to set up the instrument for another sight. To avoid any change of position, the picketman should set the picket firmly in the ground, and remove all branches or loose stones away from it. As soon as the picketman leaves, another sight should be taken, to ascertain whether it has moved or not. In passing the picket, the surveyor will have himself to blame should he not make a sufficient detour to avoid moving it.

To say anything special to the older surveyors would probably be a waste of words, as years of practice have produced methods of working that will not likely be changed. If they have been careless in their operations, they will likely be careless still. A word to the younger members of the profession may not be out of place, and I have done. The time to be careful and precise is when starting out to work, "as the twig is bent the tree inclines." Every day, in the future, will demand more care and precision in the prosecution of surveys. If you undertake a survey, you must make up your mind to do it well, whether it pays or not. Remember that there is no line run, or post placed in error but will be discovered sometime, and although they may not bear witness against you, or effect your position, still they stand as monuments either of

carelessness or ignorance. Continue your studies at every opportunity. It won't hurt you to be possessed of greater knowledge than your predecessors. "Knowledge is power," and may be a stepping stone, in your case, to an important position. When you are constantly employed in the practice of the profession the opportunities for study are only casual. On a survey of several months duration, with its attendant hardships and privations, you will not feel much inclined to study in the evenings after you have checked over the day's work. Besides this, you cannot carry a library with you, and your studies must be limited to a few subjects. Indeed constant practice is more likely to cause a loss, rather than a gain, in theoretic knowledge.

This is an age of progress, and sooner or later a more systematic and accurate survey of the Dominion will be made. In all lilkelihood it will be commenced at an early day, and successfuly prosecuted until we have a correct map of the whole Dominion. You may have a chance yet of employment on this survey, and should, while you have an opportunity, possess yourself of the knowledge that would fit you to undertake any part of the scientific or practical work required. If you are not willing to make an effort to reach the top of the ladder, better far to turn your attention to something else to obtain a livelihood, than to be a drone amongst workers, a careless operator, a producer of blunders and a disgrace to the profession. But whatever you decide to do let not carelessness or ignorace be laid to your charge, as an excuse for want of precision in your surveys.

JOHN McLATCHIE.

Ottawa, 17th February, 1889.

DISCUSSION.

THE PRESIDENT—"Mr. McLatchie is to be congratulated upon his first effort. I have had a great deal to do with surveys in the North-West Territories, and corrections of the same, and I have realized that a large percentage of the errors, connected therewith, have been made in the first case and that after errors were in a large measure the result thereof. When suggestions of the kind contained in Mr. McLatchie's paper come before the Association, they deserve great attention and carry great weight."

WM. DREWRY—"I think Mr. McLatchie's standard is too fine for practical purposes and that contraction or expansion of the chain alone might cause errors of the dimensions referred to."

A. O. WHEELER—"Mr. McLatchie has made allowances for contraction or expansion"

Mr. DREWRY—"The standard of precision should be regulated by the class of survey being performed."

J. F. SNOW—"I am glad Mr. McLatchie has called attention to alignment. I think that the pay of a contractor on North-West surveys does not allow of his going over the work twice. I have found in contract surveys that the errors of subdivision nearly always result from bad alignment in the outlines. Under such circumstances a contractor should not be expected to do work of so high a standard, when the outline work could not be depended upon.

REMARKS ON A TRIP TO ALASKA AND RETURN VIA MACKENZIE RIVER.

I presume you are all aware of the fact of the journey referred to, and in a general way with its objects and results, at least the main features of them. I now propose to give a *resumé* of my official report, which will be printed and issued with the Annual Report of the Department of the Interior for the year 1889. In an official report one does not care to put many incidents, adventures and hardships which one has experienced, and the trains of thought which they start; yet these are to the traveller, one might say, the only mementos of the occasion which are exclusively his own. His report of the condition, resources, topography and natural history of the country is public property in which he has no individuality more than the fact that such a discovery or determination was due to him, and if his discovery or determination is not worth to his fellow men more than ordinary attention, it is soon buried in oblivion, and in his connection with it when so buried, where is he?

In the course of the following remarks I will assume that you, my professional brethren, are in sympathy with me, and that I have your attention over the whole route. I will further assume that you will unanimously acquit me of egotism throughout my recital. Mr. Klotz is down on our programme for an article on the "Railway Belt in British Columbia." It is a pity some other member did not give us a "Bird's eye view of our great prairie," and another a homily on "A road through the wilderness," which would complete a description of my entire route from and to home, and give us a somewhat more intimate acquaintance with the geography and topography of the greater part of our great Dominion, and when I say great I do not at all use the word in a satirical sense, but love my country enough to confidently look forward to the time when she will, through the development of her enormous resources, and more than that the cultivation and growth of a spirit of what I will call "Canadianism" in the bosoms of her sons and daughters, take her place among the factors of the world's improvement, and become the strong right arm of that Empire on which the sun never sets.

Many might suppose, knowing my residence, that the title of this paper conveys to them remarks on the route from Ottawa to Ottawa: I

do not intend it to cover much more than a third of the journey. If any member feels aggrieved in consequence, I suppose he has legal recourse, and if he has money enough to employ the requisite talent will no doubt obtain his lawful rights, and the legal lore of the community be considerably enlarged and enriched at his or my expense, but then we will have the advantage of knowing just what a title means.

The part of the journey between Victoria and Chilkoot Inlet has been so much written of, talked of, and pictured during the past few years that I will only repeat one of the many statements made concerning it: that though it is in ocean water, and can be traversed by the largest ships, it is so sheltered by countless islands from the gales and waves of the vast Pacific, nearly the whole of the length, that its waters are always as smooth as those of a large river.

In marked contrast to this is the west coast of the United States, where harbors or shelter are like angels' visits.

My further remarks will refer only to that part of my route over which my professional work extended, some 2,700 miles.

My survey commenced at Pyramid Island, in Chilkat Inlet, the latitude and longitude of which were fixed by a party sent out by the United States Coast Survey to observe an eclipse of the sun, August 7th 1869. I made them the origin of my survey. I carried the survey over to Chilkoot Inlet at Haine's Mission; thence along the west side of Chilkoot Inlet to Taiya Inlet and up it to its head. The altitude of some of the highest peaks around the head of Taiya Inlet was determined by triangulation, and angles of elevation. The highest visible from Taiya Pass was thus determined to be 6,070 feet above a station of the survey, which was about 140 feet above high tide or about 158 above low tide.

A small river flows down Taiya Pass which is navigable for canoes to about six miles above the mouth; above this the current is much too swift and rough for boats, and everything intended for the interior has to be carried over the mountains on men's backs. The distance from the head of canoe navigation to Lake Lyndeman is seventeen and one-half miles; of these the first two (2) are comparatively easy, being clear of trees. About seven of the remaining nine (9) to the summit of the Pass are in heavy woods. Getting my two canoes through this was a slow, tedious job, which would seriously test any man's fortitude and christain forbearance. The river has to be crossed three or four times in the Pass, and as the water is ice cold and about three feet deep, it

will never be resorted to as a bathing place. The lowest crossing is about thirty (30) yards across and the current is so strong that unless one has a load on his back he can hardly stand on his feet. The Indians when crossing carry a stout stick which they use as a prop while making a step. The women while crossing, tie their skirts up—modesty forbids me to say how high—and use their canes as dexterously as the men. Before my canoes came up to this point I had to cross twice; the second time while I was very warm after clambering down the steep side of a hill 1,360 feet high.

To people living in ordinary conditions this would seem dangerous, but I think most of us have, at one time or another, had many such experiences, and our health will compare favourably with that of any other body of professional men.

When one of my canoes came up I selected a quiet pool between two rapids, and started to put over such of my material and instruments as were at hand. While doing this a couple of miners came up with their packs on their backs and asked to be put over. One of them was a young man called "Mad Hank," the other was much older. I got them both placed in the canoe and started across, when Hank told me he was no "greenhorn" in a canoe and in proof of it stood up. I ordered him to sit down; he started to give me some of his canoe experience, to do which he found it necessary to face me, and began to turn round, but ended by trying to stand on his head in the river, upsetting the canoe as he went out. I managed to get on my feet in about five feet of water and clung to the canoe to prevent her going over the next rapid, where she would probably have been torn on the rocks and drift wood. The poor old man stuck to the canoe with all the tenacity of a drowning man. I had hard work to keep on my feet in the deep water, and in struggling with the canoe turned her completely over, the old man going under her and coming up on the lower side minus his hat. With much difficulty I put the canoe ashore at the head of the next rapid and hauled her out, the old man still clinging to her, and Hank on the shore looking on in a chilled daze.

The result of the circus was that they lost every thing they had in the canoe at the time, including 50 lbs. of sugar, a double barrelled gun and some tools. I had the discs for my base rod in at the time but as they were securely tied in their case, which would float them, they were picked up uninjured below the rapid.

I intended making some appropriate remarks to Hank but found

they were all congealed within me by the cold water, besides he looked so thoroughly scared and rueful over the mishap that I laughed all my chattering teeth would at the time permit.

In keeping with his character he made the descent of the river as far as Forty mile, where he mined for about three weeks, gave it up and started out with the first outgoing parties. I met him on his way out, and to prove to me he was wise in leaving, he told me that a man had been frozen to death the previous winter while wrapped in 14 pairs of blankets, and as he had only three pairs, he thought it useless to remain.

The edge of the timber on the South side of the pass is about 2,000 feet below the summit, or 1,400 feet above the sea. The distance from the timber line to the summit is about two miles, most of which is of uniform slope and not very hard ascend. About two-thirds of the distance up there is a very steep bit in which there is a rise of 500 feet in about as many yards. When packing over the pass the Indians, if they get to the timber limit during the day, remain there until about midnight, when the snow in the pass is frozen and they can travel over it with comparative ease. On the very steep place they cut holes in the crust with a small hand axe and help themselves up with their hands, otherwise with a heavy load on their back they could not get up this part. When the snow is soft, they use a stick, which they push vertically into the snow and pull themselves up by it.

The loads some of them will carry, and the small amount of food they will subsist on while doing so, would surprise one: that is if they are paid by the weight they carry. I had one hundred and twenty packs exclusive of my smaller instruments and canoes, which the party took over. These packs ranged from 40 to 146 pounds weight, and were carried by men, women and children, and all the food any of them had as far as I could see was dried salmon and a few biscuts. If you want to see the other side of their nature hire a few of them by the day and feed them, when the load that will absolutely double their limbs under them, and the amount of your food they will stow away will be in very striking contrast to the former quantities: but if you value your christian character and reputation as a gentleman don't do it.

I have read somewhere, of red snow being seen in this region; so it is, but it is only snow colored by a vegetable juice. When I first saw it I was surprised at the confirmation of the statement I have alluded to, but soon noticed that it was confirned entirely to the line of

travel. This led me to examine it more closely, when I found it was caused by the juice of a berry which grows on a ground vine at the head of the timber limit. When pressed, this berry gives out a purple juice, which by dilution shades down to a pale pink. This juice is absorbed by the leather in the Indian's mocassins as he tramps on the berries, and afterwards stains the snow as he travels over it. This by the heat of the sun and the action of gravity on the hill side is distributed over a wide space compared with the track, and is visible after all sign of it is gone.

The red snow of the Arctic regions is in part due to vegetable coloring matter. Might not some of it come from a similar source?

The difference of elevations between the stations of the survey from the head of canoe navigation up to the summit of the Pass was determined from the distance between them and their zenith distances when referred to each other. In this way the summit was found to be 3,378 feet above the head of canoe navigation, which I assume to be 120 feet above tide water—Dr. Dawson sets it down at 124—this gives 3,498 feet as the altitude of the summit of the pass. Many of the peaks around rise upwards of 2,000 feet above this. From the summit to the timber limit on the north side is about six and a half miles, with a descent of about 800 feet. Lake Lyndeman is eight and a half miles from, and 1,354 feet below the summit of the Pass. This lake is five miles long and is separated from Lake Bennet by about ¾ of a mile of narrow rough river, with a total fall of 15 or 20 feet. Lake Bennet is at the head of navigation of the Lewes River, which from the head of the lake to the confluence with the Pelly is 375 miles, of which about 95 is lake. The westerly arm of Bennet Lake adds about 15 miles to this, and the lake called Takone Lake, known to the miners as the "Windy Arm" adds about as much more. Techo Lake is reported to be about 30 miles long, which gives us altogether about 155 miles of lake navigation in our territory; of this, Lake La Barge is below the Canon and rapids, and as it is 31 miles long, we have 124 miles of navigable lake on the head water of the Lewes River. In fact, with the exception of twenty-six (26) miles, all above the Canon might be called lake.

The Canon and rapids have been pretty well written up in several articles by several parties, all of them giving a more or less thrilling and dangerous character to them. From my standpoint of view the only danger in them is in the last few yards, and even that has been several

times run through by parties in small boats—generally against their will however. That it is dangerous no one would deny, but that there is such terrible risk and such narrow escapes as are sometimes reported is a delusion. I do not wish to deny any man any credit he may be entitled to for running through it on a raft or boat, but what I wish to decry is : that any individual should consider and report himself a hero for having done something never before attempted and in comparison with which a descent of Niagara would pale, if we were to estimate the daring of the feat by the amount of bosh used in describing it. The fact is every one runs the Canon ; all who have heavy loads carry part of it over and run through light. The only danger is in striking the sides ; keep in the channel and you are safe, except your boat is very small. I admit the run through is exciting and a person who had had his fears aroused by reading some of the highly colored descriptions of it, more especially if he had no previous experience of the kind, might loose his head and run into danger, instead of out of it. The walls are perpendicular and high, and the channel narrow, and as you go through they seem to fly past you, which increases your fears if you watch them, but that is not what you are there for, your business is to watch the channel ahead, and keep in it. You can afterwards examine the walls much more comfortably from the top of the opposite banks.

The rapids just below the Canon are not at all bad. What constitutes the real danger to parties, who are not cautious, is a piece of calm water in the rapids, in which there is a short sharp bend in the river, which hides the last or " White Horse Rapid " from sight until you are in it.

Parties always examine the Canon and immidiate rapids before going through, and on coming to the calm water suppose they have seen it all, as all noise from the lower rapid is drowned in that of the one you are at.

On this account several parties have run through the " White Horse," being ignorant of its existence until they were in it. It is told of two young French Canadians, who got into it in this way, that they started to strip for a swim but before finishing thought it best to pray, and to their surprise found themselves safely trough before they had finished either. From the head of the Canon to the foot of the " White Horse " is a little over two and three-fourth miles.

Five rivers join the Lewes. The Tahk-heena, Tes-lin-too (called by Schwatka the Newberry) Big Salmon, Little Salmon and Norden-

skiold. The Tahk-heena is reported to be navigable its whole length. It flows out of a lake which is said to be of considerable extent. The Tes-lin-too is the most important affluent of the Lewes, indeed it might be called the main river itself. If the different estimates of its length, can be relied on it must be upwards of a hundred miles longer than the part of the Lewes above it. It is reported navigable its entire length, which would give us uninterrupted navigation from Behring Sea to within a few miles of Taku River on the Pacific; and only a few miles above its mouth. The estimated length of the Yukon, Yukon-Pelly, Lewes and Tes-lin-too is about 2,300 miles, over one-half of which flows through mountainous country; yet it is all navigable, the only interruption being Rink rapids, called by the miners "The Five-fingers," and this might properly be called only a detention, as ordinary steamers could work their way up it with the aid of a line. It is only a few rods in length, and is 31 miles below the confluence of the Tes-lin-too and Lewes.

The Big Salmon, as it is described by miners who have been on it, is a river of considerable length, but is probably not deep enough to be navigable except for very light boats.

The Little Salmon is an unimportant stream, and the Nordenskiold seems of less importance.

The Pelly ranks as one of the main branches of the river; indeed if we follow the nomenclature of Robert Campbell, of the Hudson's Bay Company, the Pelly extends from the confluence down to the junction with the Porcupine. Mr. Campbell in 1840 discovered the Pelly near the head, and in 1843 he descended the river to its confluence with what he named the Lewes. Here in 1848 he built a post which he called Fort Selkirk, and in 1850 he descended the river to the mouth of the Porcupine, where in 1847 Fort Yukon had been built. He then ascended the Porcupine, crossed by Bells River to the Mackenzie and thus, for the first time, made the circuit from Fort Simpsom, by the Liard, Pelly, Porcupine, and Mackenzie, to Simpson again.

Between the Pelly and the International Boundary only two streams of any importance join the main stream, the White and Stewart Rivers. The White enters from the west side, 96 miles below the Pelly, and the Stewart 10 miles farther down on the east side.

The White was so named by Mr. Campbell on account of its very muddy water. It is of little importance as, though of considerable

volume, its current is much too swift and there are too many shifting bars in it to be navigated.

The Stewart is a larger stream than the White, but I do not think discharges any more water, as its current is much easier. It is reported navigable up to the falls : about two hundred miles from the mouth, and one or two of its branches would add somewhat to the length of its navigable waters.

About 41 miles above the Boundary, Forty-mile River enters from the west. For purposes of navigation it is useless, only 23 miles of it are in Canada. With the exception of the Tahk-heena all of these streams are known to have more or less fine gold distributed in their bars and banks. The Stewart is called by the miners, good; the Tes-lin-too, fair, and the others indifferent. Gold is found on the main stream from a few miles below Lake La Barge down to and below the Boundary.

Coarse gold, the heart's desire of all placer miners, has so far only been found on Forty-mile River, but many spots where fine gold has paid well have been found both on the main river and the tributaries.

The pay has ranged from eight dollars ($8.00) per day up to thirty ($30.00) in the fine gold areas ; in the coarse, on Forty-mile, it has been as high, it is said, as $100.00.

Coal has been found at several points, prominently at Coal Creek near Forty-mile.

Silver-bearing galena was found on Forty-mile, and some silver-bearing rock near Fort Reliance, but none of it was specially rich.

All the country along the river, from the head to the Boundary, and along all its affluents, as far as could be learned, is mountainous, and it continues so upwards of a hundred miles below the Boundary where the country is said to be low, flat and swampy. The river here spreads out to several miles in width and is filled with islands. None of the mountains seen were more than 5,000 feet above the river, and but few of them were near that.

