JOSEPH BOUCHETTE,

Surveyor-General of Lower Canada and Lieut.-Col. C. M.

PROCEEDINGS

OF THE

ASSOCIATION

OF

ONTARIO LAND SURVEYORS

At its Third Annual Meeting, since Incorporation,

HELD AT

TORONTO, FEBRUARY 26TH, 27TH AND 28TH,

1895

Being the Tenth Annual Meeting of the Association of Provincial Land Surveyors of Ontario.

The Fourth Annual Meeting (Eleventh Annual Meeting of the Association of Provincial Land Surveyors of Ontario) will be held in Toronto, commencing on Tuesday, 25th of February, 1896.

PRINTED FOR THE ASSOCIATION

BY

C. BLACKETT ROBINSON, 5 JORDAN STREET,

TORONTO.

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NOTICES.

The attention of the members is called to the list of Standing and Special Committees as given on page 6. Each member should assist the Committees as much as possible.

Members and others can be supplied with copies of the Proceedings for 1886, 1887, 1888, 1889, 1891, 1892, 1893, or 1894 by remitting fifty cents to the Secretary.

Copies of the Ontario Land Surveyors' Act and By-Laws of the Association will be sent upon receipt of three-cent stamp.

The thanks of the Association are due to the Faculty and Alumni Society of the School of Practical Science for the very interesting and instructive entertainment tendered to the members in attendance at the annual meeting of 1895.

Published annually by the Association of Ontario Land Surveyors.

Edition 1,150 copies ; price 50 cents.

PATRONIZE OUR ADVERTISERS.

PREFACE.

To the Members of the Association of Ontario Land Surveyors:

The Proceedings of the Association at its Third Annual Meeting since incorporation are herewith presented.

Appended will be found By-Laws passed by the Council since the date of the meeting.

It will be seen that the Committees have been active and earnest in the promotion of the interests of their several departments, and it is hoped that they will be even more energetic this year.

Each member of the Association, whether a member of a committee or in the ranks, is requested to lend his aid for the advancement of the profession.

Respectfully submitted on behalf of the Council,

A. J. VANNOSTRAND,

Secretary.

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ASSOCIATION OF
ONTARIO LAND SURVEYORS

(Incorporated 1892).

ORGANIZED 23RD FEBRUARY, 1886.

Officers for 1895-96.

PRESIDENT.

M. Gaviller, O L.S., Collingwood.

VICE-PRESIDENT.

Willis Chipman, O L.S., Toronto.

CHAIRMAN OF COUNCIL.

Villiers Sankey, O.L.S., Toronto.

SECRETARY-TREASURER.

A. J. VanNostrand, O.L.S , Toronto.

COUNCILLORS

Hon. A. S. Hardy, Commissioner of Crown Lands.
P. S. Gibson, Willowdale } For 3 years.
F. L. Foster, Toronto }
Villiers Sankey, Toronto } For 2 years.
H. J. Bowman, Berlin }
G. B. Kirkpatrick, Toronto } For 1 year
Alex. Niven, Haliburton. }

AUDITORS.

H. B. Proudfoot, Toronto.
A. P. Walker, Toronto.

BANKERS.

Imperial Bank of Canada (Yonge Street Branch, Toronto).

BOARD OF EXAMINERS.

Villiers Sankey, Toronto (Chairman).
M. J. Butler, Napanee } Appointed by Lieut.-Gov.
G. B. Kirkpatrick, Toronto } in Council.
P. S. Gibson, Willowdale } For 3 years, appointed by
A. Niven, Haliburton } Council.
M. Gaviller, Collingwood } For 2 years, appointed by
R. Coad, Glencoe } Council.

STANDING COMMITTEES FOR 1895-6.

LAND SURVEYING.—T. B. Speight (Chairman), James Dickson, F. L. Foster, H. H. Gibson, J. L. Morris, A. Niven, C. Unwin J. F. Whitson.

DRAINAGE.—Geo. Ross (Chairman), R. Coad, W. M. Davis, Owen McKay, J. M. Tiernan, T. H. Wiggins.

ENGINEERING.—H. J. Bowman (Chairman), G. B. Abrey, M. J. Butler, J. DeGursé, Jas. Hutcheon, T. Harry Jones, Jas. Robertson, A. P. Walker.

ENTERTAINMENT.—H. D. Ellis (Chairman), F. L. Foster, W. E. McMullen, C. J. Murphy, T. B. Speight, A. P. Walker.

PUBLICATION.—K. Gamble (Chairman), H. J. Browne, Willis Chipman, H. L. Esten, F. L. Foster, J. McAree, C. J. Murphy H W. Selby.

TOPOGRAPHICAL SURVEYING.—Willis Chipman (Chairman), M. J. Butler, T. Fawcett, K. Gamble, Otto J. Klotz, J. McAree, V. Sankey, E. Stewart, L. B. Stewart.

SPECIAL COMMITTEES.

POLAR RESEARCH.—Willis Chipman (Chairman), C. J. Murphy A. Niven, W. Ogilvie, J. A. Paterson, L. B. Stewart, J. W. Tyrrell.

STANDARD MEASURES OF LENGTH.—M. J. Butler (Chairman), G. B. Abrey, W. Chipman, H. D. Ellis, M. W. Hopkins, J. McAree, H. W. Selby.

BIOGRAPHY.—G. B. Kirkpatrick (Chairman), W. R. Aylsworth, Jas. Dickson, H. L. Esten and all exempted members.

PROGRAMME OF THE

Association of Ontario Land Surveyors

(INCORPORATED)

AT ITS THIRD ANNUAL MEETING HELD IN TORONTO,
FEBRUARY 26TH, 27TH AND 28TH, 1895.

PROGRAMME.

Tuesday, February 26th—Morning at 10 o'clock.

Meeting of Council.
Meeting of Standing Committees.

Afternoon at 2 o'clock.

Reading of Minutes of previous meeting.
Reading of Correspondence.
Report of Council of Management (including Reports of Board of Examiners and Secretary-Treasurer). V. Sankey, O. L. S, Chairman, Toronto.
Report of Committee on Publication. K. Gamble, O. L. S., Chairman, Toronto.
Report of Committee on Biography. G. B. Kirkpatrick, O. L. S., Chairman, Toronto.
President's Address.
Paper—"Indexing Office Information." D. D. James, O. L. S., C. E., Toronto.
Paper—"Flood Prevention Work at Brantford." C. C. Fairchild, O. L. S., Brantford.
Paper—"Rainy River District." J. F. Whitson, O. L. S, Toronto.

Evening at 8 o'clock.

Report of Committee on Polar Research. Willis Chipman, O. L. S, C. E., Chairman, Toronto.
Paper—"The Eightieth Meridian." Willis Chipman, O. L. S., C. E., Toronto.
Paper—"The Objects of Arctic Exploration." L. B. Stewart, O. L. S., D. T. S., Toronto.
Paper—"The Dawson Route." W. A. Browne, O. L. S., Toronto.

Wednesday, February 27th—Morning at 10 o'clock.

Report of Committee on Drainage, with "Question Drawer." Geo. Ross, O. L. S., C. E., Chairman, Welland.

Paper—"Drain Gradient Instrument." A. R. Davis, O. L. S., C. E., Napanee.

Report of Committee on Topographical Surveying. Willis Chipman, O. L. S., C. E., Chairman, Toronto.

Paper—"Aneroids." Otto J. Klotz, O. L. S., D. T. S., Ottawa.

Paper—"Triangulation Work on Topographical Surveys." H. K. Wicksteed, O. L. S., C. E., Cobourg.

Afternoon at 2 o'clock.

Report of Committee on Land Surveying. T. B. Speight, O.L.S., Chairman, Toronto.

Paper—"Co-efficient of Refraction." Otto J. Klotz, O. L. S., D. T. S., Ottawa.

Paper—"Provincial Boundaries." A. Niven, O. L. S., Haliburton.

Paper—"The Cradle Theodolite." J. M. O. Cromwell, O. L. S., Perth.

Evening at 8 o'clock.

ANNUAL DINNER.