In a paper of a length suitable to the present occasion, no detailed description can be given of such an extensive region, and I will only say that the fauna and flora would not be found very different from that along, say, the Athabasca or Peace, the most apparent difference being in the size and luxuriance of the flora, which of course no one would expect to find so much farther north and at such a greater altitude equal

to that of the more southerly districts mentioned. Lake Lyndeman is about 2,140 feet above sea level, and my barometer readings at the Boundary during the five months' stay there indicate a height above sea of about 800 feet, and it is pretty certain it is not less. From this we infer the height of all the region above the Canon to be upwards of 2,000 feet, an altitude in latitude 60 and above, incompatable with a rich flora.

The natives of the upper and river valley are few, and most of them, through long domination by the coast tribes, are spiritless and poor. Those of them who can make a trip to the coast with a few furs, have heretofore been often deprived of them by the Chilkoots or Chilkatts, often without any compensation, always at forced prices.

The coast tribes, in 1852, descended the river and pillaged Fort Selkirk, since when they have controlled the fur trade of all the upper river. Just now there are a couple of traders at the foot of Taiya Pass who, it is to be hoped, will better the condition of the interior Indians.

During the stay at the Boundary, all possible lunar culminations and occultations of stars by the moon were observed, to determine the longitude of the observatory and thence mark the position of the 141st Meridian (the International Boundary) on the river. I will make a few remarks on those observations at the conclusion of this paper.

Between 70 and 80 miners spent the winter of 1887-88 at Forty-mile, 13 or 14 at Belle Isle, 12 miles below the Boundary, and 5, 22 miles below that. They frequently during the winter exchanged visits, and in doing so my house was a resting place for them, where they always timed themselves to remain over night.

Their visits were a great relief from the monotony of our lonely position. They belong to a great many different nations, reperesenting English, Scotch, Irish, American, French, Portuguese, Prussian, Austrian, Russian, Italian, and, last but not least, Canadian, which was more largely represented than any other.

All speak English or "United States," and very seldom is any other language heard among them. Nearly all of them are characters in their way and are capable of amusing themselves under conditions and in ways that we would consider utterly at variance with the idea of amusement. They are generous to a fault, and want does not go long unprovided for with them.

They have their own code of laws, which is principally based on a

clear application of the principal of right and wrong in dealing with each other, and any party who should attempt to make wrong appear right would, I fancy, be judged more guilty than the wrong doer. Any party who has been wronged, or thinks he has, calls a meeting of the camp, which at once resolves itself into a board of trial and hears and disposes of the dispute. In all such trials a man's known character for truth and honorable dealing is an important factor in the case.

A culprit escaping on a technicality is, I think, unknown, and a party trying to bring such about would, I fancy, be punished more severely than the culprit.

All those I saw would hardly be admitted to church membership in the outside world, yet they might teach a lesson in charity and common honesty to many here who would consider them the dregs of society.

They were generally dreading the arrival among them, during the summer of 1888, of the professional gambler and thief, but had their minds made up to give them short shift if they came. All of them play poker for "dust," but the play is fair, and any attempts at "tricks" is at once discountenanced.

Playing cards and telling lies are their principal amusements in the long dreary nights. An island about a mile above Forty-mile on which about thirty of them dwelt was known as "Liars Island," and the residents the thirty liars. The author of "She" might with profit have spent a winter here. His fire of life would have been peculiarly welcome in the region. The transformation scene would not, I think, effect many there, as it did poor "Job," but would rather have been a source of amusement. To repeat any of the feats, adventures, accidents and other events invented for the nightly meetings of this club would take up too much time, and to convey an idea of their nature I refer you to the history of "Baron Munchausen."

Scurvey was prevalent in the camps in the early part of the winter, but its progress was arrested in February by the arrival of the Indians with large quantities of fresh meat. There were more than twenty cases of it at Forty-mile, only one of which proved fatal.

In my camp the members of the party enjoyed themselves fairly well reading, making the necessary articles for our trip to the Mackenzie, and out door exercise enough to keep the system in good working order. We had a slide down the side of a hill onto the river, on which there

was much amusement. Occasionally in the evening a few games of cards were played, principally "poker," with beans for cash; some large sums were lost on these games. To one not accustomed to the monotony of such an isolated life, associated with the long night in the winter months, and the utter absence of knowledge of all the world and all that is near and dear to us, the loneliness is often oppressive. To be cheerful was a part of our duty, and all endeavoured to be so. I can personally say that much of the apparent cheerfulness was assumed, and often, in spite of all effort, a gloom would overcast all my horizon that would drive me almost desperate, and almost to the point of leaving my duty unfinished and making my way to civilization, or at least to where I could hear from home.

To convey my canoes, instruments, camps and other requisites, with provisions for the use of five men for five months, I had the party make 13 toboggans, and a double toboggan made after the fashion of twin sleighs on which the canoes were mounted for transport.

On the 3rd of March we started to reach the Mackenzie by way of the Tat-on-duc, Porcupine, Bells and Peel Rivers. The party hauled all the material to the mouth of the Tat-on-duc, about forty miles. Here Indians were met, whom I induced to aid me with their dogs as far as the height of land between the Tat-on-duc and Porcupine. They turned out with nine teams—36 dogs—and came as far as the head of the river, but nothing would induce them to go farther. The party had to cross the water-shed unaided. Thence down the Porcupine about twenty miles to where the descent was safe enough for canoes. Here a halt was made until the ice would break up.

I will now turn back and give a short description of the Tat-on-duc. It is a mountain stream which is unimportant in any sense as far as is at present known. It is only 60 or 70 miles long and falls about 2,800 feet in that distance. On the lower seven or eight miles the fall is much more rapid than farther up. In many places here the ascent is so steep that the water rises at the edges and overflows the ice and adds to its thickness until it is in places, upwards of 20 feet thick, and presents the appearance of a hill.

The first Canon is eight (8) miles above the mouth. It is a chasm through a mountain 30 to 40 feet wide and 500 to 700 feet deep, the sides rising perpendicularly almost to the top. It lies at right angles to the valley of the river, and the mountains on either side of the valley,

when seen from the middle of this narrow opening, present the appearance of mountains in a picture and add to the impressiveness of the scene. It is truly a grand scene!

The Indians conveyed to me as well as they could that the noise of the stream rushing through it in high water is like the noise of thunder. They can get near the lower end of it by clambering along the side of the hills, but it is difficult, and very few and far between are their visits to it, except in the winter. Above the Canon there is nothing worthy of particular notice until we come to Sheep Mountain (about 20 miles). This is apparently the highest peak in the valley; near it the Indians described a small lake which they say never freezes, and the surface of which is constantly agitated by winds of such strength as to blow one over and into the lake if he stands near enough the edge of the basin, which appears to be very deep and steep. Afterwards, I more fully realized their meaning, when some distance above this, I came to a spot in the river where there was a large overflow of sulphureted hydrogen gas, which could be detected for several hundred yards along the river, and at one point is so strong as to make one sick. An Indian who was with me at this point made me understand that the wind at the lake was the same as this, and that it made men sick so that they fell in.

This simplified the existence of the wind at the lake which, accepting this as a fact, is nothing more than an immense escape of this gas which keeps the water in continual agitation and is concentrated enough all around the basin to kill any animal that may get into its area. They spoke of the skeletons of mountain goats and sheep being numerous around it.

When you have to get all your information by pantomime from people mentally constituted as Indians are, you all can readily understand a misunderstanding on both sides. I spoke of visiting this lake with some of them as a guide, but this aroused all their superstitious fears, and they solemnly warned me that I too would meet the fate of the animals that approached too near its brink, which they pictured to me rolling down the side of the basin and at last dying near the water or in it.

I noticed nothing in the appearance of the rocks around to warrant one in calling it the crater of an extinct volcano, which would be a simple explanation of the phenomenon.

A short distance above this we have to leave the valley of the river

and go up the valley of a creek, or it might more properly be called a glacier. The ice in it must in places be nearly a hundred feet thick.

On the river a short distance above this there is a Canon in which there is a high water-fall, which renders it impassable; hence the detour.

On the south side of the valley of the glacier a range of mountains rise about 2,000 feet, and end in an extensive table-land. On a part of the edge of this table-land an immense wall rises nearly a thousand feet above it. It is probably four or five hundred feet thick, and rises as far as could be seen, perpendicularly on both sides. It has been weathered into fantastic shapes, and is pierced by several holes, which can be seen through, to the hills beyond. What dimension of armament the builders of this mighty wall designed it for, I leave you to fancy.

About four miles up the valley we leave it to the north, and climb over a pass through the ridge between the valley of the glacier and the valley of the river.

The summit of this pass is about 700 feet above the glacier, and except on the summit it is all thickly timbered with spruce, tamarack birch and poplar of a size you would not expect at an altitude of 3,000 feet, in latitude 65° 20′.

On either side of this pass, tower two high bare peaks on whose sides numerous mountain goats could be seen cropping the scanty herbage. The peak on the west side of the pass I propose to name "Mount Deville," that on the east, "Mount King," and as in that region I was

> "Monarch of all I survey,
> My right there is none to dispute,"

On the summit of the pass it is level for about half a mile. The descent on the north side to the Tat-on-duc River is steep for a short distance, and from the middle of the summit all view of the northern slope is shut out, and the scene is bounded, on the north, by the mountains on the north side of the water-shed. The evening I reached this spot the sky was all covered with dense white clouds, which bounded the horizon to the north, and the boundary between cloud and snow could hardly be distinguished. As I stood here gazing on this, to me, boundless view, with Mounts Deville and King towering to the clouds on either hand, I felt all the awe of a mortal who had been permitted to gaze through the gateway of time into eternity. I turned away from the scene with the impression that I had been favored as no other mortal

ever was, and strange to say this delusion possessed my mind till next morning, when a cloudless sky, permitting a view of the far away northern peaks, dispelled the illusion.

The upper end of the Tat-on-duc river might be called a glacier, as I believe all the water which flows in it during the winter rises to the surface and continually adds to the thickness, until it must be over a hundred feet thick. In some places, the water rushes up through holes in the ice at such a rate that it cannot freeze until it reaches the surface: in this way hillocks are formed on the surface of the glacier, often 40 and 50 feet high.

Out of the basin in the mountains, which forms the water shed, three rivers flow, the Tat-on-duc to the Yukon-Pelly—the Porcupine to the Yukon—and a river which has been named by Mr. Johnson, Geographer to the Department of the Interior, "Ogilvie" River to Peel River. A peak at the head of "Ogilvie" River I have named "Mount Klotz."

The spring camp was made about 20 miles down the Porcupine, and during six weeks stay here the time was passed as comfortably as possible. Around us, on the mountain sides, roamed innumerable Cariboo and Moose. The former were so poor that they were useless as food, and we had not snow shoes large enough to overtake the Moose as the Indians do. To do this, you require a pair of very large size. When so equipped a man who can keep up a steady jog for 3 or 4 miles can tire them out in deep snow, when the rest is easy enough.

This camp was in latitude 65° 43′; longitude, approximately 139° 40′. The course of the valley from the camp is due north for about 16 miles, where it swerves to the right. Looking down the valley, a peak is seen which overtops all the others in the vicinity, and must rise over 4,000 feet above the river, or nearly 6,000 above the sea. I propose calling this "Mount Burgess," after our Deputy Minister.

About thirty miles from the camp, the mountains cease, their northern boundary extending nearly east and west from this point, which is in latitude 66° approximately. The last prominent peak close to the river is on the west side. The river sweeps around its base. It rises about 3,000 feet above the river, and is the most prominent object in sight from the valley, for many miles northwards. This peak I propose to name "Mount Dewdney," after the Honorable the Minister of the Interior.

The surface is hilly, and the descent in the river rapid for nearly

forty miles from "Mount Dewdney," when the surface becomes nearly flat and all thickly timbered.

May 28th the ice broke up and started out, and we followed, after having to wait a day for a jam to break up and let us proceed. Going down the Porcupine this only caused delay, but going up Bells River it caused both delay, danger and hard work. By working hard day and night we reached La Pierre's House on the 6th June, after having lost a day going up Eagle River. A day was spent at La Pierre's House taking observations. Approximately the latitude is 67° 23′. On the 8th, the journey was continued up the river to McDougall's Pass through the Rocky Mountains, but so much drift ice was encountered that it was the morning of the 12th before the pass was reached, though the distance by the river is probably only forty or fifty miles, and the current is not strong. From Bells River to the summit of the pass is about eight and three-quarter miles, of which about six is got over on a very crooked creek, and the rest is lake. A great part of the creek and all the lake was still covered with ice, and all the outfit had to be carried over. Two prominent peaks, on the north side of the pass, I have named "Mount Dennis" and "Mount Russell," after two of our past Deputy Ministers.

From Summit Lake a creek flows eastward to Trout River, an affluent of the Peel. The length of this creek is about three and three-quarter miles, most of which was then covered with ice. The whole distance over which the outfit had to be carried was about 8 miles. The summit of the pass is about 1,200 feet above sea level.

On Trout River a descent of over 1,100 feet was made in 24 miles, and only 360 of this was made in the first 11 miles, leaving nearly 800 feet to go down in 13 miles; or over 60 feet per mile. This was always exciting, and often dangerous in our canoes, but the only mishap met with was occasionally to nearly fill them with water.

Fort McPherson, on Peel River, was reached, and preparations made to make a micrometer survey from that point up the Mackenzie to Fort Chipewyan, on Lake Athabasca, a distance of 1,400 miles. McPherson is in latitude 67° 26′—the highest point reached on the survey was 67° 47′. At McPherson, on the 21st June, I observed the sun's lower transit for time. It is needless to say that the time deduced from such a low transit was not very accurate. On the evening of the 22nd June the survey was started and continued without break to a point about 80 miles above Fort Simpson, or about 850 miles;

here low flat banks and very high water prevented any further instrumental survey, until Great Slave River was reached, by making it impossible to find ground dry enough to land on. The direction of the reaches of the river were now determined by compass, and distances estimated from the time and rate made on them. This makes a break in the instrumental survey of about 240 miles. All Slave River was instrumentally surveyed from the mouth to Chipewayan, where the survey was connected with the micrometer survey of the Athabaska, made in 1884.

This paper has reached such a length that very little space can be given to the Mackenzie River. By the course of the river, from the Arctic Ocean to Great Slave Lake is upwards of a thousand miles, nearly all of which is upwards of a mile wide. In this length there are only two rapids, but they are no impediment to navigation. On our way up, we paddled over one of them and did not notice it, the water being so high that even the current over it was not particularly noticable; this one is just above the Ramparts and about 10 miles above Fort Good Hope, which is about 310 feet above the ocean. The other, "Rapid Sans Sault," is 38 miles above this. It only extends half way across the river, and consists of a ripple over a ledge of rock which extends from the eastern shore to about the middle of the channel. On the western side no sign of a rapid is perceptible, and were it not for the noise no one would fancy anything unusual in the river. The Hudson's Bay Company steamer "Wrigley" passes up and down here, and finds less difficulty in doing so than in some other parts of the river. Along the river the country is undulating and covered with timber until we come to this rapid, where the surface is diversified by mountains, which approach to and recede from the river at intervals, up to near Simpson, a distance of nearly 400 miles; here they finally leave, or rather the river, by a sudden turn to the eastward, leaves them, and we see no more mountains on the outward journey until we approach Calgary.

On the afternoon of the 21st July, about 100 miles above Good Hope, I met the Hudson's Bay Company steamer "Wrigley" on her way down to McPherson. This is only an ordinary statement and does not arouse any feeling here, but to me that was no ordinary event—to me that little boat, with the grand old flag flying aloft, was *home*, and all that the word implies. For fourteen months I had been wandering in this dreary wilderness, unknowing and unknown, and now, in the form of that small boat, burst on my view, *home*. I have somewhere heard or read that Payne, who wrote "Home Sweet Home," had no home. Be

this true or not as a fact, I can believe the idea is true, and that only those who feel the dreary aching void that nothing but home can fill, could compose and infuse so much feeling into so few words, otherwise why is the song so universally known and loved. It may seem strange, or you may as a class perhaps better understand my feelings at the moment, and pardon my weakness, but I could not restrain my tears.

I did not make any soundings in the Mackenzie, but the Captain of the "Wrigley" told me the shallowest water he found anywhere in the river was eleven feet, but that cannot be accepted as anything more than that the water happened to be that depth where he sounded—a few rods away it might have deen thrice that depth. The "Wrigley" runs between McPherson—there is nothing to prevent her going to the ocean if necessary—and Fort Smith at the foot of the rapids on Great Slave River, a distance of about 1,300 miles, of which about 140 are in Great Slave Lake.

The rapids at Fort Smith are about 16 miles long, and the total fall in them is about 240 feet. From the head of the rapids to Fort Chipewayan is over one hundred miles, of easy navigation for ordinary river boats. From Chipewayan shallow draught steamers ascend to Fort McMurray—185 miles, Above this the Athabasca is impassable for boats, by reason of numerous rapids which extend up to Grand Rapids, about 80 miles above McMurray.

Above Grand Rapids shallow draught boats can navigate at least 40 miles above Lesser Slave River, or 275 miles above Grand Rapids, and probably many miles farther.

My track, from McMurray out, was up the Clearwater River about 20 miles; thence overland to White Fish Lake; thence by a track never before travelled by white men to Lac la Biche. A rough survey was made of the track and it will appear on future maps of the district.

The language spoken by nearly all the Indians on the Mackenzie is the same as that spoken on the Porcupine and Pelly-Yukon, and so little difference is there, in the different dialects, that the Pelly-Yukon Indians have no difficulty in conversing with the Indians around Peel River. The number of Indians in our territority on both rivers, exclusive of Esquimaux, who properly belong to the coast, is about 4,000. Through the efforts of missionaries, some of them on the Pelly-Yukon, and all on the Mackenzie, are more or less civilized.

This paper has drawn out to a length I did not intend, yet I feel that I have not conveyed half what I wished to.