F. L. Foster, O. L. S., Chairman of Committee on Entertainment.

Thursday, February 28th—Morning at 10 o'clock.

Report of Auditors.

Report of Committee on Standard Measures, G. B. Abrey, O. L. S., C. E., Chairman, Toronto Junction.

Report of Committee on Engineering—T. Harry Jones, O. L. S., C. E., Chairman, Brantford.

Paper—"Highway Bridges" P. S. Gibson, O. L. S., C. E., Willowdale.

Paper—"Good Streets." H. J. Bowman, O. L. S., C. E., Berlin.

Paper—"Mining." J. D. Evans, O. L. S., C. E., Trenton.

Afternoon at 2 o'clock.

Report of Committee on Entertainment. F. L. Foster, O. L. S., Chairman.

Ratification of New By-laws.

Unfinished Business.

New Business.

Nomination of Officers (President, Vice-President, two Members of Council, Secretary-Treasurer and Auditors).

Appointment of Scrutineers.

Adjournment.

ASSOCIATION OF

ONTARIO LAND SURVEYORS

(INCORPORATED).

MINUTES OF THE THIRD ANNUAL MEETING

(Tenth Annual Meeting of Provincial Land Surveyors of Ontario),

FEBRUARY 26th, 27th and 28th, 1895.

The meeting was called to order at 2 p.m. on Tuesday, the 26th of February, in the lecture room of the Canadian Institute, 58 Richmond Street East, Toronto.

The President, Mr. M. J. Butler, in the chair.

Moved by Mr. Van Nostrand, and seconded by Mr. Niven, that the minutes of last meeting of the Association of Ontario Land Surveyors, as printed in the Proceedings, be confirmed as read. Carried.

The Secretary read a letter from the Editor of "The Surveyor and Municipal County Engineer," of London, England, thanking the Association for the report of last meeting which was sent him, and inviting Ontario Land Suveyors to contribute articles for "The Surveyor;" also one from the President of the Illinois Society of Engineers and Surveyors, regretting that it was impossible to have a representative of that Society at our annual meeting.

Mr. Sankey, on behalf of the Council of Management, asked to be allowed to defer the presentation of their report for the present. He presented the Secretary-Treasurer's report and financial statement which was referred to the auditors.

Captain Gamble presented the report of the Committee on Publication, and moved, seconded by Mr. Selby, that it be adopted. Carried.

Mr. Kirkpatrick, chairman of the Committee on Biography, presented a verbal report, stating that, in answer to the letters sent out

to the different surveyors, he had received some thirty-five or forty replies, which contain a great deal of valuable information concerning the surveyors in the early history of this Province. He suggested that the Committee be instructed to correspond with the descendants of some of these old surveyors with a view of obtaining all the information possible regarding them. On the suggestion of Mr Chipman he read a few of the replies received.

Mr. W. F King, D.T.S., being present, the President extended the courtesies of the Association to him, asking him to take part in the proceedings.

The President then read his annual address.

On motion of Mr. Sankey, seconded by Mr. Dickson, a vote of thanks was tendered the President for his address.

Mr. D. D. James read a paper on "Indexing Office Information."

In the absence of Mr. C. C. Fairchild, his paper on "Flood Prevention Work at Brantford" was read by Mr. T. Harry Jones.

In the absence of Mr. Otto J. Klotz, his paper on "Aneroids" was read by Mr. T. Fawcett.

The President announced that on Thursday evening the Alumni Association of the School of Practical Science proposed holding a stereopticon entertainment in that building for the Association of Ontario Land Surveyors if enough members would signify their intention of being present.

The meeting then adjourned at 4.45 p.m.

TUESDAY EVENING SESSION, 8 P.M.

The President in the chair.

Mr. J. F. Whitson read a paper on "The Rainy River District."

Moved by Mr. T. B. Speight, seconded by Mr. Jas. Dickson, that a vote of thanks be given Mr. Whitson for his very able paper. Carried.

The Report of the Committee on Polar Research was read by Mr. Willis Chipman, chairman of the Committee.

On motion of Mr. Chipman, seconded by Mr. Dickson, the report was adopted.

Mr. Chipman read a paper on "The Eightieth Meridian."

On motion of Mr. C. F. Aylesworth, seconded by Mr. J. W. Tyrrell, a vote of thanks was given Mr. Chipman for his valuable and interesting paper.

Mr. W. A. Browne read a paper on "The Dawson Route"

The meeting then adjourned, 10.15 p.m.

WEDNESDAY MORNING SESSION, 10 A.M.

The President in the chair.

The report of the Committee on Drainage was read by Mr. Geo. Ross, chairman of the Committee, and was discussed at length.

Mr. A. R. Davis read a paper on "Drain Gradient Instrument," in connection with which he also exhibited a model of his instrument.

The report of the Committee on Topographical Surveying was read by Mr. Chipman, chairman of the Committee.

After considerable discussion, on motion of Mr. Chipman, seconded by Mr. Dickson, the report was adopted.

The meeting then adjourned, 12.45 p.m.

WEDNESDAY AFTERNOON SESSION, 2 P.M.

The Vice-President, Mr. M. Gaviller, in the chair.

In the absence of Mr. H. K. Wicksteed, his paper on "Triangulation Work on Topographical Surveys" was read by Mr H. H. Gibson.

In the absence of Mr. Otto J. Klotz, his paper on "Co-efficient of Refraction" was read by Mr. H. H. Gibson.

On motion of Mr. Dickson, seconded by Mr. Davis, a vote of thanks was tendered Mr. Klotz for his interesting paper.

The report of the Council of Management was then read by Mr. Villiers Sankey.

By laws Nos. 36, 37, 38, 39 and 40, as enacted by the Council, were then ratified by the Association.

On motion of Mr. Sankey, seconded by Mr. Dickson, the report of the Council of Management was adopted.

The report of the Committee on Land Surveying was read by Mr. Speight, chairman of the Committee, and the questions submitted were discussed.

In the absence of Mr J. M. O. Cromwell, his paper on "The Cradle Theodolite" was read by Mr. H. H. Gibson.

The meeting then adjourned, 5.45.

The Annual Dinner was held in the evening.

THURSDAY MORNING SESSION, 10 A.M.

The President in the chair.

Mr. T. Harry Jones, chairman of the Committee on Engineering, said that his Committee had concluded to follow the precedent set

in other years and submit no written report. The members, living as they do in various parts of the country, had not been called together during the year. However, some of the papers which have been read before the Society had been procured or given by members of the Committee.

Mr. P. S. Gibson then read a paper on " Highway Bridges."

Mr. J. D. Evans read a paper on " Mining."

Mr. F. L. Foster presented the report of the Auditors, which on motion was adopted.

Mr. H. J. Bowman read a paper on " Good Streets " which was discussed at considerable length.

The meeting then adjourned, 12.30 p.m.

THURSDAY AFTERNOON SESSION, 2 P.M.

The President in the chair.

Moved by Mr. F. L. Foster, seconded by Mr. A. J. Van Nostrand, that the report of the Committee on Entertainment be taken as read and printed in the proceedings. Carried.

Moved by Mr. T. B. Speight, seconded by Mr. M. Gaviller, that any omissions or clerical errors in the records of the proceedings of this meeting, now in the hands of the Stenographer and the Secretary, be corrected by the Committee on Publication before being printed. Carried.

Moved by Mr. Willis Chipman, seconded by Mr. A. Niven, that the Secretary prepare a list of candidates who have passed the Preliminary and Final examinations for Land Surveyors of Ontario since incorporation, this list to give the date of passing and last reported address, and that it be printed in the Proceedings. Carried.

Moved by Mr. G. B. Kirkpatrick, seconded by Mr. F. L. Foster, that the Secretary-Treasurer be granted the sum of one hundred and twenty dollars for his services during the past year. Carried.

Moved by Mr. Chipman, seconded by Mr. C F. Miles, that the Council be and are hereby instructed to fit up the room in the Parliament Buildings granted the Association by the Crown Lands Department in a proper manner for the reception of books, plans, photographs, portraits, documents, instruments, etc., the expenditure for such purpose not to exceed thirty dollars. Carried.

The following were suggested as subjects for papers for next meeting :—

By Mr. P. S. Gibson : " The Survey Act as it stands at present," more particularly with reference to " Sectional Surveys—Double Fronts and Single Fronts." (Suggested by Mr. Dickson.)

By Mr. Niven : " The Eastern Boundary of this Province." (Suggested by Mr. Chipman.)

Mr. Niven explained that he had started to write a paper on "Provincial Boundaries," but found it impossible to finish it in time. He, however, promised to prepare a paper on that subject for next year.

Mr. Gaviller suggested that Mr. H. L. Esten give some information regarding cases which have been decided in the Courts, of interest to the profession, as he had at one time commenced to make a compilation of them. This Mr. Esten said he would be very happy to do.

Mr. Chipman suggested a paper on "The Surveys that were made before 1790 in Ontario."

Mr. Niven suggested that Mr. Dickson give a paper on something in the line of Crown Surveys.

Mr. Speight suggested that Mr. H. D. Lumsden prepare a paper on Railway Work.

Mr. Sankey said he thought it would be well to have an index made of the information contained in the Exchanges and the Reports of the Association and have it printed and sent to each member.

Mr. Chipman thought that this should be done every five years.

Mr. Chipman suggested a paper on "Statute Labor."

Mr. Sankey suggested a paper on "The Areas in Ontario that may be Reclaimed by Drainage."

Moved by Mr. Sankey, seconded by Mr. P. S. Gibson, that the Secretary-Treasurer issue a circular as soon as possible to all members, active and retired, requesting contributions for the repository of any books, plans, pamphlets, field notes, diaries, etc., and any other documents pertaining to the early surveys in Canada, also of old instruments, or other curios of interest to the profession. Each member is also to be requested to forward a photograph of himself, with brief biographical sketch, name and address. Carried.

Moved by Mr. G. B. Kirkpatrick, seconded by Mr. P. S. Gibson, that we have learned with regret of the death, since our last meeting, of Mr. William Robinson, P.L.S, London, Ontario, and we desire to convey to his relatives this expression of sympathy with them in their bereavement. Carried.

Moved by Mr. Chipman, seconded by Mr. Sankey, that the meeting do now adjourn for ten minutes. Carried.

After the adjournment, the nomination of officers was proceeded with.

The President—Last year I suggested that the office of President be for one year only, and that for the future there would be no feeling on the part of any person that he had been cut off summarily. There are many members of the Society who are well fitted for the office of

President, but, in the ordinary course of affairs, it is impossible that it reach all that deserve to be there; therefore, I made that suggestion, and I think we had better bear that in mind now before making any nominations, that it be understood from this date that the President's term be for one year.

Mr. Jas. Dickson moved, seconded by Mr. W. A. Browne, that Mr. Maurice Gaviller be President for the ensuing year.

There being no other nominations, Mr. Gaviller was declared elected.

Moved by Mr. P. S. Gibson, seconded by Mr. Niven, that Mr. Willis Chipman be Vice-President for the ensuing year.

There being no other nominations, Mr. Chipman was declared elected.

As Mr. Gibson and Mr. Chipman were the retiring members of the Council, the following nominations were made to take their places:

Mr. P S. Gibson, nominated by Mr. Kirkpatrick, seconded by Mr. Niven.

Mr. James Dickson, nominated by Mr. W. A. Browne, seconded by Mr. Speight.

Mr. Thos. B. Speight, nominated by Mr. Sankey, seconded by Mr. Bowman.

Mr. George Ross, nominated by Mr. Van Nostrand, seconded by Mr. Esten.

Mr. J. D. Evans, nominated by Mr. Gaviller, seconded by Mr. Foster.

Mr. W. M. Davis, nominated by Mr. Bowman, seconded by Captain Gamble.

Mr. Harry J. Browne, nominated by Mr. Gibson, seconded by Mr. Speight.

Mr. T. Harry Jones, nominated by Mr. Kirkpatrick, seconded by Mr. W. A. Browne.

Mr. F. L. Foster, nominated by Mr. Chipman, seconded by Mr. Niven.

Auditors.

Mr. Jas. Dickson moved, seconded by Mr. M. Gaviller, that the retiring Auditors be re-nominated.

As Mr. F. L. Foster was nominated for the Council, he asked to have his name withdrawn from the nominations for Auditors, and Mr. Gaviller nominated Mr. A. P. Walker in his place as one of the Auditors. There being no other nominations, Messrs. Proudfoot and Walker were declared elected.

Mr. Sankey moved, seconded by Mr. P. S. Gibson, that Mr. Van Nostrand be nominated as Secretary-Treasurer for the ensuing year.

There being no further nominations, Mr. Van Nostrand was declared elected.

The President then appointed Captain Gamble and Mr. W. A. Browne as scrutineers.

On motion of Mr. Sankey, the President then left the chair and Mr. Dickson took it *pro tem.*

Mr. V. Sankey, seconded by Mr. A. Niven, then moved a cordial vote of thanks to the retiring President, Mr. M. J. Butler, for his services as President, and for the trouble he had taken and the valuable assistance he had rendered to the Association, from its commencement to the present time, which was carried unanimously, and to which the retiring President made the following reply:

Mr. Chairman and Gentlemen,—I am sure I thank you very much indeed for the kind manner in which you have received this vote of thanks to me. I appreciate it very much indeed. As suggested by one of our members, I did assist at the birth of this Association, and I attended it through its early infancy, but it has now reached the age of ten years and ought to be able to walk alone pretty strongly. It is getting to be a pretty full grown boy now, and I think our sphere ought to keep on enlarging and broadening until, as suggested by Mr. Bowman, our surveyors will be, without exception, engineers. Then the reflection that was cast upon surveyors in times past, "Oh, yes, that is the fellow with the Jacob's staff and two or three hundred link chain," will not be hinted at in regard to any member of the Ontario Land Surveyors' Association I thank you indeed for your appreciation of the services I was able to render to the Association, little as they were, during the past year. (Applause.)

On motion of Mr. Dickson, seconded by Mr. Foster, the meeting then adjourned, 4 p m.

MEMBERS IN ATTENDANCE AT THE THIRD ANNUAL MEETING.

Abrey, G. B.
Aylsworth, C. F., jr.
Beatty, W.
Bowman, C. D.
Bowman, H. J.
Browne, H. J.
Browne, W. A.
Butler, M. J.
Chipman, W.
Davis, A. R.
Davis, J.
DeGurse, J.
Dickson, J.
Ellis, H. D.
Esten, H. L.
Evans, J. D.
Fawcett, T.
Foster, F. L.
Gamble, K.
Gaviller, M
Gibson, H. H.
Gibson, P. S.
Hutcheon, Jas.
James, D. D.
Johnson, R. T.
Jones, T.
Kirkpatrick, G. B.
Laird, R.
Lumsden, H. D.
McFarlen, G. W.
McMullen, W. E.
Miles, C. F.
Murphy, C. J.
Niven, A.
O'Hara, W F.
Proudfoot, H. B.
Robertson, Jas.
Ross, G.
Selby, H. W.
Sankey, V.
Sewell, H. DeQ.
Silvester, G. E.
Speight, T. B.
Stewart, L. B.
Spry, W.
Tyrrell, J. W.
Unwin, C.
VanNostrand, A J.
Walker, A. P.
Wheelock, C. R.
Whitson, J. F.

RESULT OF ELECTIONS.

President.....M. Gaviller .....(by acclamation).
Vice-President.....Willis Chipman .....(by acclamation).
Secretary-Treasurer.....A. J. VanNostrand .....(by acclamation).

Councillors elected for ensuing three years.

P. S. Gibson, F. L. Foster.

Auditors for ensuing year (by acclamation).

H. B. Proudfoot, A. P. Walker.

I hereby declare the above-named Councillors and Auditors elected.

A. J. VanNostrand,
Secretary-Treasurer.

Certified correct.

Killaly Gamble,
W. A. Browne,
Scrutineers of Ballots.

REPORT OF THE COUNCIL.

The Council met in April and November.