In conclusion, a few remarks on some of the work will not be out of place. The micrometer measurements on the Lewes, and Pelly-Yukon —when checked by latitude observation were 1 in 61 too long. On the Mackenzie it was somewhat more. In order to determine as closely as possible the longitude of a point near the Boundary, from which it was to be located, a programme, embracing some sixty occulatations of stars by the moon, was arranged by Mr. King, Chief Astronomer of the Surveys Branch, to be observed by him at Kamloops, and by myself at or near the Boundary on the Yukon-Pelly River. Owing to bad weather, at my point, only one of these occultations was observed, and the two lunations through which the programme extended passed without my accomplishing anything.

I then turned my attention to every available method of determining the longitude, more especially moon culminations. This in the ordinary way consits of observing the meridian transit of three or four stars which transit nearly at the same time as the moon and are nearly of the same declination. From the known Right Ascension of the stars and the chronometer times of their transit, and the time of the moon's transit, its Right Ascension is inferred; hence the longitude by comparsion with its tabulation or observed Right Ascension at some standard observatory, or well determined point.

The value of the result by this method depends largely on whether or not our line of colimation is exactly in the meridian, and as the stars observed are nearly in the same declination, the observation itself gives us practically no indication of how much error there may be in our azimuth.

It occurred to me that a just as simple, and much more certain method, would be to combine the ordinary form of observation of star transits for exact time and the moon's transit, and from the observations themselves deduce all the instrumental errors and apply them to the observed time of the moon's transit,

The arrangement was as follows:—Ten stars were selected succeeding each other in Right Ascension, about five minutes apart, and such that the moon transited about midway in the group. Four of these were of nearly the same declination as the moon, four as nearly zenith stars, as possible and two polar stars. The first half of the group and the moon were observed with the telescope clamp east. The telescope was then inverted and other half observed.

From this by the method of least squares the chronometer error,

and azimuth and colimation error of the telescope, at the time of the moon's transit, are deduced and applied to it, so that its determined Right Ascension at transit of our meridian is certain within small limits of error, and of course the resulting longitude is just as certain.

Occultations require a long and tedious computation—or a graphic solution devised by Mr. King which much shortens and simplifies the work—before we observe, and a very tedious calculation, afterwards to deduce our longitude; besides we require to know our chronometer error at the instant of occultation very exactly, and we have one such programme of stars as I have described either immediately before or after occultation—or both is still better—to observe. We have then to deduce from these the chronometer error of the observed instant of occultation, and afterwards compute from the corrected time, as I before said, by a laborious calculation, the longitude. Now the method I advocate reduces the programme of observations to one, and all the preparation required is to select from a good catalogue of star places suitable stars, which you can do in a few minutes by inspection, and the resulting computation is vastly simpler and shorter.

It is curious that Mr. Klotz and myself, though each entirely ignorant of the other's views, and fourteen or fifteen hundred miles apart, each thought of and used this method.

Occultations would probably give more accurate results, but we must recollect that the limit of error of all astronomical methods of determining longitude is much too large for any purpose except a preliminary one, which is of more or less value as the number of observations is large or small. They will certainly never take the place of determination by star transits and electric telegraph. This being the case there is little use in splitting hairs over method, and as this method requires only an astronomical transit mounted in or near the meridian, and a chronometer, and reduces the labor and trouble very much, I would recommend it to any of you who may be required to make such determinations.

I had hoped to show, by way of comparison, the values of longitudes deduced from occultations at some standard observatory during a period of three or four months, and then show my results at the Boundary, but I have been so far unable to obtain the former. I give the results by the method described, and any of you who can obtain a series of values by occultations can judge the relative value of the methods; while doing so it must be borne in mind that of the 22 ob-

servations given only two were taken when the thermometer was above zero, 16 when it was below −30°, 9 when it was below −40° and 2 when it was −50°. The results are given in time west of Greenwich, those on the first limb being given first and those on the second limb afterwards. I would give those on the first limb the greater weight as they were taken early in the evening when my nervous system was in normal condition. Those on the second limb came on after midnight and in the morning when I was somewhat wearied sitting up.

	H.	M.	SEC.
1st limb.....	9	23	35.89
	"	"	24.19
	"	"	28.02
	"	"	23.73
	"	"	21.54
	"	"	27.32
	"	"	33.16
	"	"	29.15
	"	"	30.19
	"	"	27.50
	"	"	37.72
	"	"	30.92
	"	"	32.68
mean	9	23	28.92
probable error.....			3.01
	H.	M.	SEC.
On 2nd limb.....	9	23	40.42
	"	"	44.18
	"	"	52.24
	"	"	46.07
	"	"	39.96
	"	"	45.44
	"	"	39.70
	"	"	44.87
mean	9	23	44.00
probable error.....			2.81
mean of all.....	9	23	36.46

On one occasion the moon was sensibly full at time of transit, and both limbs were observed. The results were :

	H.	M.	SEC.
	9	23	33.16
and	"	"	39 70
the mean of which..	9	23	36 43

is practically the same as the mean of all. Were the moon's altitudes for each observation given it would be noticed that the greater the altitude the greater the resulting longitude. In observing a high transit one is stooped and in an uncomfortable position; besides I was so clothed that it was much more so than if in ordinary conditions of temperature. This may account for the difference with me, but whether any other observer would find the same or a similar difference is a question that can only be decided by trial. It might be, and probably would be found that with an instrument differently mounted I would find different results myself. To illustrate how little does make a difference, I will state that with the moon's mean rate of motion, an error of one-tenth of a second in its observed transit produces nearly three seconds in time error in the resulting longitude.

WILLIAM OGILVIE.

HYDROGRAPHIC SURVEYING.

In taking up the survey of an extensive coast such as the shores of Georgian Bay, the first or chief consideration is the scale on which the work is to be plotted.

This will be governed by the character of the shore, straight or indented, water deep or shallow, the object being to shew everything necessary for the mariner without being cramped for room.

Some old chart can generally be found to give an idea of the nature of the coast, and in addition will serve as a useful diagram for the arrangement of the beacons to be erected, as well as give an idea of the general lay of the land. For the outer coasts of Georgian Bay I have adopted the scale of one to one and a half inches to the nautical mile.

Surveys of harbours and narrow, shallow passages have to be plotted on larger scales.

Having determined upon the scale, the next thing is to find a place suitable for measuring a small base, and a good opportunity is afforded for this while traversing the coast in connection with the main triangulation.

By the time the latter is completed a selection must be made.

Before the members for this Association, to say that we do not waste our time over the measurements of elaborate base lines may sound very shocking.

It must nevertheless be confessed that if we can find a tolerably level spot such as a beach or the head of a bay, some 1,000 to 1,200 feet in length we consider ourselves fortunate, and a day's labour suffices to give us our base.

For an extensive geodetic survey for land purposes, I take it that the measurement of a base cannot be too elaborately done, but in a purely hydrographical survey we act on the principle, to fill in the detail of our work just so correct that the sailor, for whom the work is intended, can detect no error.

Should the Government of Canada ever undertake an elaborate triangulation of its vast territory, it would be good to leave secondary points along the coast at a distance of about five miles apart as opportunity offers. These stations the future hydrographical surveyor

could pick up, and so, save himself the time of measuring a base and perhaps observing for astronomical meridian, latitude and longitude.

Having measured our small base, we proceed to throw as good a triangulation over our projected season's work as the natural features of the coast will permit.

As long a side as possible is calculated and from it the remainder of the stations are plotted.

During the season the latitudes and longitudes of two extreme points are obtained, and by means of these the chart is graduated in the winter in office. The astronomical distance calculated between these two extreme points determines the scale, and should agree nearly with the assumed scale obtained from the small base.

While the triangulation is being carried on, principally by the chief, his assistants are sketching in the coast line in the boats.

This consists in pulling from point to point with a patent log towing astern, the index on the rail of the boat, and offsetting by estimation the indentations when they do not exceed a distance of 100 yards. Over that amount a patent log distance is run from the original line.

Beacons made from the drift wood on the beach are erected about every half mile, and fixed by the main triangulation stations.

A theodolite is set up at all of these minor stations and lines taken to all the salient points, and depths of bays, to check the offsets on the coast line sketch. Any hill-tops, conspicuous falls or other topographical features are cut in. Angles of elevation are taken to the hills, the difference of level being calculated by this angle, and the distance taken off the chart, allowance being made for curvature and refraction.

As most of our bacons are near the water's edge, the height of the eye above the surface is readily measured.

The height of a hill is usually the mean of three or four observations from different stations.

These small stations also serve to fix the boat's soundings, and the inshore ends of the ship's lines, as well as the outlying dangers.

When the coast line is all sketched and all the stations plotted, the next and most important thing of all is to do the sectional lines of sounding, selecting the fine calm days for the boats, and the clear though perhaps breezy days for the ships.

The boat's lines are run about 200 yards apart and at right angles to the general trend of coast, unless the shore runs nearly east and west,

or north and south, when the lines are run in these directions for appearance sake.

The boat soundings are run out to a depth of seven fathoms, or if the shore is very steep, to a distance of 400 yards. This gives the ship safe room to turn in changing her lines.

The officer takes away in his boat a small sheet of the points on the portion of the shore he is to sound. There is one here for your present or after inspection.

He also takes a sextant, station pointer, protracter, tracing paper and pencils not forgetting his pipe and baccy, if a smoker.

Supposing he is dropped by the ship near the outer end of the line he intends to commence on, he first ascertains his whereabouts by a couple of angles to three of his beacons and plots his position; if on the line, well and good, if not he works himself onto his line, and with his boat stationary he takes from his plan the angle which his line makes with some one of his beacons, puts that angle on his sextant and makes a good mental note of the part of the shore the line strikes, pulling for it, keeping some stone, cliff, tree or log on the shore in line with some topographical feature in the back ground, as a peculiar tree, gap, fall or top of a hill.

An experienced eye will always detect *some* range, to check which, every sixth sounding is fixed and the position of the boat ascertained.

When all the sectional lines are transferred to the chart and the soundings inked in, the suspicious coasts are re-transferred back to the boat's board, as you see on the small sheet before you, and are especially examined for the shoalest spot.

This is a general outline of an ordinary trigonometrical coast survey; but on some coasts, as the one we were on last year, viz: the north-east shore of Georgian Bay, there was not a level spot a couple of hundred feet in length to measure a base on.

I had therefore to select a couple of prominent spots mutually visible ascertain their latitudes by north and south stars, also the astronomical bearing and so calculated the distance, in this case about twelve nautical miles.

From this base I worked in the remainder of the stations. In calculating an astronomical distance, knowing the difference of latitude and astronomical bearing, I take the mean bearing for the angle and the difference of latitude for the side of a plain right angled triangle.

The seconds of latitude are brought to feet by multiplying by the number of feet in a second of middle latitude. If the difference of longitude is required the resulting departure is divided by the number of feet in a second of difference of longitude for the middle latitude.

This is a simple rule, and the results differ very little from those by the most elaborate spheroidal calculation. I have worked several examples by both methods, and for hydrographical purpose find no practical difference.

For the sectional sounding of a large shallow bank a long way off shore, we make use of two or three flag buoys. These are put down by the vessel a couple of angles being instantaneously taken by two officers to fix them. These can be fixed by sextant angles to points which from a small boat would likely be below the horizon. With these local stations, in the shape of buoys, the bank is soon sounded If the day continues fine the boats return to the ship, which is hove to in the vicinity, for a few minutes, the sectional lines of soundings are inked in and the boats return onto the bank once more to pick out the plums, in other words to find the shoalest spots which are indicated by the shallowest soundings on the lines. This done the buoys are picked up and new pastures sought.

Given a calm day, these floating beacons serve many useful purposes; as, for instance, to get down the straight shore near Cape Rich, Owen Sound Bay, in 1888.

This piece of coast has nothing opposite it to make a triangulation of but sky and water and is surmounted by high land at the back.

No other way, therefore, was left to get the minor shore beacons down but by floating beacons in such places as we should have preferred seeing islands.

In regard to the excellent hydrographic work done by the United States surveyors, it is as well to mention that the methods adopted by the officers of each nation in sounding a coast differ. In my service we are taught to work on the one-man-do-everything principle.

As far as I know, the boat sounding of a piece of coast by the American surveyors would entail the services of three officers, perhaps four, two in the boat and two with theodolites at the shore beacons to fix the boat by intersecting lines at preconcerted signals. With us the one officer steers his boat, fixes his position, records his soundings, unassisted. We usually sound alternate times in the boats, keeping abreast of each other as well as we can.

It soon becomes evident then if one boat is off her line, as a boat 26 feet long presents quite an object at 200 yards.

If an officer has not had sufficient experience, or is not clever a estimating distances, he has the angle subtended by the other boat, which he can put on his sextant.

Two, or perhaps three, boats sounding together also adds cheerfulness to what sometimes would be a desolate scene, encourages a spirit of emulation among the crews, and in case of accident to one boat there is assistance at hand.

The ship's lines are run by the chief of the survey, assisted by one officer. These lines are from a quarter to half a mile apart, according to the depth. Every second or third sounding is fixed by a couple of angles and the ship kept as nearly as possible on the lines previously ruled.

In Georgian Bay, where there is very little current, with the error of the compass ascertained, a tolerably calm day and a good helmsman, keeping on the line is not a difficult matter. Where the depth does not exceed about 24 fanthoms the ship steams steadly on at about 5½ nautical miles per hour. The sounding machine, with a lead from 25 to 40 lbs. weight attached to it, is hauled out by a traveller, on a wire rope, to the bow of the vessel. It is detached from the traveller by a tripping line when a cast is wanted. The line travels through the hand of a man aft and at a depth of over twenty fathoms, the lead would be fifty or sixty feet astern of the vessel before striking the bottom. An experienced and attentive sounder easily notices the slacking up of the line, which is then brought to the steam winch and hove up.

The bottom of the lead being armed with clean tallow before each cast, the sounder's opinion of the lead being down is corroborated by the nature of the bottom brought up. The interval between the soundings is regulated by an ordinary time-piece with a second-hand.

With a level bottom of twenty fathoms, an interval of three minutes gives a distance of about a quarter of a mile. The soundings are carried off shore as far as the land-marks are visable.

When the soundings are all inked in, and the shoal spots examined, the vessel proceeds to run clearing marks, or ranges as the lake seamen call them, to lead clear of the shoals by daylight.

During the season, the valuation of the compass is obtained at intervals of ten or fifteen miles.

I fear this is a meagre and uninteresting paper, but my brother

surveyors, here assembled, will easily appreciate the difficulty of delivering a treatise on a foreign branch of surveying in the short space of some twenty minutes.

If I have bored the members of this Society, I trust that your indefatigable Sec.-Treasurer will receive his share of censure; for had it not been for his importunity I would not have inflicted myself upon you.

J. G. BOULTON,
Staff Commander, R. N.

In order to illustrate his paper Commander Boulton exhibited the boat's sounding sheets, on which the work is laid down while in actual progress; also a chart of the season's survey, complete in every respect, and ready to forward to the Admiralty to be copied and printed for publication. These records of the survey were examined by the meeting with much interest.

THE RAILWAY BELT IN BRITISH COLUMBIA.

Looking over the statutes I find the following references to lands dependent upon the position of certain railways.

In the Statues of Ontario, 52 Vic., Chap. 35, Sec. 4, we find.:—

"Whereas the construction of colinization railways will promote the settlement, and increase the value of certain unsettled lands of the Province; and whereas it is desireable that a portion of the said lands should be set apart and sold for the purpose of forming a fund to recoup the Province in respect of moneys expended in aiding railways—there is hereby set apart for the purpose of being sold and the proceeds applied to form the fund aforesaid—a tract of land at least ten miles in width on each side of the lines of railways to which aid is granted, as aforesaid, or on each side of the lines of the said railways, as the same may be finally located and established."

It will be noticed in the above that the lands appropriated for railway purposes remain vested in the Government, that is, are not granted to the Railway Company, and furthermore that it is optional with the Government to extend the limits of such lands beyond ten miles from the railway, and hence there is no definite limit to the "railway belt" as we will find it to be the case in British Columbia.

In the contract and agreement made between the Dominion of Canada and the Canadian Pacific Railway Company, amongst other things the Company was granted 25,000,000 acres of land. 44 Vic., Chap. 1, Sec. 11, says:— "The grant of land hereby agreed to be made to the Company, shall be so made in alternate sections of 640 acres each, extending back 24 miles deep, on each side of the railway, from Winnipeg to Jasper House, in so faras such lands shall be vested in the Government,—the Company receiving the sections bearing uneven numbers....."

Although the above description lacks precision and accuracy yet its obvious intention is that the Company is to receive lands within 24 miles of the railway. The lack of precision alluded to is that as there will be very many fractional uneven numbered sections along the 24 mile limit, no provision is made for the grant thereof as fractional sections, although by another part of the same section the Government

may grant lands outside of the 24 miles to the Company, in order to supply, or partially supply, any deficiency of the 25,000,000 acres.

In passing, the inaccuracy may be referred to: it is, in stating "in alternate sections of 640 acres each." This, according to our surveys, is an impossibility; better it would have been to have said, "in alternate sections of the system of Dominion Land Surveys."

But to return to the apparent limit of the 24 miles. By the subsequent part of the above section, the limit is practically obliterated, so that there can be no occasion for determining or establishing such limit on the ground.

The only definite limit of a railway belt in Canada, so far as known to the writer, is that of British Columbia.

We have in Article IV, paragraph 2, of the Convention between Great Britain and Russia in 1825, a belt (South-eastern Alaska) somewhat similar in its conditions to the railway belt in British Columbia, in "That wherever the summit of the mountains, which extend in a direction parallel to the coast, from the 56th degree of north latitude to the point of intersection of the 141st degree of west longitude, shall prove to be at the distance of more than ten marine leagues from the ocean, the limit between the British possessions and the line of coast which is to belong to Russia, as above mentioned, shall be formed by a line parallel to the windings of the coast, and which shall never exceed the distance of ten marine leagues therefrom."

By the Imperial Order in Council of May 16th, 1871, British Columbia conveys to the Dominion in trust ".....not to exceed 20 miles on each side of said line" (railway line).

"Twenty miles on each side of said line" is a simple and unequivocal description of the railway belt; its demarcation on the ground, however, irrespective of mountains, is by no means so simple.

In 1885 and 1886 the Dominion Government had an accurate azimuth survey made of the line of the railway through British Columbia. This survey was adjusted to the astronomic determinations of latitude and longitude at Port Moody, Kamloops, Revelstoke and Field.

From this adjustment resulted the position of the railway with reference to the net of section, township and range lines of Dominion Lands projected over the railway belt, and hence the position of every point of the line of railway from the nearest section lines became known

For uniformity of descriptions of points, the north and east limits of section in which the point lay were used as reference lines, instead of the nearest section lines.

The foregoing furnished the data for the computation of the limits of the railway belt.

The first step in the latter computation was to ascertain the position, with reference to the system of Dominion Lands, of the extremity of the radius of 20 miles, extending from and at right angles successively to the courses of the railway, and at the beginning of each course.

From the azimuth of the chord of the line of railway was obtained the direction of the 20-mile radius. This was then resolved into its equivalents of latitude and longitude in terms of townships, sections and chains; and ranges, sections and chains respectively, due regard being had for the curvature of the earth.

From this long and tedious computation evolve a series of points referred to the co-ordinates of Dominion Lands. Many of these points will fall, however, inside of the railway belt, although distant 20 miles from the particular point of the railway line from which they have been computed.

The railway belt resolves itself into this: "that tract of land lying on each side of the line of railway, the distance from any point on the limit of said tract to the nearest point in said line of railway shall not exceed 20 miles."

When we take into account the curving of the railway, a little consideration will show that the extremity of a 20-mile radius at right angles to the railway will not necessarily give a point on the limit of the railway belt.

The railway belt is the area covered by a radius of 20 miles moving at right angles to the line of railway on each side thereof; but in following the various curves the radius is continually swaying backward and forward, in the general forward motion; thereby making complicated intersections on the limits of the railway belt.

These intersections must be computed ere surveyors can be sent to establish the limits on the ground.

There are very nearly 6,000 positions of termini of radii to be computed for the railway belt in British Columbia, corresponding to half that number of azimuth stations along the railway. As an illustration of how the position, in terms of the Dominion Lands, of the extremity

of the 20-mile radius is determined, the following example is given: As data we have the position of the azimuth stations of the railway referred to the system of Dominion Lands.

BOUNDARIES OF TWENTY MILE BELT.

K = 1600 CHAINS.

Station.	Bearing of Radius.	K Cos Z	2nd Corr	K Cos Z –Corr.–	K Cos Z +Corr.–	K Sin Z
121	347°.86	1564.26	0.22	1564.04	1564.48	+336.30

The first step is to convert the 20-mile radius of given azimuth, column 2, into its equivalent in chains of latitude and longitude, columns, 3 and 7.

It is obvious that the latitude ordinate in the right angled triangle projects beyond the parallel of latitude passing through the extremity of the 20-mile radius when the azimuth of the latter lies between 270° and 90°, and when that azimuth lies between 90° and 270° (reckoning from north through east) the ordinate does not reach the parallel, hence a correction is necessary to bring the ordinate to the parallel. This correction to the parallel, marked Corr. in column 4, is obtained from the formula:

$$\text{Correction} = \cdot 00000196\ (K \sin Z)^2$$

in which K = 1600 chains (20 miles)

Z = azimuth of radius.

Column 5 KCosZ–Corr.– gives the meridian ordinate to the north.
" 6 KCosZ + Corr.– gives the ordinate to be measnred south.
" 7 KSinZ is made + when to the west, and – when to be east.

The following is an explanation of the nineteen columns of the Computation Sheet:

Column 1. Gives the number of the azimuth survey station on the line of railway.

" 2. Expresses in chains the meridian ordinate to the north.

Column 3. In this T., S. show the nearest number of townships and tiers of sections greater than K Cos Z – Corr., and Ch. shows in chains the excess of T., S. over K Cos Z – Corr.; or in other words, how far the northern extremity of K Cos. Z – Corr. is from the northern limit of the section in the Initial Meridian of such tiers.

" 10. Is the position given in column 9 reduced on the meridian to the Correction Line intervening between Q and the station.

" 11. Gives the jog on the Correction Line at the reduced position of the station.

" 12. Gives the position of the station referred to the north (or south) side of Correction Line.

" 13. Gives the convergence of meridians for the distance expressed by chains in the last column to bring it to Q.

" 14. Is the addition of the last two columns and gives the position of Q in ranges, tiers of sections, and chains on the parallel of Q west from the Initial Meridian. The point Q is on the meridian of the station and distance from it K Cos Z $\mp$ Corr.

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TWENTY MILE BELT COMPUTATION—BRITISH COLUMBIA.

NORTH SIDE.

Station No.	K. Cos. z. —Corr. Ch.	T.,S.,Ch.	Station. T.,S.,Ch.	Q. T.,S.,Ch.	K.Sin. z. Ch.	Converg. Ch.	R.,S.,Ch.	Station. R.,S.,Ch.	Station reduced to Corr. Line.	Jog. Ch.	Station reduced to Corr. Line.	Converg. Ch.	Q. R.,S.,Ch.	Point in R.,S.,Ch.	RESULT. S.,T.,R.	Mer.	Northing Ch.	Easting. Ch.
121	1564.04	3-2-45.96	27-6-48.99	31-1-14.42	336.30	—1.13	0-4-11.17	18-0-22.01	18-0-21.88	67-16	17-5-36.03	—.01	17-5-36.02	18-3-47-19	4-31-19	5	14.42	47.19

the Initial Meridian of such tiers.

" 10. Is the position given in column 9 reduced on the meridian to the Correction Line intervening between Q and the station.

" 11. Gives the jog on the Correction Line at the reduced position of the station.

" 12. Gives the position of the station referred to the north (or south) side of Correction Line.

" 13. Gives the convergence of meridians for the distance expressed by chains in the last column to bring it to Q.

" 14. Is the addition of the last two columns and gives the position of Q in ranges, tiers of sections, and chains on the parallel of Q west from the Initial Meridian. The point Q is on the meridian of the station and distance from it K Cos Z ∓ Corr.

of the 20-mile radius is determined, the following example is given: As data we have the position of the azimuth stations of the railway referred to the system of Dominion Lands.

BOUNDARIES OF TWENTY MILE BELT.

formula:

$$\text{Correction} = \cdot 00000196\ (K \sin Z)^2$$

in which K = 1600 chains (20 miles)

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Column 5 KCosZ–Corr.– gives the meridian ordinate to the north.
" 6 KCosZ + Corr.– gives the ordinate to be measnred south.
" 7 KSinZ is made + when to the west, and – when to be east.

The following is an explanation of the nineteen columns of the Computation Sheet:

Column 1. Gives the number of the azimuth survey station on the line of railway.
" 2. Expresses in chains the meridian ordinate to the north.

Column 3. In this T., S. show the nearest number of townships and tiers of sections greater than K Cos Z – Corr., and Ch. shows in chains the excess of T., S. over K Cos Z – Corr.; or in other words, how far the northern extremity of K Cos. Z – Corr. is from the northern limit of the section in which the extremity or point is situated.

" 4. This gives the position in latitude, expressed in terms of the system of Dominion Lands, of the azimuth survey station on the railway. The S indicates the tier of sections, beginning at the south side of the township in which the station is situated, and the Ch. the number of chains it is distant from the north side of the tier of sections.

" 5. Is the addition (or subtraction) of the two preceding columns. If the sum of the chains is greater that 80.50, 80.50 must be subtracted and S reduced by one section.

" 6. Expresses in chains the easting or westing of the radius from the station on the railway.

" 7. Expresses in chains the convergence of meridians, obtained with argument—distance of Q from base line and argument K Sin Z.

" 8. Is the addition of the two immediately preceding columns, and expressed in ranges, tiers of sections and chains.

" 9. Gives the posi ion in longitude of the station on the railway, in terms of ranges, tiers of sections and chains, west of the Initial Meridian of such tiers.

" 10. Is the position given in column 9 reduced on the meridian to the Correction Line intervening between Q and the station.

" 11. Gives the jog on the Correction Line at the reduced position of the station.

" 12. Gives the position of the station referred to the north (or south) side of Correction Line.

" 13. Gives the convergence of meridians for the distance expressed by chains in the last column to bring it to Q.

" 14. Is the addition of the last two columns and gives the position of Q in ranges, tiers of sections, and chains on the parallel of Q west from the Initial Meridian. The point Q is on the meridian of the station and distance from it K Cos Z $\mp$ Corr.

Column 15. Is the addition of columns 14 and 8, and gives the position (in long.) of the point or extremity of the radius on the belt limit.

In the example given, the interpretation of column 15 would be:—the point is distant from the Initial Meridian, measured west along the parallel of the point, 18 ranges 3 sections and 47·19 chains, hence the point is in the fourth tier of sections in Range 19.

We have now the position of the extremity of the 20 mile radius expressed in latitude by giving the number of townships and tiers of sections from the First Base Line or International Boundary, and besides, stating the distance in chains from the northern limit of the last tier of sections;—and expressed in longitude by giving the number of ranges and tiers of sections from the Initial Meridian, and also the number of chains that the point or extremity of radius is west from the west limit of the last mentioned tier of sections. Hence nothing remains to be done but to combine these expressions and give the distinctive number of the township, of the range, and of the section of the system of Dominion Lands in which the point is situated.

The township number, as given in column 5 for Q, will be the same for the extremity of the radius; the number of the range will be greater by one than the number of ranges given in column 15, for as the point is a certain number of ranges and sections west, it follows that it must be in that range of the Dominion Lands expressed by the number greater by one than the number in column 15.

The number of the section is found by knowing the horizontal and vertical tiers of sections in which the point lies, counting from the south and east of the township respectively.

Column 16. This gives the particuiar section, township and range in which the point or extremity of the radius is situated.

" 17. Is the Initial Meridian from which the ranges are numbered westward.

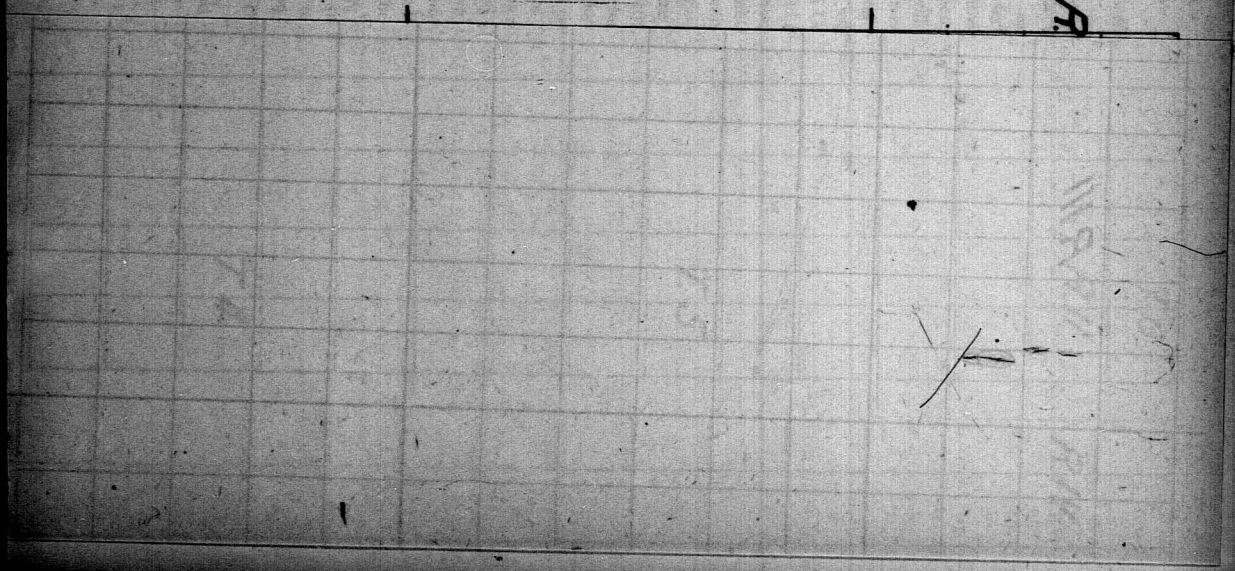
(The Initial Meridians, to which the railway belt of British Columbia is referred are the 5th, 6th and 7th, corresponding to the meridians of 114°, 118° and 122° west longitude respectively).

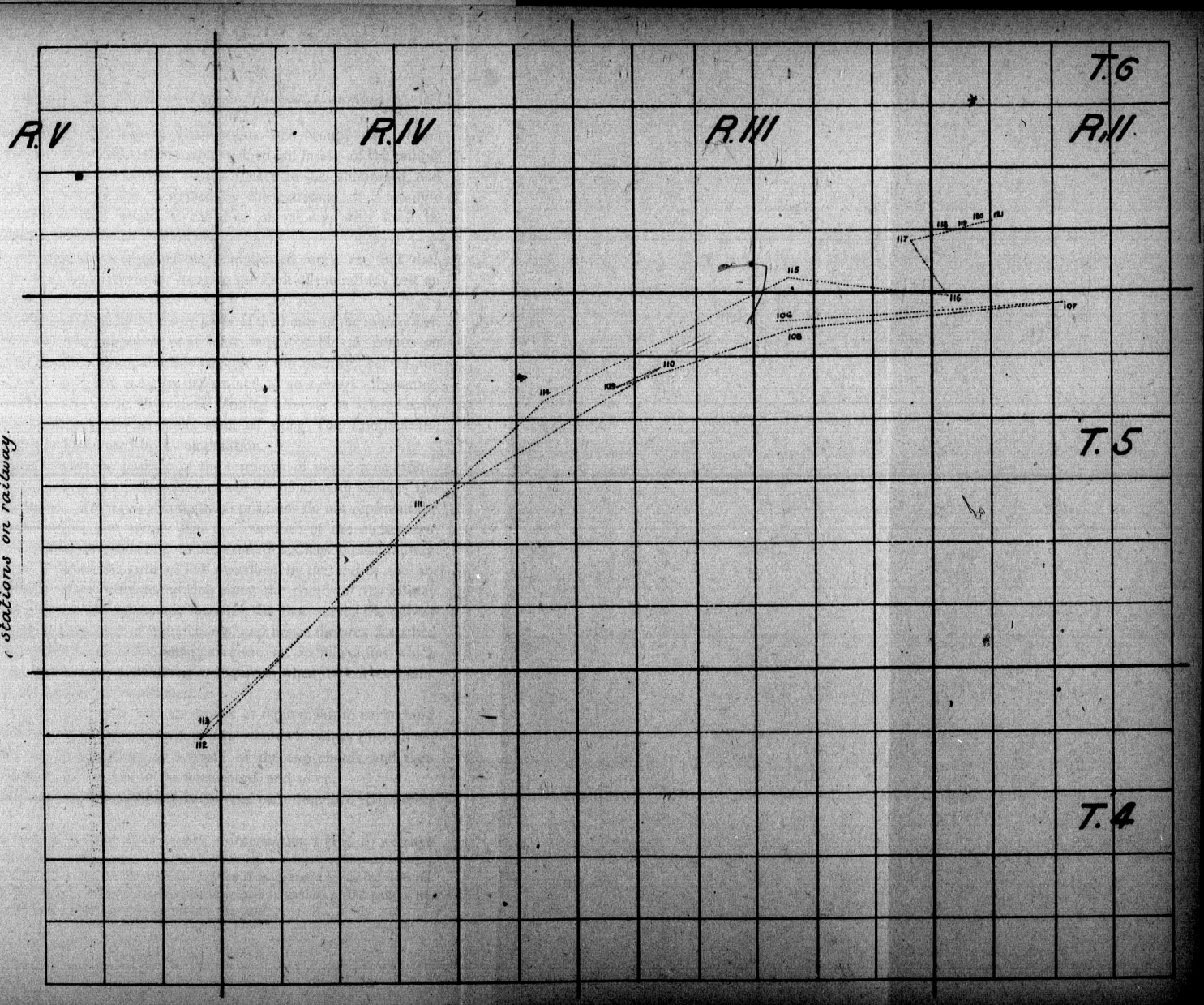
" 18 Is the distance of the point from the north side of the section.

" 19 Is the distance of the point from the east side of the section.

FIG. 1

Positions of termini of 20-mile radii from azimuth stations on railway.





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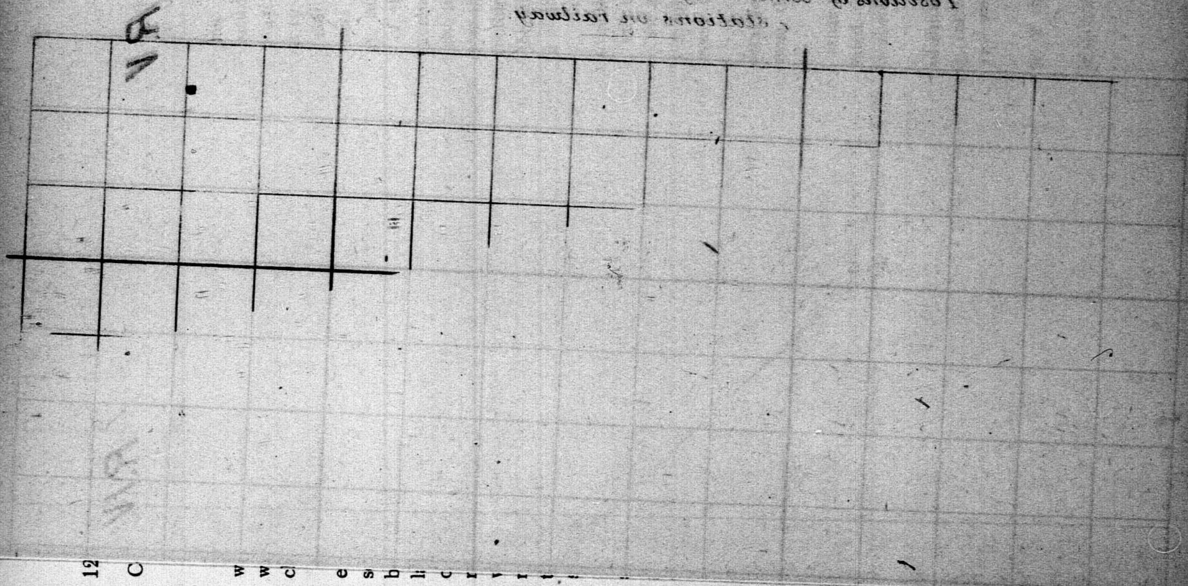


The computation of these 6000 points will occupy one person nearly a year. Thereafter, those points which fall inside of the railway belt, for reasons already pointed out, will have to be eliminated, and the intersections of the line, described by the extremity of a 20-mile radius moving at right angles to the line of railway, with itself be determined,

This will again entail considerable complicated work ere full data can be given to the surveyor for locating the limit of the railway belt on the ground.