At the April meeting, By-Laws Nos. 36, 37, 38 and 39 were passed, under the authority of By-Law No. 33, and at the November meeting By-Law No. 40 was passed under the same authority, and are now reported to the Association for ratification or otherwise. At the meeting of the new Council in April Mr. Sankey was elected chairman, and Messrs. Gaviller and Coad were appointed as members of the Board of Examiners. The several Standing Committees were appointed, as provided in By-Law No 5. (See Report 1894, p. 6). It was also resolved by the Council to print the examination papers, as far as practicable, of November, '93, in the report. This has been done at a cost of about $20, and the Council hopes that the Association will concur in this practice being continued in future for the following reasons: 1. The publishing of these papers gives intending candidates opportunity of preparing themselves properly for the Examinations. 2. It shews to the members of the Association the manner in which the Board of Examiners is carrying out its duties, and gives opportunity to suggest improvements in the style and scope of the Examinations. 3. The enhanced value of the Report which has been already favourably commented on, and also the evidence these papers bear, that to become an Ontario Land Surveyor a candidate must be well grounded in the several subjects required. It may be here stated that an oral examination is required as well in each subject.

The Council, knowing that a large amount of information of interest to the profession is scattered throughout the Province, and that the first move in order to collect it was to secure a convenient repository for the same, an application was therefore made to the Hon. the Commissioner of Crown Lands for the use of some room in the New Parliament Buildings, the result being that he has most kindly placed a suitable room, fitted up with shelves, tables and chairs, at our disposal. We are now in a position to keep an index, plans, maps, books, instruments, etc , and the members of the Association are earnestly requested to further the enterprise by securing for this repository donations of such information, instruments, etc., as they may think of interest. The use of the room and benefit of the information will be always at the disposal of all our members.

With regard to the election of the several officers the Council would suggest that the Association will consider the advisability of permitting members, who are unable to attend the annual meeting, to send in their nominations in writing. This would tend to increase the interest of members from all parts of the Province. As there may, however, be reasons why this plan will not work, the Council hopes the matter may be fully discussed before being adopted.

The plan of printing some of our papers before the Annual Meeting has been tried this session.

It is recommended that in future all papers for the annual meeting of the Association be sent to the Secretary by February 1st, in order that they may be printed and mailed to the members at least a week before the annual meeting, and that discussions be written out and sent in by the members, or personally read by them after the reading of the paper.

In response to Circular No. 16, the Secretary has received many replies which shew that in some places unlicensed men are now practising. The Council has decided to enquire into these cases, and to prosecute in all cases where the evidence will warrant such action. Any member able to assist in giving information, or the names of persons from whom such information may be had, will please communicate at once with the Secretary.

The Reports of the Board of Examiners and of the Secretary-Treasurer are herewith presented, having been adopted by the Council The Council has again to record the high appreciation of the energy and ability with which the Secretary-Treasurer discharges his many and, in some cases, onerous duties.

Respectfully submitted.

VILLIERS SANKEY,

Chairman of Council.

NEW BY-LAWS.

By-Law No. 36. "The following Surveyors having duly registered, and having proved to the satisfaction of the Council that they had been respectively, in actual practice as duly authorized and qualified Land Surveyors for Ontario for a period of not less than 35 years prior to July 1st, 1892, are hereby placed on the list of registered Surveyors for Ontario, and are exempt from the payment of further dues under the authority of sub-section 4 of section 10, Chapter 34, Ontario Statutes, 1892, viz., Thomas Coltrin Keefer, Nathaniel Edward Low, Thomas Cheesman, James McCallum and Thomas W Walsh." Passed by Council of Management, 4th April, 1894.

By-Law No. 37. "Whereas it has been proven to the satisfaction of the Council that Royal Wilkinson Hermon was granted a certificate as Provincial Land Surveyor, dated 13th July, 1857, and had therefore been a duly qualified Land Surveyor for 35 years, less 12 days, prior to the first day of July, 1892; it is therefore enacted that the said Royal Wilkinson Hermon is hereby granted exemption from dues under the authority of sub-section 4 of Section 10, Chapter 34, Ontario Statutes, 1892." Passed by Council of Management, 4th April, 1894.

By-Law No. 38. "Whereas it has been recommended by the Board of Examiners that the minimum marks in the subject of levelling be reduced from 40 to 35, it is therefore hereby enacted that the

minimum number of marks required to be taken by each successful candidate in the subject of levelling shall be 35 instead of 40 as set forth in By-Law No 29." Passed by Council of Management, 4th April, 1894.

By-Law No. 39. "Whereas any registered surveyor desiring to give up practice can have his name removed from the registered list of practitioners at any time, upon giving written notice of such desire, and whereas it is desirable that such surveyors may contribute papers and secure the reports of the transactions of this Association and exchanges, therefore this Council hereby enacts that such surveyors shall have the aforesaid privileges upon the payment of an annual fee of two dollars, and their names shall be printed in the list of members in the annual report of the Association and properly marked." Passed by Council of Management, 7th April, 1894.

By-Law No. 40. "The following surveyors having duly registered and having proved to the satisfaction of the Council that they had been respectively in actual practice as duly authorized and qualified land surveyors for Ontario for a period of not less than thirty-five years prior to July 1st, 1892, are hereby placed on the list of registered surveyors for Ontario and are exempt from the payment of further dues under the authority of sub-section 4, of section 10, chapter 34, Ontario Statutes, 1892, viz., Tom S. Rubidge and James A. Gibson." Passed by Council of Management, 6th November, 1894.

REPORT OF THE BOARD OF EXAMINERS.

The Board of Examiners met in April and November, when the following candidates passed, the finals being sworn in, and the following bonds were approved and filed with the Provincial Registrar. (See lists below.)

One candidate failed in April, and two others were required to take a supplemental examination in two subjects each.

A list is also presented showing the names of the various students who have filed articles and with whom they are now serving. This will bring the list, which was published in the Report of 1893, pages 154-5, up to date.

The Board, in order to reduce the cost of the examinations, decided that $5 00 per day would be the fee payable to the members for the April meeting, and that attendance of the examiners should be so regulated that just a sufficient quorum might be in attendance. This has reduced the cost, and was found to be workable when there were not a great many candidates.

Respectfully submitted,

VILLIERS SANKEY,

Chairman of Board.

LIST OF ARTICLED PUPILS.

Name of Pupil.	Name of Surveyor.	Residence.	Date of Articles	Term
Heaman, John Andrew	Moore & Henry	London	9th November, 1893,	Three years
Chalmers, William James	Rorke, Louis Valentine	Sudbury	31st March, 1894	One year.
Ardagh, James Arthur Gowan	Bowman, Herbert Joseph	Berlin	10th May, 1894	One year.
Mitchell, Charles Hamilton	Tyrrell, James Williams	Hamilton	17th May, 1894	One year.
Bergey, Aaron E	Bowman, Herbert Joseph	Berlin	4th June, 1894	One year.
Chalmers, John	Burke, William Robert	Ingersoll	1st July, 1894	One year.
MacLean, William Arthur	Campbell, Archibald William	St. Thomas	4th April, 1894	Three years.
Ford, William Butterton	Davis, William Mahlon	Woodstock	4th April, 1894	Three years.
Gillon, Douglas John	McCallum, James	Rat Portage	16th June 1894	One year.
Squire, Richard Herbert	Jones, Thomas Henry	Brantford	20th July, 1894	One year.
Newman, John James	Newman, William	Windsor	4th April, 1894	Three years.
Ward, Archeson Thomas	Speight & VanNostrand	Toronto	4th April, 1894	Three years.
Fairbairn, John M. R.	Wilkins, Frederick William	Peterborough	4th June, 1894	One year.
Gibson, Wilbert Silas	Gibson, Peter Silas	Willowdale	5th April, 1894	Three years.
McNaughton, Finlay Donald	Brown, David Rose	Cornwall	5th April, 1894	Three years.
Mackenzie, William	Baird, Alexander	Leamington	23rd January, 1894	One year.
Brown, George Laing	Brown, David Rose	Cornwall	2nd April, 1894	One year.
McPherson, Archibald John	McCulloch, Andrew Lake	Galt	28th March, 1894	One year.
Johnson, Sydney Munnings	VanBuskirk, William Fraser	Stratford	24th October, 1894	One year.
Smith, Angus	Scane, Thomas	Ridgetown	18th December, 1894	One year.