There will undoubtedly be many parts of the limits of the railway belt in British Columbia impossible or at least impracticable to define on the ground from the mountainous character of the country, yet in the computation every point must be determined, as no *a priori* elimination of any point can be made. By careful plotting however on a large scale some prominent and obvious points, such as along The Loop in the Silkirks, can be eliminated from computation.

Figure 1 shows the position of the terminus of the 20-mile radius, on the north side of the railway, from each of the azimuth stations 106 to 121 inclusive. The lines joining these positions do not represent the path of the radius, but simply join the positions of the consecutive computed points, corresponding to the azimuth stations on the railway.

Figure 2* shows the path or line described by the end of the 20-mile radius or rather ordinate, moving along the chords of the railway as surveyed in the azimuth survey thereof. In that survey the railway is laid down as composed of finite chords, and hence the arcs described by the radius will be all of the same curvature, *i.e.* 20-mile radius, which will not be the case, as we shall see in Figure 4, when the curves themselves of the railway are considered.

In Fig. 2 the 20-mile ordinate moves at right angles to each chord on the railway; at the intersection of two chords it swings through an arc equal to the difference in azimuth of the two chords, and then moves again at right angles to the next chord, and so on.

This swinging of the ordinate causes the path described to intersect itself.

To find for instance such a point of intersection I (Fig. 2) we have

* In Figs. 2, 3 and 4 the scale for railway is exaggerated compared with the 20-mile radius, so as to show to better advantage the intersections of the path of the ordinate with itself.—The dotted lines indicate the path.

given FF′ = FG, GG′ = GH, and the angle FIG′ = FGH, quantities all known from the railway traverse, hence

$$IF' = IG = R \text{ Cot } \tfrac{1}{2} I .$$

(I being equal to the difference in azimuth between the chords, and R = 20 miles = 1600 chs.) therefore $FI = FF' - R \text{ Cot } \frac{1}{2} I$.

It will generally be found that the point of intersection (I) falls behind F, that is on F′F produced, R Cot½ I being generally greater than any chord of the azimuth survey, whence

$$FI = R \text{ Cot} \tfrac{1}{2} I - FF'.$$

In the latter case the intersection of the tangents IF′ and IG falls *outside* of the 20-mile limit, as shown in Fig. 3. Hence the position of I′ on the limit must be determined.

IF becomes known as shown above.

$$\frac{IF}{FS = R} = \text{Cot SIF}$$

hence I′Io is known, being equal to I − SIF,

$$SI = \sqrt{(IF^2 + R^2)}$$

therefore in triangle I′IS are known the angle I′IS and the sides I′S and IS, whence I′I becomes known, and hence also the arc I′o, and similarly the arc FO.

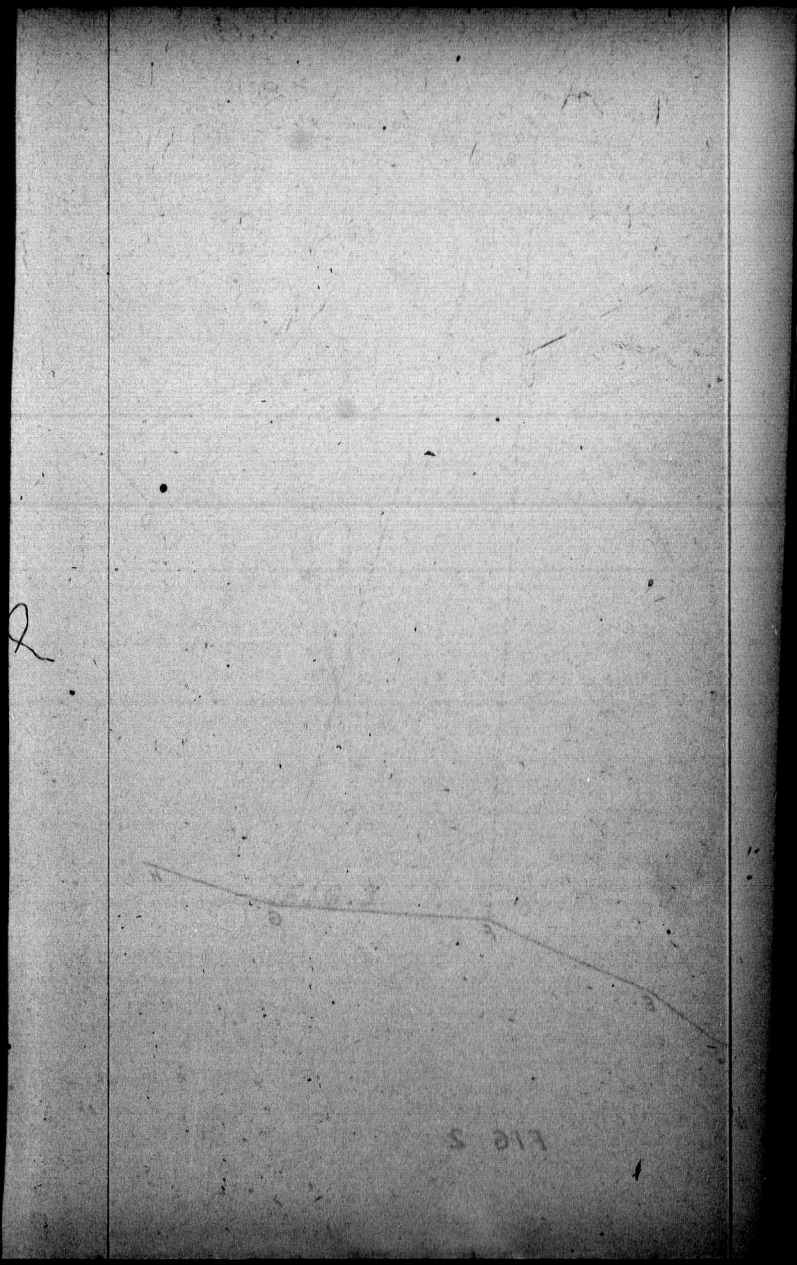
Having the arc FI′ in angular measure with radius of 1600 chains, the arc is readily reduced to linear measure too, which gives us the desired quantity to measure from the known point F′, or from the preceding known position of E (Fig. 2).

Figure 4 shows the theoretic path described by an ordinate of 20 miles to the railway, following the curves and not the chords thereof as in Figure 2.

The 20-mile ordinate resolves itself into a radius of 20 miles ± radius of corresponding railway curve. This is obvious from the figure (4). It will be found that the path described by the extremity of the 20-mile ordinate, when equal to 20 miles minus radius of corresponding railway curve, will fall *within* the belt limit, and hence the curvature of the limit is that of a radius equal to 20 miles plus radius of corresponding railway curve. This holds too for the case of a tangent on the railway, when the radius will be infinity.

After the computations have been made as indicated, the necessary data for the surveyor in the field will evolve.

To define the belt properly its limit should be laid down as in



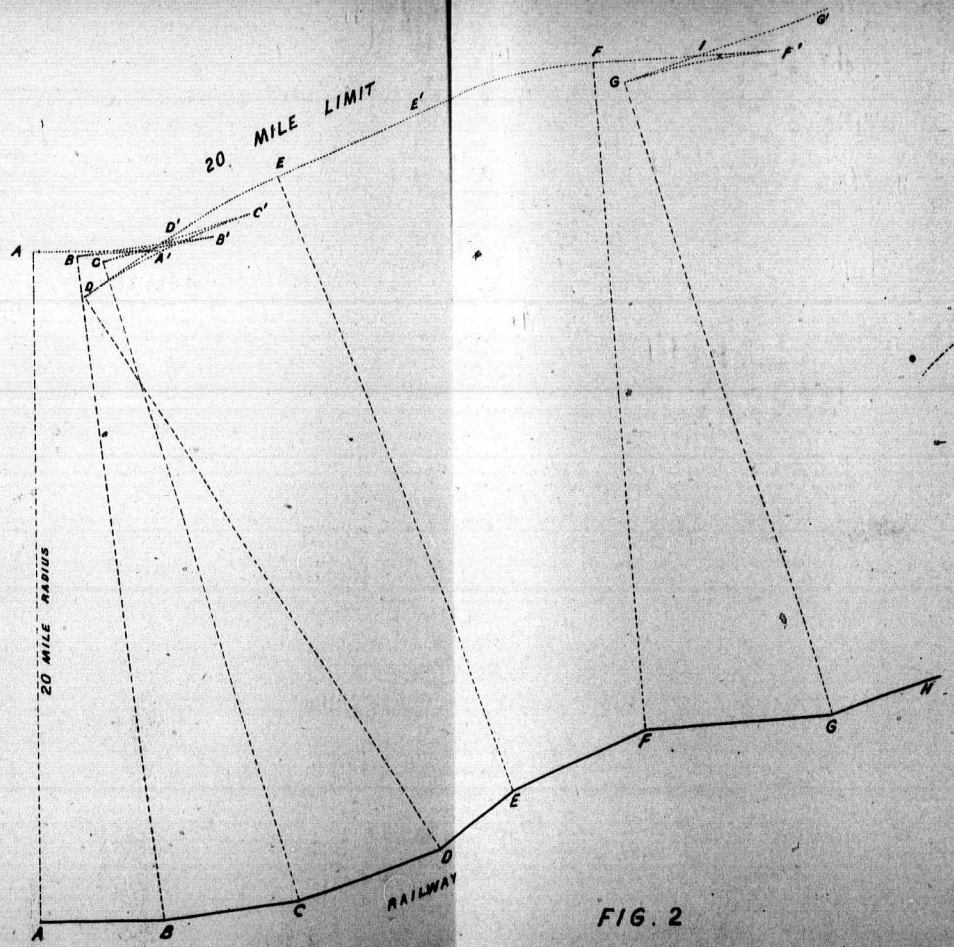


FIG. 2

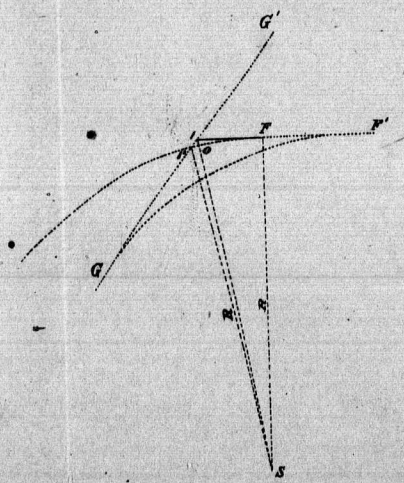


FIG. 3

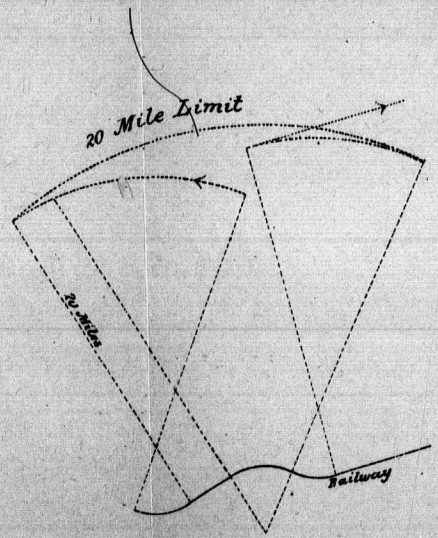
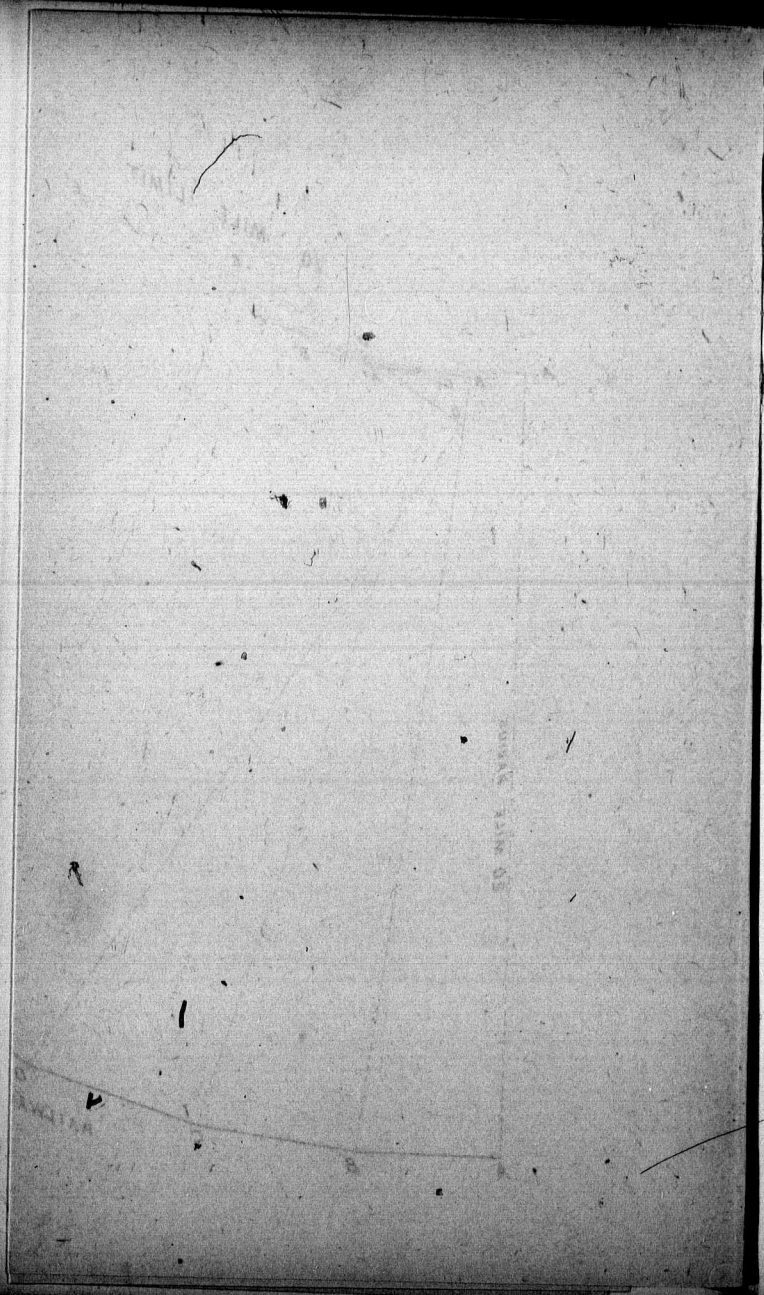


FIG. 4



railway surveys, by drawing chords of the respective curves and for such distances as indicated by the furnished data.

The British Columbia Railway Belt has furnished, I think, the most intricate and longest computation that has so far occurred in connection with Dominion Lands.

OTTO J. KLOTZ.

[Mr. Klotz illustrated his paper by diagrams on the blackboard.]

PLANS AND FIELDNOTES OF SURVEYS OF DOMINION LANDS

MR. PRESIDENT AND GENTLEMEN,—

It was with some hesitation that I agreed to read a paper before you, not being able to add to my name the honorable letters "D.L.S." and therefore not being a full member of the Association. However, I have thought that a few notes on the subject of what we usually call "returns" might not be unacceptable. It has been my lot to see a good deal of the returns of Dominion Lands Surveys: in fact, I believe all such that have been made have passed through my hands, and in a large proportion I have had the task, not always a pleasing one to a sensitive mind, of hunting for mistakes.

When a survey has been made, there are two results, two records of it, remaining; one consists of the posts and other marks on the ground; the other is the subject of this paper, the plans and notes stored in the Department of the Interior. The latter is, I venture to think, the more important of the results of the survey, though surveyors who have come in after a long spell of hard work in the field are rather apt to undervalue the importance of the returns, and to look down upon office work as something that any fellow can do.

A few words as to other returns than the final plans and fieldnotes. The *sketches* sent in while work is in progress are valuable as giving early notice of just where surveys have been made, sometimes several months before the final returns are received and enabling us sometimes to improve maps that are about to be issued: and they also serve contract surveyors as a sort of account for advances of money, according to the rule so laconically expressed in the Manual of Surveys "No sketches, no money."

The first progress sketches were drawn on a scale of 4 miles to an inch, corresponding to the scale of the first maps of any importance shewing the surveys. When maps were issued on a six mile scale, the sketches followed suit, but this scale was altogether too small for the purpose. Of late years we have used forms on a one mile scale for subdivision, and two miles to an inch with four townships on one sketch for outlines. The latter it has been recently decided to abandon, so as

to use one form for all surveys. This reduces the number of forms and makes them more easily kept in order when filed away, as well as giving the surveyor a larger scale to work on, which I think will suit him better.

A *timber report* is required for each township surveyor, in very many cases of course only to convey the negative information "No timber." The timber plans were found to be unnecessary, the printed plans shewing the position of bush well enough and giving more information of other kinds.

The *Statutory Declarations* obtained from settlers have developed from the old simple form into quite a catechism. They do not trouble me much, we pass them on for what they are worth, but I fancy the land agents must sometimes be puzzled over the answers. There are still one or two questions that could be added, such as that asked Artemus Ward "Have you had the measles? If so how many?"

The Forms of *Plans and Fieldnotes* have varied only in minor details since the surveys were established, and that so little change has been found needful is a standing tribute to the sound judgment and foresight of the late Col. Dennis, our first Surveyor General of Dominion Lands. The scale of the plans, the method of shewing road allowances with a heavy line on the side surveyed, the title of township plans, the table of contents, the colouring bush swamps, &c.—all these remain as first established and I think it would be hard to suggest any great change that would be an improvement really worth making.

The *Field-books* used for the first ten years were square books, somewhat uncomfortable for the pocket. The system of one section side to a page was adopted at once, and the rest of the form for field-notes has changed but little. The chief differences are that the depth of alluvial soil is called for and that the road allowance must now be ruled in instead of using the one column to hold the distances and represent the road allowance. This had the disadvantage that topography could scarcely be shewn on the road allowance without intefering with the figures for distances. The surveyor was supposed to shew which side of the road was run by ruling a thick line on that side; sometimes he did this, more often perhaps he omitted it. In 1881 a form of fieldbook for sub-division surveys was issued, having the headings of the pages all ready printed, the road allowances ruled in, the section numbers given at the sides of the pages and the skeleton index filled up. This at first sight appeared to be an improvement, but it

turned out to be a great source of errors and trouble. If a township happened to be all prairie and the surveyor ran his lines in the order prescribed, it was all right: but there are a large proportion of townships where the order of running the lines cannot be adhered to, and even when it is possible, the surveyor often finds that he would lose much time by doing so.

The instructions for sub division in the first edition of the manual gave this order for running the lines. In the first system of survey where the meridians are made parallel to the eastern boundary, there was perhaps more reason for begining at the N. E. corner of section 35 or the S. E. corner of 2 than in the later systems, but it was always hard to insist on a matter which was not of vital importance.

With the form of fieldbook I am speaking of, if the lines were run in any other order, or in different directions to those intended, endless confusion arose: the heading, the road allowance, the section numbers, all had to be altered. The consequence was that this form of fieldbook quickly disappeared and about the only trace left of this experiment in our present form is the division of the centre column by dots for the tallies. These dots certainly make the page neater, when there are but few notes to insert, and perhaps are an assistance to the chainman in remembering to enter the tallies; but when there happen to be many notes to enter within a few chains they are apt to be crowded together and made indistinct in putting them into the three-qurters of an inch allotted for ten chains of the line, and for this reason I have serious doubts whether they would not be better omitted. Another form of fieldbook which was but short lived was for outlines. It was rather clumsy to handle and had the page ruled in green squares, like section paper, with the intention that the topography should be sketched in approximately. This form could not be said to work well; it is hard, I suppose, to get a chainman who will take the trouble to plot carefully on the squares in the field, and I must say I should not like to have to do it when the flies were buzzing round in summer, or when the winter breezes were blowing. Anyone who has had to take notes with half frozen fingers knows that the simpler and easier they can be made the better.

Our present form for a page of field notes, the same for outlines as for subdivision, has this great advantage of simplicity; and "simplicity is the essence of perfection," a motto which has often recurred to my memory since I heard it from my first teacher in surveying, himself

entitled to be called a D.L.S. though I doubt if he knows it, for it is thirty years or more, I believe, since he was in Canada. There is also a fieldbook with the alternate pages prepared for triangulation, data and corrections for slope and temperature of chain. These were for block surveys ; but the days of block surveys seem to have departed, perhaps never to return.

Now let me say a few words on one or two little matters in the fieldbook and the various ways in which they are put in.

The *class of soil* is entered as 1st, 2nd, 3rd or 4th. This is rather a rough way of estimating its value, and liable to considerable variation from the personal equation, so to speak, of different surveyors ; what is one man's 1st class is another's 2nd. Still I suppose it answers the purpose. Now and then we find attempts made to improve on it. One surveyor added a 5th class to express something worse than the worst ; this evidently destroys the value of the series ; we might go on then to class six and class four would become by comparison quite respectable. Another gentleman once inserted decimal fractions, such as class 2.5 or 3.7 but such refinement, I fear, is wasted ; it reminds me of the Hindoo musicians who they say can distinguish eight musical notes between two notes of our scale, though one would not expect such acute musical feelings from the sound of their toms-toms. Yet another gentleman gave some o soil in his notes, but whether this was rather superior to first class, as one versed in algebra might think, or whether it meant there was no soil at all, I am not able to say. Perhaps it is the equivalent of a description which occurs on one page of a fieldbook on record, "Land no good except for a fine view from the top of the hill." Land prospectors are not usually in search of the picturesque, and very likely the fine view is still open for settlement.

The *depth of alluvial soil* is, of course, only expected where pits have been dug, but it is sometimes entered "Through bush, through briar, through flood, through fire." I remember the depth of 48 inches of alluvial soil being given over a large extent of mostly timbered country and on the surveyor being questioned on the matter he maintained that he knew it was 48 inches everywhere.

The Manual allows certain *abbreviations* to be used in the fieldnotes and no others. This matter of abbreviations is occasionally a cause of trouble. It becomes wearisome to write the same words over and over, page after page ; it is necessary, however, that the use of

abbreviations should be strictly limited; the habit is apt to grow on one. After writing "Scattered tamarac" a few times, one feels inclined to reduce it to "Scat. tam." and further on in the book perhaps to "S.T.," but we must remember that a book of fieldnotes is not often read straight through, like you read your Bibles. It is frequently only one page that has to be referred to, and this page should be quite complete in itself and able to stand alone. We had before now to write and ask a surveyor what was the meaning of "B. and S. Will. Pop." The "S." has been known to pop certainly, but it turned out to be "Brush and shrub, willow and poplar."

We find in the office that the most fruitful source of errors is carelessness in copying the fieldnotes; a very large part of the trouble with returns comes from this. I have heard such an expression dropped (in the days of 15 per cent. bonuses) as "I got them in in time anyhow, if there are mistakes I suppose you will find them." If a mistake is made in copying the notes and the plan is made to agree it is obvious that in many cases we cannot discover anything wrong. Allow me to suggest that the plan should be plotted from the original notes, not from the copy, or at least checked with the original notes before sending it in. Do not trust to your young friends, pupils or others, and think they will make returns all right for you; they won't. A good look over the copied notes by the surveyor would save many an error which he has to correct afterwards and many also which now go on record and may rise up some day from their tombs in the Eastern Block, bringing trouble and discredit with them. The surest way of checking over a fieldbook is to take one thing at a time. Look all through the book at the headings of the pages to see that they are correct, then check them with the index. Look through again at the dates, again for the class of soil and so on. One of the commonest errors found is that different pages do not agree in the description of a corner, especially where there are bearing trees; this, of course, is usually an error in copying.

One point on which it has occurred to me that we do not get nearly enough information is as to "High water marks." In a country like the North-West Territory it is of great importance to know, not only where water is now standing, but where it has been and may be again. A vast amount of trouble and expense would have been saved to the Government and to private persons if surveyors had taken the trouble to keep better record of old water lines.

The *Reports* are an exceedingly valuable part of the returns. The

general reports sent in by outliners should give a description of each township side separately, giving the class of soil, 1st., 2nd., etc., so that these reports can be combined together to give some idea of the nature of a township before its sub-division and assist in making a fuller general description of the township after its survey. Many of these reports, as well as those of other surveys, are excellent specimens of what such reports should be; in some cases, however, there must be a good deal of useful information in the the surveyor's possession which he does not seem to think of giving to the world. Almost any facts that can be given may turn out to be of value, especially if the facts are carefully noted and precisely stated. It is very well to say a place is stony, for instance, but what sort of stones? It is all right to say there is plenty of water, but is it good water? In the mention of trees, brush, grasses and scrub, in the mention of rocks, boulders, gravel, etc., I think surveyors might often supply many more useful details than they do as a rule. It is not to be expected that every surveyor will be a botanist, but he should be able to distinguish between different species and varieties of pine, oak, poplar, etc., and give the country the benefit of his knowledge. If the scientific names of some of the trees could be given as well as their popular names it would add greatly sometimes to the real value of a report; the popular names vary, as you know, in different parts of the country. It is true that but few persons reading the report know any difference between one variety of a tree and another, but the scientific names being given would enable them at any time to be referred to those who do know for identification. It is not to be expected that every surveyor will be a mineralogist, but he might and should know the common rocks of the region he is working in and the ordinary minerals found their or to be expected, and he should have some idea of the geology too.

To come to *plans*. In 1872 when I entered the then recently established Dominion Lands office there were no blank forms for plans, and the work done in 1871 was represented in a very miscellaneous manner. I well remember the tedious business of replotting from the notes and making uniform plans, the road allowances, section numbers, titles, everything to be done by hand on each plan. This could not last long and by the next season we had blank township diagrams. These were at first printed in three forms, marked A, B and C, one for townships on a base line, another for those north of a correction line, and yet another for townships south of a correction line. It was soon

found, however, that the variations in the lengths of lines on the forms due to unequal stretching of the paper would exceed the differences usually shown by the lengths found on the ground, and it was also difficult to get a surveyor to make the plan on the proper form where the difference was so slight. After that first issue the forms were made the same for all townships. It is by trying such experiments as this, rejecting those that turn out unprofitable and retaining those that are found good, that a system is gradually improved, and it is not, I think, altogether uninteresting to look back occasionally over the path we have come and review some of the abortive experiments.

Perhaps it would surprise some gentlemen to know the number of forms for township plans that are now in use. In the case of original township plans, for which we send the forms to surveyors, there are four varieties—old system, new system, British Columbia Railway Belt and New Westminster District, where the Provincial system is retained; but five other forms are needed in the office for compiling plans, and even then sometimes we cannot find one to suit. A great part of the plans now have to be compiled before they can be printed; in some of the townships in British Columbia the work of from six to ten different surveyors has been used on one plan.

The colors used are green for bush, blue for water, brown for brulé, yellow for swamp and red for cultivated land. In the office we use for bush Hooker's Green No. 2, which is a good color, easy to lay on and permanent on paper. On tracing cloth, however, the yellow ingredient runs after a time; on old tracings we often find that there is a slight tinge of yellow a long way round a patch of bush and what should be green has become pure blue. For water we use Prussian blue, for brulé burnt sienna, for swamps gamboge and for cultivated land carmine. These colors are all easily obtained, good to work with and transparent. Opaque colors, such as emerald green, are objectionable for our purpose, obscuring the printed lines and being hard to work over with a pen.

Roads are best shown by a double dotted line, this is generally unmistakable, but if they are shown by a single dotted line "Road" or "Trail" should be written on them.

Buildings are usually indicated by solid black specks, but these need to have "House," "Stable," or whatever it may be written against them; otherwise in the summer time a few able-bodied flies may add buildings to the township faster even than the gentlemen who are said

to jump claims with portable residences. A railway is best represented by the well-known line crossed by ties; this should not be used, as it sometimes is, for a mere railway survey line found on the ground.

Hills can be shown best by etching with the pen, the top of the hill being made the heaviest part. To make them look well requires considerable practice at that sort of work, but I cannot suggest anything easier. Of course hill work can be done much more quickly with a brush (in sepia, neutral tint, or some other color) and if nicely done this suits very well for the plans we are speaking of, but it needs some skill and careful handling to work them in so as to agree with the notes and so that their meaning may be clear and they may not interfere with the areas or distances. Of course, if done in this way, the hills, as well as the rest of the coloring, must be put on before the plan is inked. When the hills are etched with the pen they ought to be done later on, so that the hills can be worked round the lettering and figures without confusing them.

As to the *lettering and figures* on township and outline plans, the first essential is that they should be distinct. Fancy lettering of any sort is out of place; good plain italics or "stump" writing are the great standby. There is nothing better for areas and distances, names of rivers and lakes and descriptions of soil, bush, &c.

I have just mentioned *descriptions of soil, &c.*, as being on the plans. In most cases one or two such remarks of only a few words, written across the plan or on seperate portions of it, give the general character of the country sufficiently. It is a waste of trouble to write small notes along the lines, showing slight changes in the nature of the bush or anything of that kind.

Everything on the plans ought to be intelligible without going to the field notes; dotted lines wandering about a plan when you cannot see what they mean are worse than useless. Nothing should be on the plans but what can be found in the notes, at least along the surveyed lines, but the converse of this that everything in the notes must be on the plans is by no means true; to show swamps a chain wide, or to distinguish small belts or clumps of different bush on the 40 chain scale confuses the plan without adding to its practical value.

If you compare one of our printed township plans with the original sent in by the surveyor, you will often find that though it agrees exactly on the lines actually surveyed, there is a good deal of connecting topography inserted between. For instance in your original plan you show

the crossings of a trail on different section lines. We connect these when compiling the subdivision plan with the outlines if we think we can safely do so, making the plan more intelligible, especially to unprofessional persons who seldom understand how much has actually been measured on the ground. In the same way, if we find one creek running into a section and one running out, it is generally safe to assume that these can be joined, and if the creek has regular banks on each side wherever noted on the section lines it is highly probable that the banks continue across the sections. But if one creek runs in and two go out of a section, or two sections between the surveyed lines, we usually have to leave these loose ends where they cross the lines, not knowing how to join them. Now you could do this much better than we can, I was not there, but you were. You remember which way that creek goes; you followed it for a short cut to camp that night the horse was lost; you upbraided that creek for taking such a twist and making you late for supper. Now if you would look over your plan and sketch in some of these connections that plan will be a more accurate representation of the country, and therefore of greater value.

For *Plans of Township Outlines* we have used for some years blank forms the same size as those for township plans, giving 30 miles on one plan—a form for meridian exteriors, one for base lines and one for correction lines. These save a good deal of trouble and are much more convenient to handle and file away than the plans of all shapes and sizes such as we formerly received. Certainly a large plan, giving a whole block or more, gives a better general idea of the country, but the advantages of the small and uniform plans far outweigh any loss in this respect.

I have not yet mentioned the subject of *traverses*. The style of the fieldnotes for section lines is strictly defined, but for traverse notes the surveyor is left pretty much to his own judgment, and perhaps this is as well. The amount of traverse in a township varies so much, and also the nature of it, that an attempt to make the notes more uniform would possibly result in more trouble than it is worth. There is a great difference in the cases of section line notes and notes of traverses, copies of the former are often wanted by various persons, but the notes and plots of a traverse are rarely looked at again after they have been examined and placed on record. The deductions from them, shown by the shore lines, &c., and the broken areas on the plan of the township, are all that is generally wanted for further reference. The Manuel

recommends, without insisting on it, that bearings, distances and offsets should be given in a separate table, and says they *need* not be marked on the plot. I should be much inclined, if it depended on me, to make the instructions read "*shall* not be marked on the plot." I think this way of showing them is a relic of barbarism, which is connected with the old practice of running a traverse as near the shore or other line to be surveyed as convenient and giving no offsets. It is difficult, especially if the courses are short, to give, without confusion, the bearings, distances and offsets, the distances on traverse lines to the offsets and to section lines, and the distances on section lines from corners to the traverses, and yet all this information is wanted. The tabular form is of course an improvement, but in my humble opinion far inferior to regular fieldnotes, with the distance placed in a centre column, the shore lines sketched in and offsets given in their proper sides. If this be done there is no difficulty in showing, when necessary, islands, buildings or other details, with as many offsets and as much description as is required to plot them properly.

There has been a great improvement in the notes and plots of traverses since the early Dominion Lands surveys, but still it is a part of the work on which a little more care would be very well expended. The last two or three courses often shew a feverish eagerness to reach their closing point which they would be spared if their predecessors had been a little more carefully plotted. It is a tedious job checking over long traverse plots at the best, and many a surveyor in want of funds who has grumbled at the time we spent examining his returns would have been merrily paid off long before if he had put this part of his work in better shape. I remember being rather puzzled once over a small lake traverse which, when plotted, sprawled all over the township with something the shape of a boomerang, only it never came back to the starting point as those weapons are said to do, it took a little time to discover that the chaining was continuous all round the lake, and the length I had taken for each course was greater than the sum of all the courses before it.

Liberty has been given the last four years to use a micrometer for traverses in subdivision work. Of this permission very little advantage has been taken, as far as I remember only one surveyor has ever sent in township work in which a micrometer had been used for traversing. Whether it is not so much saving of time and trouble as one would be inclined to think, or whether most surveyors are disinclined to use an

instrument that is not very familiar, or what may be the cause of this probably most of you know better than I do. From my point of view the less micrometer work the better, the notes are awkward to check, especially as no two surveyors keep them quite in the same way; and I do not think that the work will be found to fit in as well as that done with the chain.

I have touched only on the returns of regular surveys for laying out lands into townships and sections for settlement and do not propose to speak of the returns of extensive traverses and explorations of which so many have been made under intructions from the Surveyor General, nor shall I attempt to enter on the subject of mapping, though it is an important part of our office work, and is a natural result of our receiving the surveyors' returns. Already, perhaps, I have encroached too much on your time.

I will close these notes with the hope that I have touched some points of interest which may suggest remarks from some of the gentlemen present, and I trust that the hints I have thrown out will be taken in good part and that any mention made of errors and imperfections in the returns sent in to the Dominion Lands office will not be misunderstood as intended to cast any slur on the members of a profession for which I entertain the sincerest respect, and of the work to which my own is so closely related.

P. B. SYMES

DISCUSSION.

THE PRESIDENT—"Mr. Symes says that he is diffident about speaking before the Association, but I do not think any member is better fitted to make representations on this subject, and I am sure all such will be received in good part."

A. O. WHEELER, to Mr. Symes—"What is stump writing?"

P. B. SYMES—"Italics with square tops, in distinction to italics with round tops. I do not know if the expression is used in this country. It is much more easy than the italics proper."

GRAPHIC SOLUTION OF SPHERICAL TRIANGLES BY THE GNOMONIC PROJECTION.

The object of this paper is to indicate a method of roughly solving spherical triangles by means of ordinary plotting instruments, without using logarithmic or other tables. Any projection or development of the sphere on a flat surface may be used for the purpose; for instance, in Chambers' Mathematics rules will be found for solving spherical triangles by means of the stereographic projection. The projection which I propose to use is the gnomonic projection, which has the advantage that all great circles are projected into straight lines, so that spherical triangles become plane triangles in the projection.