APRIL EXAMINATION.

Preliminary.

Bow, James Alexander	Orillia.
Gibson, Wilbert Silas	Willowdale.
MacLean, William Arthur	St. Thomas.
McNaughton, Finlay Donald	Cornwall.
Ford, William Butterton	London.
Ward, Archeson Thomas	Toronto.
Newman, John James	Windsor.

Final.

Fairchild, Charles Court	Brantford.

NOVEMBER EXAMINATION.

Preliminary.

No candidate.

Final.

ALLAN, JOHN RICHARD (Supplemental).

BONDS—APRIL, 1894.

HARVEY, THOMAS ALEXANDER.
MCLENNAN MURDOCH JOHN.
HOPKINS, MARSHAL L. WILLARD.

NOVEMBER, 1894.

FAIRCHILD, CHARLES COURT.

REPORT OF THE SECRETARY-TREASURER.

MR. CHAIRMAN,—In compliance with the By-laws, I beg to present the following report of the official proceedings of the Association, as transacted by my department between February 26th, 1894, and February 25th, 1895:—

The following circulars have been issued:

No. 14.	Ballot for 1894-5	225 copies
" 15.	Explanation of Ballot	225 "
" 16.	*Re* Court Decisions, etc	225 "
" 17.	*Re* Biographical Sketches	40 "
" 18.	Announcement of Annual Meeting, 1895	250 "
" 19.	Programme for " " "	325 "

Letters and Accounts sent from Secretary's office	709
Postal Cards " " "	50
Letters, Postal Cards and Biographical Sketches received	479

The Register stands as follows:

Active members, subject to dues	197
" " exempted from dues	16
Withdrawn from practice	43
Dead	2
Total number of registrations	258

The following table shows the present location of both "active" and "withdrawn" members :—

County or District.	*Active Members.*	*Withdrawn Members.*
Algoma	2	
Brant	3	
British Columbia		10
Bruce	4	
Carleton	11	5
Dufferin	2	
Durham	1	
Dundas	1	
Elgin	4	
Essex	7	
Frontenac	4	
Grey	3	
Grenville	1	
Glengarry	1	
Haliburton	1	
Halton	2	
Hastings	4	
Haldimand	2	
Huron	2	
Kent	8	
Lambton	5	
Lanark	4	
Leeds	3	
Lennox	4	
Lincoln	1	1
Middlesex	10	
Manitoba	1	6
Manitoulin	1	
Muskoka	4	
Nipissing	4	
Norfolk	2	
North-West Territories		6
Northumberland	4	
Ontario	3	
Oxford	4	
Parry Sound	1	
Peel	1	
Perth	7	
Peterboro'	4	2
Prince Edward	1	
Quebec		3
Renfrew	5	
Russell	1	
Rainy River	4	
Simcoe	7	1
Stormont	2	
Thunder Bay	4	
Victoria	3	
Waterloo	4	1
Welland	1	
Wellington	5	
Wentworth	7	1
York	35	6
United States	5	4

Number of Candidates passed Final Examination 2
" " " Preliminary Examination 7
" Pupils filing Articles 19

The demand for our Annual Reports having increased, it was deemed advisable to enlarge the issue to 1,150, 1,046 of which were sent to exchanges, members, advertisers, libraries, newspapers, etc., and 104 remain on hand.

Single copies have been sent by request to the following institutions, viz. :—

Public Library, Toronto.
Canadian Society of Civil Engineers, Montreal.
Library of Parliament, Ottawa.
Meteorological Office, Toronto.
Ontario Department of Crown Lands, Toronto.
Ontario Bureau of Mines, Toronto.
Ontario Department of Agriculture, Toronto.
City Engineer, Toronto.
Association of Provincial Land Surveyors of British Columbia, Victoria, B.C.
Engineers' Society of Western Pennsylvania, Allegheny, Pa.
Cornell University, Ithaca, N.Y.
Massachusetts Institute of Technology, Boston, Mass.
State Normal and Training School, Cortland, N.Y.
University of Minnesota, Minneapolis, Minn.
Thayer School of Engineering, Hanover, New Hampshire.
Correspondence School of Mechanics, Scranton, Pa., and *The Surveyor*, London, England, and in nearly every instance at least one volume has been received in exchange. The Editor of *The Surveyor* has kindly continued the name of our Association on the weekly mailing list in exchange for a single copy of our report. It is hoped that in exchange for this courtesy some of our "sanitary" members will contribute, as requested in the letter of the Editor, to the sanitary columns of that valuable publication.

In addition to the single exchanges mentioned above, our library has been further enriched through the generosity of Mr. Chipman by 56 bound and unbound volumes, a catalogue of which has been made.

Another member of the Council of Management has also kindly donated a set of charts from the United States Hydrographers' Department, showing the St. Lawrence River from its mouth to Ile de Grace.

Now that we have secured a safe repository for our library, and other properties, in the Crown Lands Department, it is hoped that others will contribute in the form of books, maps, old instruments, or curios, of interest to the profession.

Accompanying this report is a statement of the receipts and expenditures for the association during the past year, which, when duly audited, will be presented

All of which is respectfully submitted.

A. J. VANNOSTRAND,

Secretary-Treasurer.

Toronto, 25th February, 1895.

STATEMENT OF RECEIPTS AND EXPENDITURES BETWEEN 26TH FEBRUARY, 1894, AND 25TH FEBRUARY, 1895.

1894-5.	RECEIPTS.		
To balance on hand 26th February, 1894			$752 94
" Amounts collected from advertisements in '93 Report		$ 25 00	
" " " " " '94 "		75 00	
			100 00
" Proceedings sold, 7 copies and postage			3 60
" 10 Registration fees, at $1		$ 10 00	
" 1 Annual Dues for 1st Association year, $4.00		4 00	
" 14 " " 2nd " " "		56 00	
" 148 " " 3rd " " "		592 00	
" 1 " " 4th " " "		4 00	
			666 00
" Interest accrued on $511.09 in Savings Bank			18 00
" Surplus from Board of Examiners' account			163 10
Total			$1,703 64

1894-5.	EXPENDITURES.	
By postage		$ 56 10
" Bank collections		75
" Printing circulars, wrappers, stationery and biographical blanks		50 85
" Publishing Report of Proceedings 1894 Annual Meeting		290 60
" Freight on exchanges received		2 41
" Customs brokerage on exchanges received		2 00
" Amount paid to Secretary-Treasurer for 1893		120 00
" Amount paid to Stenographer for 1894 meeting		35 00
" Rent of Rooms for 1894 meeting		10 00
" Blank books and forms		6 40
" Extra numbers of 1893 exchanges		39 80
" Extra numbers of 1894 exchanges		38 95
" Expenses of Council Meetings, April and November		10 00
" Expenses on copies of 1886 Report recovered		1 00
" Money orders when paying for 1893 exchanges		40
" Repairs to typewriter		35
" Amount paid for packing and shipping to exchanges		3 90
" Amount paid for tin box for papers		2 50
		$ 671 01
" Balance on hand in Savings account	$529 09	
" Balance on hand in current account	503 54	
Total balance		1,032 63
Total		$1,703 64

A. J. VANNOSTRAND,
Secretary-Treasurer.

REPORT OF AUDITORS.

We hereby certify that we have examined the accounts of the Secretary-Treasurer and vouchers therefor, as well as the financial statement, and have found them correct.

H. B. PROUDFOOT,
FRED. L. FOSTER, } *Auditors.*

Toronto, 25th February, 1895.

DISCUSSION.

Mr. Dickson—I think that idea of having the papers sent in several weeks before the meeting of the Association and printed is a capital one. It is a very difficult thing for any member who has never heard about a certain subject to get up and discuss it intelligently. In this way he can get his remarks ready beforehand, and either deliver them orally or read them out before the meeting. The only danger is that some of us might make it too long. I am afraid I would be inclined to do that myself. But I think if we made it just as short as we possibly could and made it sufficiently plain it would be a good thing.