The gnomonic projection is made on a plane touching the sphere by straight lines joining the centre of the sphere with the several points whose representation on the plane is required. For the sake of simplicity one angle of a triangle can be taken as the pole—that is, the point where the plane touches the sphere. Then the spherical angle at this point will be the same as the plane angle, and the two sides of the spherical triangle which meet in this point will become sides of the plane triangle equal in length to the radius of the sphere multiplied by the tangents of the sides of the spherical triangle.

To measure an arc terminated by the pole.

Hence arcs terminated by the pole can be laid down on the projection by means of a scale of natural tangents, and conversely the arcs corresponding to a given line on the projection terminated by the pole can be measured with the scale.

Measure of any line.

Any line of the projection not passing through the pole can be measured in the following manner:—Let A B in Fig. 1 be the line (on the projection) which it is required to measure, *i. e.*, it is required to find the length of the arc of the great circle of the sphere joining the points on the sphere corresponding to A and B. Let C be the pole of the projection.

With centre C and radius equal to the tangent of 45° (as given on the scale of tangents) describe a circle. The radius of this circle is equal to the radius of the sphere; as this circle is used in all the constructions, it will be called, for the sake of brevity, the *unit circle.* Through C draw CE parallel to AB to meet the unit circle in E. Also draw CDF perpendicular to AB and cutting AB in D. With D as

centre and DE as radius describe a circle cutting CD produced in F. Join AF and BF. The angle AFB, which may be measured either with a common circular protractor, or with a tangent scale, is the measure of the arc joining the points of the sphere corresponding to A and B.

Measure of an angle.

As stated above the angle ACB is the same in the sphere as on the projection. To find the spherical angle corresponding to the plane angle CBA proceed as follows (Fig. 1):—

Let CB produced (if necessary) meet the unit circle in L. Draw CG perpendicular to CL to meet the unit circle in G. Draw LM parallel to BA to meet CG in M. Draw MN perpendicular to CM meeting BG in N. Then BN will be the tangent of the spherical angle corresponding to CBA, and the angle can be read off the tangent scale applied to the line BN.

By a reversal of this process the projection of a given spherical angle can be laid down.

Solution of triangles.

Hence, if from the three given parts, out of the six parts of a triangle, three sides and three angles, the projection of the triangle can be drawn, the other parts can be measured by the rules given above.

The problem of solving a spherical triangle is then reduced to the construction, from the three given parts, of the projected plane triangle.

There are then six principal cases, viz.:—

(1) Given the three sides.
(2) Given two sides and the included angle.
(3) Given two sides and an angle opposite to one of them.
(4) Given two angles and the included side.
(5) Given two angles and a side opposite to one of them.
(6) Given the three angles.

But since any one of the angles may be taken as the pole of the projection, and for particular reasons the choice of the polar angle may be restricted, there are several sub-cases; these are—

Case (2) If two sides and the included angle are given,
- (*a*) The included angle may be made the pole.
- (*b*) One of the other angles may be made the pole.

Case (3) If two sides and an opposite angle be given,
- (*a*) The given angle may be made the pole.
- (*b*) The given sides may be drawn from the pole, and the given angle may be one of the base angles of the triangle.
- (*c*) One of the given sides may terminate in the pole, and the

FIG. 1

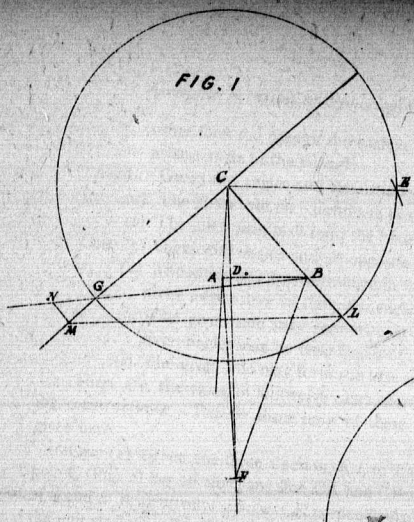


FIG. 2

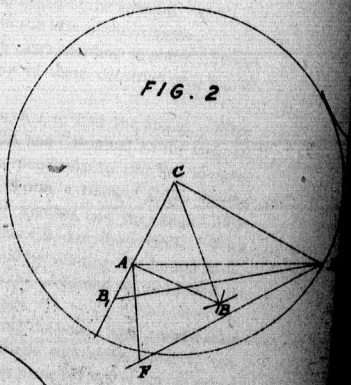
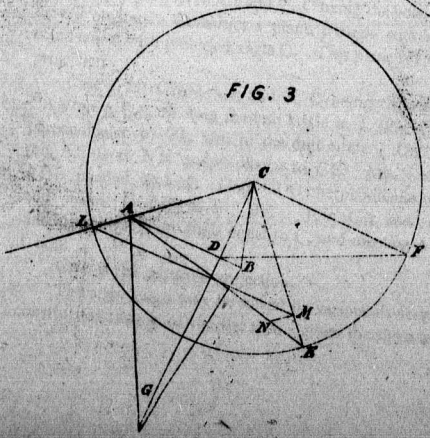


FIG. 3



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other form the base of the triangle, and the given angle be a base angle of the triangle.

Case (4) Given two angles and the included side,

(*a*) The given side may terminate in the pole.

(*b*) The given side may form the base of the triangle.

Case (5) Given two angles and an opposite side,

(*a*) The given side may terminate in the pole, and one of the given angles may be the polar angle.

(*b*) The given side may terminate in the pole, and both the given angles may be base angles of the triangle.

(*c*) The given side may form the base of the triangle.

There are, therefore, in all twelve cases affording as many interesting constructions. Two or three only of these constructions will be given here.

Case (1) Given the three sides, *a*, *b*, *c*, to find the angles. From pole C (Fig. 2) lay off along any line CA and CB, equal to the tangents of *b* and *a* respectively. Draw CE perpendicular to this line to meet the unit circle in E. Join EA, EB. Form a triangle EAF, having EA for one side, EF equal to EB, for another, and the angle AEF equal to C. With centre C and radius CB, describe a circle. With centre A and distance AF describe another, cutting the former in B. Join CB, BA. The triangle CAB is the prejection required and its angles can be measured by the above rules.

Case 2, (*a*) Given *a*, *b* and C, C being the pole. The construction here is obvious. Construct a plane triangle with sides equal to tan *a* and tan. *b*, with included angle C. This plane triangle is the required projection.

Case 2, (*b*) Given *b*, *c* and A, C being the pole. From C draw CA = tan. *b*, CA meeting the unit circle in L (Fig. 3). Also draw CE perpendicular to CL, also to the unit circle. On AE lay off AN = tan. A. Draw NM perpendicular to CE. Join LM. Draw CF and ADB″ parallel to LM. Draw CDG perpendicular to AB. Join DF and make DG equal to DF. Join GA and draw a line GB making with GA an angle equal to C, and meeting ADB in B. Join CB.

CAB is the required projection.

The other cases may be solved by various devices. An interesting construction is that for the last case : given the three angles.

Applications—The first case, given the three sides, to find the angles, may be used to find the time from the altitude of a given star. As the angle may be measured to say a quarter of a degree, and this may probably be taken as the limit of accuracy of the construction, the hour angle may be found within a quarter of a degree, that is, the time within one minute, which is sufficiently accurate for many proposes.

By the case, given two sides and the included angle, may be solved the problem of finding the azimuth at any time. This may be applied in finding the declination of the needle of a pocket or prismatic compass, to say within a quarter of a degree.

This case may also be applied to finding the great circle distance (and the azimuth) between two points on the earth's surface, of known latitudes and longitudes, as for instance, the shortest distance between two ports. Here the perpendicular from the vertex on the base of the triangle is the complement of the highest latitude reached, and the shortest distance when restricted to sailing below a certain latitude may be found by drawing tangents from the terminal points to the circle representing that circle of latitude. In this case, if anything like a precise result is wanted, care must be taken to keep the error in construction small, as a quarter of a degree means fifteen nautical miles. Most of the other cases are more of theoretical than of practical interest.

Particular cases presenting difficulty—In the gnomonic projection, the lengths of lines rapidly increase as we recede from the pole, the equator being at an infinite distance. Therefore the construction becomes impracticable beyond seventy-five degrees or so from the pole, and hence frequently, as indicated above, we are restricted in our choice as to which angle to make the pole, for it will generally be convenient to make the two shorter sides meet in the pole.

When a side is greater than 90°, recourse may be had to the polar triangle, or to the supplimentary triangle formed by producing the sides of the original triangle to 180°.

W. F. KING

[Mr. King illustrated his paper by diagrams on the blackboard.]

Members' Record.

The following Record is submitted to the Association with an apology. The facts have been hastily collected, and the results are necessarily very incomplete, the names only of such members as replied to the circular of the 2nd of April last appearing. It is hoped with the next Annual Report to issue a full and complete Record, of which this is the initiation. Each member is responsible for the statements appearing under his name.

Secretary-Treasurer.

ACTIVE MEMBERS.

ABREY, GEORGE BROCKITT, D.L.S. and P.L.S. Ontario: *Practice*—General City Surveying and Civil Engineering. *Location and Field*—Cities of Toronto, Hamilton and vicinity. *Employment for year 1889*—Surveying: City work. Engineering: Roads, Sewers and Bridges. *Employment for year 1890*—Expects to be engaged as last year. *Professional Specialty*—Practice for the Courts.

BRADY, JAMES, D.L.S. M.E. and P.L.S. Ontario: *Practice*—Examinations, Surveys, Reports, &c., on Mineral Lands and Mines. *Location and Field*—Victoria and British Columbia generally. *Employment for year 1889*—Selkirk Mining and Smelting Co., Illecillewaet, B.C. (Silver and Lead Mine). Laura Hydraulic Gold Mining Co., Rock Creek, Okanagan Dist., B.C. Ophir Bed Rock Flume Co., Big Bend, Columbia River, Kootenay Dist., B.C. *Employment for year 1890*—Expects to be engaged as last year; also with Findlay Creek Hydraulic Mines; Thunder Hill Gold Quartz Mine; mineral exploration of the coast and islands of British Columbia, and the Glân Môre Brick, Tile and Terra Cotta Works. *Professional Specialty*—Mining Engineering.

BRAY, EDGAR, D.L.S. and P.L.S. Ontario: *Practice*—Local. *Location and Field*—Oakville, Ont., and Manitoba and the North-West Territories. *Employment for year 1889*—Township Outlines in the Lake Dauphin District, Manitoba.

BRAY, SAMUEL, D.L.S., P.L.S. Ontario, and C.E.: *Practice*—Surveying: Provincial Lands Surveys in Ontario. Dominion Lands

Surveys in Rainy River District, Ontario. Mining Surveys in Mexico. Engineering: Location and construction of railways in Ontario, Michigan and Wisconsin. Now permanently appointed as an Assistant Surveyor in the Technical Branch of the Department of Indian Affairs.

BROWNLEE, J. H., D.L.S. and P.L.S. Ontario and Manitoba: *Practice*—General Surveying and Engineering. *Location and Field*—Brandon, Man., and Western Manitoba. *Employment for year 1889*—Surveying: Dominion Government Survey of Townships 5 and 6, Ranges 31 and 32 W. of P. M. Engineering: City and Municipal improvements. Railway location. *Employment for year 1890*—Expects to be engaged on Dominion Government surveys; general Surveying and Engineering.

CHALMERS, T. W., D.L.S.: Inspector of the North-West Mounted Police, Battleford.

COZENS, JOSEPH, D.L.S. and P.L.S. Ontario: *Practice*—General Surveys. Geological Explorations and Mining Engineering. *Location and Field*—Sault Ste. Marie, Ont., and generally in District of Algoma. *Employment for year 1889*—Town Engineer for Sault Ste. Marie. Mining Surveys and Explorations. Promoting and obtaining charters for the construction of a railway from Sault Ste. Marie to Hudson's Bay, and making the exploratory survey of same. *Employment for year 1890*—Expects to be engaged re-opening Michipicoten Island Copper Mines; making geological surveys and explorations on line of Sault Ste. Marie and Hudson's Bay Railway. *Professional Specialty*—Mining Engineering and Surveying.

DREWRY, WILLIAM S., D.L.S. and P.L.S. Ontario: *Practice*—General Surveying and Engineering. Assistant Engineer on Central Ontario Railway on preliminary and location surveys. Assistant Engineer on construction of dam and combined highway and railway bridge across the Trent River at Trenton, Ont. Surveys in the North-West Territories and photo-topographical surveys in British Columbia. *Location and Field*—Belleville, Ont., and Hastings, Prince Edward and Northumberland Counties, Ontario, the North-West Territories and British Columbia. *Employment for year 1889*—Preliminary triangulation of Railway Belt in the Rocky Mountains to establish initial points of departure for detail surveys. Established a number of points contiguous to Bow Pass in the Rocky Mountains. *Employment for year 1890*—Expects to be engaged on the continuation of the triangulation of the Railway Belt. *Professional Specialty*—Photo-topographical surveying and mountain triangulation.

DUFRENSE, J. I., D.T.S. and P.L.S. Quebec: *Practice*—Dominion Government Surveys. *Location and Field*—St. Thomas de Montmagny, Que., and Manitoba, the North-West Territories and British Columbia. *Employment for year 1889*—Township Outline Survey on the North Shores of the North Branch of the Saskatchewan River between Battleford and Prince Albert.

DUFRESNE, L. ACHILLE, D.L.S. and P.L.S. Quebec: *Practice*—Local Surveying. Dominion Lands Surveys and Quebec Government Surveys. *Location and Field*—Dufresne Mills, Que., and Quebec and North-West Territories. *Employment for year 1889*—Observer of angles on the Triangulation Survey of the Railway Belt in the Rocky Mountains to locate accurately the points of reference in connection with the Topographical Surveys. *Employment for year 1890*—Expects to be employed in the North-West Territories.

FITTON, CHAS. E., D.L.S. and P.L.S. Ontario. *Practice*—General local work. Exploring and survey of mines. *Location and Field*—Orillia, Ont., and County of Simcoe. *Employment for year 1890*—Expects to be engaged exploring in Algoma for minerals. *Professional Specialty*—Location and survey of Mines. Valuations and estimates of Timber Limits.

GORE, T. S., D.L.S. and P.L.S. Ontario: *Practice*—Land surveys in British Columbia. *Location and Field*—Victoria, B.C., and principally along the coast from Victoria to Alaska. *Employment for year 1889*—Exploration and survey of coal lands on Queen Charlotte Islands; very satisfactory results. *Employment for year 1890*—Expects to be engaged on work similar to last year.

HENDERSON, WALTER, D.L.S.: *Practice*—Surveying: Laying out Town Lots and subdividing Pre-emption Claims. *Location and Field*—Chilliwhack, B.C., and New Westminster District and vicinity. *Employment for year 1889*—Surveys of Pre-emption Claims and Town Lots. *Employment for year 1890*—Expects to be engaged on surveys of Town Lots; Subdivision of Farms; timber Limits and Drainage Surveys.

IRWIN, HENRY, D.L.S., B.A.L.C.E., Trinity College, Dublin, P.L.S. Quebec: *Practice*—1872 to 1874, Assistant County Surveyor. Antrim Co., Ireland. 1874 to 1887, Assistant and afterwards manager to J. Rielle, P.L.S., Montreal. 1887 to date, Assistant Engineer, Canadian Pacific Railway, at Chief Engineer's Office, Montreal. *Employment for year 1889*—Assistant Engineer and Provincial Land Surveyor in neighborhood of Montreal. *Employment for year 1890*—Expects to be engaged as last year.

JEPHSON, RICHARD JEREMY, D.L.S. and P.L.S. Ontario and Manitoba; *Practice*—Local Surveying and Surveys of Timber Limits. *Location and Field*—Portage La Prairie, Man., and Counties of Russell, Silver Creek and Shell River, Man. *Employment for year* 1889—Construction on the Manitoba and North-Western Railway and local work in the Counties of Russell and Shell River. *Employment for year* 1890—Expects to be engaged on local work. *Professional Specialty*—Exploration of Timber Limits.

KIRK, JOHN ALBERT, D.L.S. and P.L.S. Ontario: *Practice*—Local Surveying and Engineering. Dominion Government Surveys in Manitoba, the North-West Territories and British Columbia. *Location and Field*—New Westminster, B.C., and British Columbia. *Employment for year* 1889—Fixing the boundaries of a portion of the Railway Belt in British Columbia by traversing Harrison River and Lake. Subdivision of lands in the Valley of Stave River, and traverse of Islands in the Fraser River for settlement purposes. *Employment for year* 1890—Expects to be engaged on surveys common to a general practice.

KLOTZ, OTTO, J., D.T.S, C.E.: *Practice*—Astronomic work. *Location and Field*—Preston, Ont., and Pacific Coast. *Employment for year* 1889—Astronomic work. *Employment for year* 1890—Expects to be engaged on Astronomic work. *Professional Specialty*—Astronomic work.

MURDOCH, WILLIAM, D.L.S., Deputy Surveyor of Lands, New Brunswick, C. E.: *Practice*—For past twenty years employed on the Sewerage and Water Supply of the united cities of St. John and Portland. General practice as a Civil Engineer and Land Surveyor. *Location and Field*—St. John, N.B., and Province of New Brunswick. *Employment for year* 1889—Surveying: Engaged upon the plans and descriptions required by the Commission appointed under an Act of the Provincial Legislature to arrange terms of union of the cities of St. John and Portland. Engineering: Planned a system of sewerage for the District of Carleton and executed 6,690 feet of sewers, varying in length from 60 feet to 1,065 feet, distributed over the united cities. *Employment for year* 1890—Expects to be engaged on sewerage work and water supply extensions in the city of St. John. General survey work in the city, county and elsewhere. *Professional Specialty*—Sewerage and Water Supply, together with other branches that come under the head of Hydraulic Engineering. The design and construction of Parks and Cemeteries. Disputed boundaries of land in the city and county.