Mr. Gaviller—I quite agree with what has been said. It would put the discussion in better shape and make it more intelligible.

Mr. Sankey—The principal object in making the suggestion was that we find as a rule the discussion is limited to the front benches; the men sitting in the back part of the hall are all more or less of a retiring and timid nature and they don't like to speak Then there is another class of men; they are the ones who know most about the subject probably, but don't like to make a statement that may hereafter be brought up against them. It may not be known that men of the legal profession look over our reports, and it may sometime be said: 'Well, you made such and such a statement in the Surveyors' meeting; are you prepared to go back on that?" You know we are not just merely a "little" meeting now-a-days; we have some weight in the country. We don't want to check discussion at all, but we want to give an opportunity of having a sensible and really business-like discussion on the various papers brought before us.

About the room we have secured in the Parliament Buildings, I think it is well to add that it is a very convenient room. The key will be in Mr. Kirkpatrick's office. We hope to make a collection of books of all kinds. We also wish to make a collection of maps and plans of all parts of the Province, or other countries. People sometimes want to get a look at a map that is not found in Canada. I know we can get maps from the various departments in Ottawa and Ontario that are useful for surveyors to have a look at; also old instruments, etc. We have already had a donation in that line. I would like to ask some of you to go up and look at the room.

Mr. Gaviller—There is a point I would like to draw attention to, that is as to members who find it impossible to attend the meeting sending in nominations in writing. They feel as it is that they are cut out entirely from taking any part in the nominations until the ballot is sent in, and then they find somebody perhaps whom they would like to see a candidate is not mentioned at all. I would like to hear the sense of the Association on that, because you all may be affected by it some day.

Mr. Sankey—I was in hopes that this matter would be discussed. In many cases members fail to send in their ballot papers marked for any one. They say simply: "We don't know any of the gentlemen proposed, and so we don't care to vote for them particularly," and I think in that way interest is to a certain degree lost in some sections

of the Province. If these nominations could be received by the Secretary before the annual meeting, he could read them out when the ordinary nominations are being made. There is just one point, I think, we ought to take into consideration in managing an Association of this kind where the members are so very much separated. A certain amount of concentration is undoubtedly necessary. We must be within reach of a certain quorum of our Council as the governing body of the Association. It is just possible that these nominations may have the effect of distributing the Council so far apart that practically the whole business of the Association would have to be done by letter writing. Of course, a great deal can be done in that way, but you can all understand it is very advisable to be able at times to discuss matters that will probably have to be discussed at two or three different meetings before anything arises out of them.

Mr. Speight—Do you know if that method of nominating candidates is adopted by any other Association?

Mr. Sankey—I can't answer that question; I don't know positively. But you know that our election is by post, so that, arguing from that backward, there is no reason why the nomination should not be by letter. We are not interfering with the electing powers of the Association at all, but we thought it advisable to bring this up for discussion.

Mr. Dickson—Supposing I should send in a nomination that was not seconded?

Mr. Sankey—Up to the present we have received nominations for the Council without a seconder. As a rule, our President and Vice-President have been elected by acclamation by standing vote in the room. Well, somebody might put in a name in a letter, and that would prevent the nomination being unanimous. As a rule, the Vice-President has been made President, and we have found it works very well so far. There is just a little feeling in some parts of the Province that they have not a chance of nominating men that they would like to vote for, but that could easily be done by writing to some member of the Association and asking him to propose so and so.

Mr. Dickson—I think there has always been a very fair representation here, and I have never heard anything said in the way of complaint at not having had a share in the nomination. Parties might send in a nomination and cause a great deal of trouble. I think those who take the trouble to come here, some a considerable distance—and I am sorry that more don't come—I think they should certainly have the privilege of nominating officers when all the members of the Association are equally asked to record their votes.

Mr. Sewell—I think the best thing is to leave well alone. Our nominations should be made here in the room. I think it is far the better way.

Mr. Gaviller—The Council are not going to act in haste in this matter, and that is one reason why Mr. Sankey and the Council are anxious to hear your opinion on it.

The report of the Council was then adopted.

REPORT OF PUBLICATION COMMITTEE.

MR. PRESIDENT,—This Committee has had but little to occupy it save the usual routine of business.

Eleven hundred and fifty copies of the Report of the Proceedings were printed by the Presbyterian Printing and Publishing Company at a cost of $290.60, being rather more than in former years, as the illustrations were more expensive, and the examination papers were added to the Report.

We continue to exchange our reports with other societies as in the past.

Members sending in "Papers" for publication are requested to have the accompanying diagrams accurately drawn on a scale suitable for insertion in the Report.

It is most desirable that all members of our Association would endeavour to forward the interests of our advertisers in every way in their power.

EXCHANGES, SENT TO

Iowa Civil Engineers and Surveyors' Society	55 copies.
Illinois Society of Engineers and Surveyors	100 "
Michigan Engineers' Society	140 "
Ohio Society of Surveyors and Civil Engineers	130 "
Indiana Engineering Society	130 "
School of Practical Science Engineering Society	200 "

Respectfully submitted,

KILLALY GAMBLE,
Chairman.

REPORT OF COMMITTEE ON BIOGRAPHY.

(Verbal Report. See Minutes).

REPORT OF COMMITTEE ON POLAR RESEARCH.

MR. PRESIDENT,—At the last meeting of this Association a committee of seven was appointed for specific purposes mentioned in the resolution which will be found on page 13 of the 1894 Report of Proceedings.

The purposes for which this Committee was appointed have not been interpreted literally by the Committee, but in a broader spirit.

This Committee has been an active one, all the members taking a keen interest in the problem.

We are of opinion that the Canadian Land Surveyors are better fitted for Arctic research than any other class of people on the globe, accustomed as they are to low temperatures, the use of toboggans, snowshoes and dog teams—fertile in resources, patient under adversities.

Your Committee would strongly urge upon the members of this Association to acquaint themselves fully with the history and geography of "Arctic Canada" and to give moral support to the promoters of Canadian expeditions

Your Committee presents herewith letters from Professor Angelo Heilprin, President of the Geographical Club of Philadelphia, who relieved Lieutenant Peary in 1893, respecting the organization of an expedition to relieve him in the summer of 1895.

From this correspondence it will be seen that the Association of Ontario Land Surveyors can send a representative in this expedition by contributing $1,000 towards the cost. While we believe that it would be foolish to send an expedition composed of inexperienced men north of latitude 80°, we do not think the Association can at present afford to contribute the large amount required to gain a summer's experience. We hope that there will arise from among our members some few who will volunteer to spend a year in North Greenland or Grinnel Land to gain the experience necessary before attempting exploring north of latitude 83°, and that the Association will contribute something towards the cost of outfit.

We are of opinion that our Governments, Federal and Provincial, will not consent to expend any large amount upon any exploring scheme that promises so little in return as a polar expedition. We must stimulate the patriotism of some of our wealthy men, upon whose liberality we must rely for the necessary funds, but we cannot appeal to them until we can prove the fitness of our men for the work. The men selected must have spent at least one year within the Arctic Circle in America before assuming to lead an expedition Volunteers for this work must be physically and mentally robust, possessed of indomitable will power, and must be prepared to sacrifice two or three years at least in a life of hardship

The party should not be large—say 12 men all told—supplied with three years' provisions, sledges, boats, dogs, snowshoes, etc., etc. The cost of such an expedition should not exceed $50,000 (possibly half this would do), a large part of which must go towards chartering a vessel to take the party and all supplies as far north, *via* Smith Sound, as possible.

For the present the Association can do nothing, but the individual members can awaken public interest in Arctic Canada, and arouse enthusiasm by recounting the adventures of the many noble men who have explored the north coast of America and the archipelago of islands to the north of it.

With the hard-fisted utilitarian we cannot afford time to argue. We can only refer them to the long list of talented, educated and brave men who spent years in Arctic research.

Frobisher, Hudson and Baffin were representative of the seventeenth century. In the next hundred years Behring discovered the strait between Asia and America, Wrangell the land named after him, while Hearn and Mackenzie explored the central part of British America.

In our own century we have Scoresby, Ross, Parry, Franklin, Back, Dease, Simpson, Richardson, Rae, McClure, Collinson Penny, Austen, Belcher, Osborn, Kellatt, McClintock, De Haven, Dr. Kane, Hall, Koldeway, Nordenskiöld, Payer, Weyprecht, Smith, Nares, Markham, Schwatka, De Long, Greely, Lockwood, Nansen, Peary.

This list is not a complete one, but we cannot read the history of the lives of those men without a feeling of pride to know that the great majority are of the Anglo-Saxon race, whose example we should not hesitate to follow. We should not rest until British North America has been fully explored and mapped. This large region probably contains the largest area of unmapped territory in the world, not excepting Central Africa, the Sahara, or North-western Australia.

WILLIS CHIPMAN,
Chairman.

REPORT OF COMMITTEE ON DRAINAGE.

MR. PRESIDENT,—Your Committee on Drainage beg to report as follows:

For the past few years the whole drainage question in this Province has been most carefully investigated in all its bearings with the object of having the laws respecting the same drawn up so as to meet any case that might arise, in a manner that would do justice to all parties, and clearly indicate on what lands and in what proportion the cost of constructing and maintaining drainage works should be levied without draining the pockets of the owners of the lands instead of their lands by unnecessary litigation. As a result of all this painstaking research, The Ditches and the Watercourses Act, of 1894, became the law of this Province on the fifth day of May last, and an Act to consolidate and amend the Drainage Laws, received the royal assent at the same time, and came into operation on the first of June. Drafts of these Acts were sent out in 1893 to "councils, surveyors, public officers, etc., etc., with a view to the expression of public opinion thereon," and at the Annual Meeting of this Association a year ago the Drainage Committee only suggested a few comparatively unimportant changes, but these, with one solitary exception, met an untimely fate. However, several important amendments were made in the bills before finally becoming law in 1894, among which may be mentioned the changes in Sections 59 and 60 of the Drainage Act, when work is extended into another municipality. The Act of 1894 provides for the initiating municipality to complete the whole work, instead of having each municipality extend the drain beyond its limits as was proposed in the draft of 1893.

A corresponding change was not made in Sections 69 and 70 as to maintenance of a drain continued into or through more than one municipality but each municipality is to maintain the portion in such municipality at the expense of the lands and roads in any way assessed for the construction thereof and in the proportion determined by the engineer, or surveyor, in his report and assessment for the

original construction. This may seem simple enough but in actual practice there is reason for careful enquiry. Suppose a case where the drain is continued into three municipalities, and any one township repairs the portion therein, should the lands in all three townships be assessed for the work done in any one? This would be perfectly fair only when the repairs are undertaken in all three municipalities about the same time.

In the Ditches and Watercourses Act an important change was made in Sec. 5 of the 1893 draft, as to the limit of the work which enables a drain to be extended without a petition into seven instead of five original township lots, and considerably increases the "one man's power" of which so much is heard at meetings under this Act, where there is opposition to the proposed work

Some cases have already come up before the referee, where assessments have been made under Sub-Secs. 3 and 4 of Sec. 3 of the Drainage Act of 1894, but we do not know of any where the decision has yet been given. It has been found very difficult to distinguish between "outlet liability" and "injuring liability." Sub-Sec. 5 of Sec. 3 specifies that the assessment for injuring liability and for outlet liability shall have regard to the speed of the water artificially caused to flow upon the injured lands or into the drainage work Does this mean the speed with which the drainage work carries off the water from the lands or roads liable for such assessments? The principles that guide the relative amount of assessment for "benefit" and outlet seems as elusive as ever and will probably be fought over and over again in the courts.

Sub-Sec. 4 of Sec. 3 provides for assessing the lands and roads of any municipality, company or individual using any drainage work as an outlet, either directly or through the medium of any other drainage work, or a swale, ravine, creek or watercourse. The interpretation of this has already been argued before the referee. Does this in any case cover the cost of works constructed before the Act came into force? Can uplands, draining through a large swale, with no perceptable current, be assessed? From the decisions that may be given, these questions may be answered a year from now. In the meantime your Committee would ask all members to send full notes on all decided cases of any importance to the Chairman of the Drainage Committee; otherwise many interesting points of much value may not become known to the majority of the members. Owing to the changes made in the Drainage Act, the decisions in several cases that have been tried during the last year or two, are not of so much value as they would otherwise be, but they all shed a certain amount of light on the miry path and a list of several is hereto appended with some notes or extracts from the digest in the law reports.

On the whole about an average amount of drainage work was undertaken during the past season, and the new Acts are considered to be a decided improvement on the former drainage laws and when better understood will no doubt prove very satisfactory.

All of which is respectfully submitted,

GEO. ROSS,
Chairman.

22 Ont. Reports, p. 664.

Re Suskey and the Corporation of the Township of Romney. Argued Nov. 22, 1892, before Boyd, C.

A by-law amending a drainage by-law under Sec. 573 of the Consolidated Municipal Act, 1892, "in order fully to carry out the intention thereof" where sufficient funds have not been authorized by the original by-law, is one which provides for the completion of the work, so as to make it efficient, although there may be some deviations and variations, or even additions to the work as originally planned.

During the construction of the drain it was found that stone portals were needed for the work, and that the outlet to the lake had to be deepened, and certain other extra work and necessities were recommended by the engineer. *Held* that the by-law providing for them was an amending by-law under Sec. 573 of the Consolidated Municipal Act, 1892, and that the township council had power to pass it under that Section.

23 Ont. Reports, p. 651.

Queen's Bench Division, Williams *v* Richards *et al.*

WATERS AND WATERCOURSES.

That cannot be called a defined channel or watercourse which has no visible banks within which the water can be confined, and an occupant or owner of land has no right to drain into his neighbour's land the surface water from his own land, not flowing in a defined channel.

The rule of the civil law that the lower of two joining estates owes servitude to the upper to receive all the natural drainage, has not been adopted in this Province.

Judgment by Robertson J. at Chatham Spring Sittings, 1893, confirmed by Divisional Court, June 10, 1893

23 Ont Reports, p. 99.

COMMON PLEAS DIVISION.

Close *et al*, *v.* the Corporation of the Town of Woodstock. Tried before Falconbridge J., 12 March, 1891.

A Municipal Corporation having constructed a drain without by-law for a particular portion passing through private property whereby noxious matter was brought down and deposited thereon, was held liable for damages sustained thereby, notwithstanding that there were excavations on the land but for which the noxious matter might have passed off; the owner not having been bound to leave his land in a state of nature; nor was it answer that the drain was used for similar purposes by others as well as the corporation. In such a case the remedy is by action and not by submission to arbitration.

21 Ont. Reports, p. 12.

QUEEN'S BENCH DIVISION.

York *et al. v.* Township of Osgoode *et al*, Ditches and Watercourses Act.

Where the engineer of a Municipal Corporation purports to make an award under the Ditches and Watercourses Act, with respect to the making of a drain, the affirmance of such award by the County Court Judge does not preclude the High Court from entertaining the objection that the engineer had no jurisdiction to make the award, nor is such an objection one for the CountyCourt Judge.

The decision by the County Court Judge as to matters over which the engineer has jurisdiction cannot be reviewed by the Court; and whether the plaintiffs were benefited by the proposed work was a matter to be determined by the engineer and subject of appeal to the County Judge.

Judgment by Falconbridge J., 12th May, 1893. Confirmed by Divisional Court, June 10, 1893.

In this case a majority of the owners were required under the Act of 1883, and it was held that "owners" were persons assessed as such.

21 Ont. Appeal Reports, p. 168.

At the Court of Appeal, April 16, 1894, it was decided that "owners" were actual, not assessed owners. This reversed the decision of the lower court, but the term "owner" is now defined in the Act of 1894.

25 Ont. Reports, p. 399.

CHANCERY DIVISION.

Re Jenkins and the Corporation of the Township of Enniskillen.