MCAREE, JOHN, D.T.S. and P.L.S. Ontario: *Practice*—Local surveys, City of Toronto. Dominion Government surveys in the North-

West Territories. *Location and Field*—Toronto, Ont., and City of Toronto, Manitoba and the North-West Territories. *Employment for year* 1889—Correction and Inspection Surveys in Manitoba. Laying out Lots for the Half-Breed Settlement at Pine Creek, Lake Winnipegosis. *Employment for year* 1890—Expects to be engaged on Subdivision Surveys in Manitoba.

McARTHUR, J. J., D.L.S. and P.L.S. Quebec: *Practice*—1879 to 1880, Subdivision Surveys in the North-West Territories. 1881 to 1886, Survey of Meridian Exteriors, Base Lines and Exploratory Surveys in the North-West Territories. Since 1886, engaged on Topographical Survey of the Rocky Mountains. *Location and Field*—Ottawa, Ont., and North-West Territories. *Employment for year* 1889—Photo-topographical Survey of the Rocky Mountains. Contour map of country covered by survey (covered 350 square miles). *Employment for year* 1890—Expects to be engaged on Photo-topographical Survey. *Professional Specialty*—Mountain Triangulation and Photo-topography.

McLATCHIE, JOHN, D.L.S. and P.L.S. Ontario and Quebec: *Practice*—Local Surveys. Surveys of Timber limits and Mining locations. Dominion Government Surveys. *Location and Field*—New Edinburgh, Ont., and Quebec, Ontario, Manitoba, the North-West Territories and British Columbia. *Employment for year* 1889—Township Outline Surveys in the North-West Territories. *Employment for year* 1890—Expects to be engaged on Township Subdivision in the North-West Territories; timber limit surveys and local practice.

NIVEN, ALEXANDER, D.L.S. and P.L.S. Ontario: *Practice*—Chiefly local surveying. *Location and Field*—Haliburton, Ont., and Ontario. *Employment for year* 1889—Outlining Townships head of Lake Temiscamingue. *Employment for year* 1890—Expects to be engaged on Township Outlining at Lake Temiscamingue. *Professional Specialty*—Adjustment of disputed boundaries.

PATTEN, T. J., D.L.S. and P.L.S. Ontario: *Practice*—Surveys of Mining and Mill locations. Disputed boundaries. Retracing original boundaries. Survey of water fronts for wharves, etc. Subdivisions in Villages and Towns. Defining Timber Limit boundaries. *Location and Field*—Little Current, Ont., and Manitoulin Island and mainland opposite. *Employment for year* 1889—Survey of Thessalon Town Plot under instructions from the Indian Department. Survey of flooded lands on the Blind River. Defining the north and east limits of Timber Berth No. 188 and north limit of the Township of McGivern, north shore of Lake Huron. Location of some important mining claims. *Employment for year* 1890—Expects to be engaged on Drainage work on the Manitoulin

Island; location of Mining Claims, etc. *Professional Specialty*—Drainage. Disputed boundaries. Writing descriptions. Exploring for Timber and Minerals.

PEARCE, WILLIAM, D.L.S.: *Practice*—Superintendent of Mines within Dominion lands. Member of Dominion Lands Board. *Location and Field*—Calgary, and The North-West Territories and British Columbia. *Employment for year* 1889—See Report of the Department of the Interior.

SEWELL, HENRY DE Q., D.L.S., P.L.S. Ontario and M. E.: *Practice*—Surveyor to Municipal Council of Neebing. Mining Engineering Surveys of Mining locations. *Location and Field*—Port Arthur, and Thunder Bay and Rainy River District. *Employment for year* 1889—Survey of the Township of Scoble. Re-survey of part of the Towship of Paipoonge. Mining surveys and survey of Mining locations. *Employment for year* 1890—Expects to be engaged on Mining surveys; surveys of Mining locations and sale of such properties. *Professional Specialty*—Mining Engineering, including the underground surveys of Mines. Surveys of Mines and Mining locations. Reports on Mineral properties.

WHEELER, ARTHUR O., D.L.S. and P.L.S. Ontario and Manitoba: *Practice*—1880, Local surveys. 1881 to 1883, Township subdivision and Town Plot surveys. 1883 to 1885, Township Outline and Subdivision Surveys for the Dominion Government. 1885, appointed on Staff of the Technical Branch of the Department of the Interior. 1887, permanently appointed and attached to the Timber, Minerals and Grazing Lands Office of the same Department.

VICARS, JOHN, D.L.S. and P.L.S. Ontario: *Practice*—Dominion Government Surveys. *Location ond Field*—Cannington, Ont., and British Columbia. *Employment for year* 1889—Location of the Railway Belt in British Columbia from Hope to the Pacific. Traverse of Coquitlam River and Burrard Inlet.

ASSOCIATE MEMBERS.

MCEVOY, JAMES, B.A.Sc., Geological Surveyor: *Practice*—Two years topographical surveying in Cariboo District, B. C. One year exploration survey in Yukon District. Two years Geological and Topographical Surveying in Southern Interior of British Columbia. *Location and Field*—Ottawa, Ont., and British Columbia and the North West Territories. *Employment for year* 1889—Assistant to Dr. G. M. Dawson in Geological and Topographical Survey of the Southern Interior of British Columbia. Map of area 80 miles square. *Employment for year* 1890.—Expects to be engaged on continu-

ation of last year's work. *Professional Specialty.*—Topography in connection with Geology by panoramic sketches, with transit for azimuths.

ODELL, C. M., C.E.: *Practice.*—Since 1879 employed on location and construction of railways in Canada. *Location and Field.*—Truro, N.S., and Nova Scotia. *Employment for year* 1889.—In charge of 14 miles of construction on Cape Breton Railway including some heavy bridge work, steel trestling, etc. Grading, laying of rails and ballasting on said railway. *Employment for year* 1890—Expects to be engaged on same 14 miles in charge of ballasting, drainage, erection of station houses and water service. *Professional Specialty*—Location and construction of railways.

STEPHEN, ARTHUR, C.E. and Architect: *Practice*—General Engineering and Achitecture. *Location and Field*—Collingwood, Ont., and surrounding country. *Employment for year* 1889—Collingwood water works. Local Architecture. *Employment for year* 1890—Expects to be engaged on railway work in Texas.

NOTE.—As a record such as the foregoing cannot fail to be of interest to our members, and serves well to show that the Association is composed of men who are not only competent to undertake, but are carrying on important works throughout the Dominion, it is earnestly hoped that those whose names do not appear will, when again requested to do so, furnish the information required to compile a more complete and systematic record for our next Annual Report.

Secretary-Treasurer.

List of Members.

HONORARY MEMBERS.

BELL, ROBERT, B.A., Sc., C.E., M.D., LL.D., Assistant Director of the Geological and Natural History Survey of Canada.
Geological Survey, Ottawa, Ont.

BOULTON, J. G., Staff Commander, R.N., engaged in the Hydrographic Survey of the Georgian Bay of Lake Huron.
Ottawa, Ont.

DAWSON, GEORGE MERCER, D. Sc., Assoc. R.S.M., F.G.S., F.R.S.C., Assistant Director of the Geological and Natural History Survey of Canada.
Geological Survey, Ottawa, Ont.

DEVILLE, E., F.R.A.S., D.T.S., F.R.C.S., Surveyor General, Pres. of Board of Examiners for D.L. and D.T.S.
Technical Branch, Department of the Interior, Ottawa, Ont.

GALBRAITH, JOHN, M.A., D.T.S., Professor of Engineering, School of Practical Science, Toronto.
70 St. Mary Street, Toronto, Ont.

HARRINGTON, BERNARD JAMES, B.A., Ph.D., F.G.S., F.R.S.C., Professor of Chemistry and Mineralogy, McGill College.
Walbrae Place, University Street, Montreal, Que.

KING, W. F., D.T.S., B A., Chief Astronomer to the Department of the Interior, Member of Board of Examiners for D.L. and D.T.S.
Technical Branch, Department of the Interior, Ottawa, Ont.

MACOUN, JOHN, M.A., F.L.S., F.R.S.C., Botanist and Naturalist to the Department of the Interior.
Geological Survey, Ottawa, Ont.

MAGRATH, BOULTON, Inspector of Schools, Member of Board of Examiners for D.L. and D.T.S.
Aylmer, Que.

SELWYN, ALFRED R. C., C.M.G., LL.D., F.R.S., Director of the Geological and Natural History Survey of Canada.
Geological Survey, Ottawa, Ont.

TACHE, E. E., Assistant Commissioner of Crown Lands, Quebec
Crown Lands Department, Que.

ACTIVE MEMBERS.

NOTE.—All active members are Dominion Topographical Surveyors or Dominion Land Surveyors.

ABBEY, GEORGE BROCKITT, Provincial Land Surveyor for Ontario.
17 Yonge Street Arcade, Toronto, Ont.

BEATTY, WALTER, Provincial Land Surveyor for Ontario.
Delta, Ont.

BELLEAU, JOSEPH ALPHONSE, Provincial Land Surveyor for Quebec, Draughtsman, Department of Interior.
87 Water Street, Ottawa, Ont.

BIGGER, C. A., Provincial Land Surveyor for Ontario.
Ottawa, Ont.

BOURGAULT, CHARLES EUGENE, Provincial Land Surveyor for Quebec.
St. Jean Port Joli, Que.

BOWMAN, HERBERT J., Provincial Land Surveyor for Ontario, Grad. S.P. Sc. (Toronto), A.M. Can. Soc. C.E.
Berlin, Ont.

BRABAZON, S. L., Provincial Land Surveyor for Quebec.
Portage du Fort, Que.

BRABAZON, A. J., Provincial Land Surveyor for Quebec.
Portage du Fort, Que.

BRADY, JAMES, Mining Engineer, Provincial Land Surveyor for Ontario.
80 Henry Street, Victoria, B.C.

BRAY, EDGAR, Provincial Land Surveyor for Ontario.
P. O. Box 165, Oakville, Ont.

BRAY, SAMUEL, Provincial Land Surveyor for Ontario, C.E., Vice-President of the Association, Indian Department.
Ottawa, Ont.

BREENE, THOMAS, Resident Engineer.
P. O Box 1041, Quebec, Que.

BROWNLEE, J. H., Provincial Land Surveyor for Ontario and Manitoba, Map Publisher, etc.
Brandon, Man.

CHALMERS, T. W., 1st Class, Royal Military College, Kingston, Inspector North-West Mounted Police.
Battleford, N. W. T.

COZENS, JOSEPH, Provincial Land Surveyor for Ontario, Town Engineer Sault Ste. Marie.
Sault Ste. Marie, Ontario.

CRAWFORD, WILLIAM,
Winnipeg, Man.

DE CHESNE, LUDGER MIVILLE, Provincial Land Surveyor for Quebec.
Village des Aulnets, St. Roch, L'Islet, Que.

DENNIS, J. S., D.T.S., Inspector of Surveys, Mem. Ex. Committee of the Association.
Technical Branch, Department of the Interior, Ottawa, Ont.

DICKSON, HENRY GODKIN, Provincial Land Surveyor for Manitoba.
P. O. Box 34, Selkirk, Man.

DOUPE, J. LONSDAL, B.A., Provincial Land Surveyor for Manitoba.
Winnipeg, Man.

DREWRY, WILLIAM S., Provincial Land Surveyor for Ontario, A.M. Can. Soc. C E.
Belleville, Ont.

DRISCOLL, FRED.,
Aylmer, Que.

DRUMMOND, THOMAS, D.T.S., Mining Engineer.
993 Sherbrooke Street, Montreal, Que.

DUMAIS, P. T. C., Provincal Land Surveyor for Quebec.
Hull, Que.

DUFRESNE, J. I., D.T.S., Member of Board of Examiners for D. L. and D.T.S., Provincal Land Surveyor for Quebec.
St. Thomas de Montmagny, Que.

DUFRESNE, LAURENT ACHILLE.
2388 Notre Dame Street, Montreal, Que.

FAWCETT, THOMAS, D.T.S., Provincial Land Surveyor for Ontario.
Gravenhurst, Ont.

FITTON, CHARLES EDWARD, Provincial Land Surveyor for Ontario, Engineer Wahnapatae Mining Co.
P. O. Drawer 31, Orillia, Ont.

FOSTER, FREDERICK LUCAS, Provincial Land Surveyor for Ontario.
Medical Council Buildings, corner Richmond and Bay Streets, Toronto, Ont.

FREEMAN, N. A.,
Milton, N.S.

GARDEN, JAMES F., Provincial Land Surveyor for Ontario.
Vancouver, B.C.

GAVILLER, MAURICE, C.E., (McGill), Provincial Land Surveyor for Ontario.
Collingwood, Ont.

GORE, THOMAS S., Provincial Land Surveyor for Ontario.
Victoria, B.C.

GREEN, THOMAS D., Provincial Land Surveyor for Ontario.
Department of Indian Affairs, Ottawa.

HARRIS, J. W., City Surveyor, Assessment Commissioner, Secretary P.L.S. Association and Board of Examiners for P.L.S. of Manitoba.
Winnipeg, Man.

HENDERSON, WALTER, Provincial Land Surveyor for British Columbia.
Chilliwhack, B.C.

IRWIN, HENRY, B.A.L.C E., Trinity College, Dublin, Provincial Land Surveyor for Quebec, Assistant Engineer C. P. Railway.
103 Union Avenue, Montreal, Que.

JEPHSON, RICHARD JEREMY, Provincial Land Surveyor for Ontario and Manitoba.
Portage La Prairie, Man.

KIRK, JOHN ALBERT, Provincial Land Surveyor for Ontario.
New Westminster, B.C.

KLOTZ, OTTO JULIUS, D.T.S., C.E., (University of Michigan), Astronomer Department of the Interior, Member of Board of Examiners for D.L. and D.T.S. Mem. Ex. Committee of the Association.
P.O Box 101, Preston, Ont.

LAURIE, RICHARD CAMSY, Provincial Land Surveyor for Manitoba.
Battleford, Saskatchewan District, N.W.T.

MADDOCK, JUNIUS ARTHUR, Provincial Land Surveyor for Ontario.
Duarte, California, U.S.A.

MAGRATH, CHARLES A., D.T.S., Land Commissioner, North-West Coal and Navigation Co.
Lethbridge, Alberta District, N.W.T.

MOUNTAIN, GEO. A., Provincial Land Surveyor for Ontario, Chief Engineer of Canada Atlantic Railway.
Ottawa, Ont.

MORENCY, D. C., Member of Board of Examiners for D.L. and D.T.S., Provincial Land Surveyor for Quebec, Inspector of Surveys, P.Q.
Levis, Que.

MURDOCH, WILLIAM, Deputy Surveyor of Lands, Province of New Brunswick. Civil Engineer in charge of Sewerage and Water Supply, united cities of St. John and Portland.
P. O. Box 275, St. John, N.B.

MCAREE, JOHN, D.T.S, Grad. School Practical Science, Provincial Land Surveyor for Ontario, Mining Engineer.
113 Winchester Street, Toronto, Ont.

MCARTHUR, J. J., Provincial Land Surveyor for Quebec.
Ottawa, Ont.

McLATCHIE, JOHN, Provincial Land Surveyor for Ontario and Quebec, Mem. of Ex. Committee of the Association.
New Edinburgh, Ottawa, Ont.

NELSON, J. C.,
Technical Branch, Department of Indian Affairs, Ottawa, Ont.
Regina, Assiniboia District, N.W.T.

NIVEN, ALEXANDER, Provincial Land Surveyor for Ontario.
Haliburton, Ont.

OGILVIE, WILLIAM, Provincial Land Surveyor for Ontario, President of the Association.
Gloucester, Ont.

PEARCE, WILLIAM, Provincial Land Surveyor for Ontario, Superintendent of Mines, Member of Dominion Lands Board, Member of Board of Examiners for D.L. and D.T.S.
Calgary, Alberta District, N.W.T.

PURVIS, FRANK, Provincial Land Surveyor for Ontario, Municipal Engineer.
Eganville, Ont.

POUDRIER, A. L., Provincial Land Surveyor for Quebec.
Donald, B.C.

PATTEN, T. J., Provincial Land Surveyor for Ontario.
Little Current, Ont.

RAUSCHER, R., Provincial Land Surveyor for Quebec.
Technical Branch, Department of the Interior, Ottawa, Ont.

REID, J. LESTOCK, Provincial Land Surveyor for Ontario.
Port Hope, Ont.

ROBERTSON, HENRY H., Provincial Land Surveyor for Quebec.
St. Thomas de Montmagny, Que.

SIROIS, JOSEPH EUSTACHE, Provincial Land Surveyor for Quebec, Civil Engineer and Hydrographic Surveyor.
P. O. Box 26, Ste. Anne de la Pocatiere, Kamouraska Co., Que.

SELBY, HENRY W., Provincial Land Surveyor for Ontario.
Stayner, Ont.

SEWELL, H. DEQ., Provincial Land Surveyor for Ontario, Mining Engineer, Assoc. M. Inst. C.E.
Port Arthur, Ont.

STARKEY, S. M., Provincial Land Surveyor for Quebec.
Starkey, N.B.

STEWART, LOUIS BEAUFORT, D.T.S., Provincial Land Surveyor for Ontario.
Banff, Alberta District, N.W.T.

SYMMES, CHARLES THOMAS, Second Engineer of the Inspeccion General of Ferrocarriles en Construccion.
Ferrocarriles del Estado, Linea de Talca a Constitucion, Talca, Chile.

ST. CYR, ARTHUR.
Almonte House, Ottawa, Ont.

TALBOT, A. C., Provincial Land Surveyor for Quebec.
Montmagny, Que.

TALBOT, PIERRE CLEOPHAS, Provincial Land Surveyor for Quebec.
Montmagny, Que.

THOMPSON, W. T., D.T.S.
Qu'Appelle Station, Assinaboia District, N.W.T.

VICARS, JOHN, Provincial Surveyor for Ontario.
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Note: Should there be an error in the name, standing or address of any gentleman in the foregoing list, the Secretary-Treasurer will be not only happy to correct the same in the next issue, but will be very much obliged for any information that will enable him to do so.