A township council, finding that a government drain in the township did not carry off the water by reason of the natural flow being in another direction, accepted a report made by their engineer, and passed a by-law adopting a scheme for a new drain, leading from the middle of the government drain into an adjoining township, where it was to find an outlet:—

Held, that the proposed drain properly came within the description of a new outlet, although not at the end of the government drain, and although the former outlet remained to serve to carry off a part of the water; and so long as the proposed drain was designed merely as an outlet for the water from the government drain, it might, under Sec. 585 of the Municipal Act. of 1892, be provided for without any petition under Sec. 569, even although it should incidentally benefit the ocality through which it ran, nothing being included in the plan beyond what was reasonably requisite for the purpose intended.

Although a township council is not powerless with regard to the prainage report of its engineer, it is contrary to the spirit and

meaning of the Act that two adjoining councils should agree upon a drainage scheme and upon the proportion of its cost to be borne by each, and that the engineer of one of them should be instructed to make a report to carry out the scheme and charging each municipality with the sums agreed on; for such a course would interfere with the independent judgment of the engineer, and pledge each township in advance not to appeal against the share of cost imposed upon it, to the possible detriment of the property owners assessed for the portion of that share.

And where such a course was pursued, a by-law of one of the councils, adopting the engineer's report, was quashed.

In describing lands for assessment "the north east part," even with the addition of the acreage, is an ambiguous description; and *quære* as to the effect upon the validity of a by-law.

Judgment by Street J., July 21, 1894.

25 Ont Reports, p. 465.

COMMON PLEAS DIVISION.

The Canadian Pacific Railway *v* the Corporation of the Township of Chatham.

Cost of culvert built by railway under agreement with defendants at a cost of a little over $200. Agreement held to be ultra vires and not coming under Sec. 573.

Judgment by Street J., June 15, 1893, and affirmed by Divisional Court, Rose J., dissenting.

30 Law Journal.

P. 105, Dagenais *v* Corporation of Trenton; p. 687, Stephens and the Township of Moore; p. 730, Harwich and Raleigh.

20 Ont. Appeal Reports, p. 225.

Hiles *v.* Ellice, Crooks *v.* Ellice.

23 Supreme Court of Canada, p. 429.

Upon reference of an action under the Drainage Trials Act of Ontario (54 v. c. 51) whether, under Sec. 11, or Sec. 19, the Referee has full power to deal with the case as he sees fit and to make of his own motion all necessary amendments to enable him to decide according to the very right and justice of the case and may convert the claim for damages under Sec. 11 into a claim for damages arising under Sec. 591 of the Municipal Act.

The referee has no jurisdiction to adjudicate as to the propriety of the route selected by the engineer and adopted by by-law, the only remedy, if any, being by appeal against the project proposed by the by-law.

A municipality constructing a drain cannot let water loose just inside or anywhere within an adjoining municipality, without being liable for injury, caused thereby in lands in such adjoining municipality.

21 Ont. Appeal Reports, p. 504.

Gibson *v.* Township of North Easthope.

Judgment 30 June, 1894, reversing decision of Queen's Bench Division. Withdrawal from petition.

Township of Rochester *v.* Townships of Mersea and Gosfield.

This was a case in which the Township of Rochester undertook to repair that portion of the Ruscom drain in their township which was constructed originally under a by-law of the County of Essex, and under which certain lands in Mersea and Gosfield were assessed, as well as the lands in Rochester, certain work at that time having been performed in Mersea and Gosfield.

The points raised were that the referee had no jurisdiction, and that if he had, the work was legal under the old Act, and upon the facts the appeal should be dismissed, in this the referee held that he had jurisdiction, and dismissed the case upon the facts, Rochester from this decision of the referee, appealed to the Court of Appeal, in which the referee was upheld as far as the facts were concerned but did not decide as to his jurisdiction, virtually disallowing Rochester's appeal.

Decided by Court of Appeal, 1895.

The municipal law requires considerable modelling to meet the ever-changing necessities, but frequently attempts to better it have proved the reverse, yet there is one case in which, in our opinion, a change is necessary and desirable. More particularly is this the case in this part of Ontario where drainage assessments form one of the principal burdens of the farmer. No one is secure from such an assessment and any legislation that can lighten the burden ought to meet the approval of a majority of the legislature, which is composed very largely of farmers or men interested in farming lands. We have now a direct case in point. Some time ago parties who live near the mouth of Sturgeon Creek, applied for relief to the municipal council of Mersea, claiming that their lands were flooded by waters brought down the creek and that they would hold the council responsible unless relief was granted. The lands in dispute are about 35 acres, which are liable to be flooded at any time that a freshet occurs. The council, it appears, has no option in the matter if the petition and demand is in accord with the statute. In accordance with the appeal, they appointed an engineer to examine into the matter and make a report. This was done, the report accepted, and the engineer instructed to make an assessment, which he did, no doubt to the best

of his ability, and in doing so, assessed the Township of Gosfield $136 for injuring liability. That township appealed and the case came before His Lordship Justice Britton who, after hearing all the evidence, reserved decision. The cost of repairing the drain or enlarging it, so as to prevent the flooding complained of, was about $1,000 and the costs of reference will be in the neighborhood of $500 or about $43 an acre for the lands occasionally submerged. The same trouble is likely to occur again and again, and under the present law there is no redress. The municipality must make the survey and assessment. Were the law so amended that the municipality interested could acquire such land by right of purchase, assessing parties for payment who would be liable were a drain constructed, it would settle the matter for all time, and prevent any demands being made for damages. United action should be taken by the municipalities in Kent and Essex and strong appeals be presented to the Government for redress.—*Leamington Post, February 14th, 1895.*

DISCUSSION.

Mr. Gibson—I had a case last fall in which the party through whose land the ditch would be made (where there was no ditch before) objected to the whole proceeding, on the ground that there was no provision made apparently under the Ditches and Watercourses Act for being recouped for the damage that the ditch would do, and asserted that if I went on and made my award, as is generally done under the Ditches and Watercourses Act, he would enter an action for damages—that it would undoubtedly be a damage to the land. Now, the question is this: Under the Drainage Act of 1894 there is an injuring liability and outlet liability and benefit liability, but under our Ditches and Watercourses Act there is no provision made apparently for a person being recouped for any injury that may be done him over and above the benefit. I have a case in the Township of Vaughan where the party claims that if I go on and make my award that it will be a very great damage to him Now, does the Ditches and Watercourses Act provide for injury, or is it necessary to appeal to the courts on common law principles for damages? Of course, at the same time I advised the parties that I would make my award in such a way as to do as little damage as possible, and that afterwards, when they got over their temper, they could probably dig the ditch and nobody would say anything about it.

The President—I have learnt that there is a good deal of difficulty in the interpretation of Sub-sec. 5 of Sec. 3 of the Drainage Act in the construction of drainage work. "The assessment for injuring liability and outlet liability provided for in the two next preceding sub-sections shall be based upon the volume, and shall also have regard to the speed of the water artificially caused to flow upon the injured lands or into the drainage work from the lands and roads liable for such assessments." That question, I believe, has been up two or three times before the Drainage Commissioner, and there has

not yet been an engineer who has been able to answer it What does it mean? An expression of opinion from this Association would be a help to the members who have to work at it, and would without doubt assist the Drainage Commissioner very often in coming to a decision. Does that mean that the engineer is to take that water in flood time and calculate its velocity, or in the normal flow of the channel, or under what conditions?

Mr. Gibson—He would have to consider the difference in the volume before the ditch was made and after.

Mr. Bowman—You may remember, gentlemen, that our Drainage Report last year touched on this point, adjusting between "injuring liability" and "outlet liability," and our recommendation was that that method of assessment be left optional with the engineer. From what we could tell at the last meeting, very few drainage engineers understood what was meant, and it seems to me that we are not called upon to advise the Drainage Referee how to carry out this Act. They enacted against our wishes, and if they have got into a muddle they had better get out, or repeal it and leave it optional, as we suggested.

The President—If it is something that is unworkable, let us point it out.

Mr. Gibson—What right have they to refer in the Act to the volume of water? They should just let it alone.

The President—Who put that there?

Mr. Ross—The Drainage Commission.

Mr. Gibson—That is hampering the engineer; they should not have put it in at all. He should be allowed to judge between "injuring liability" and "outlet liability."

The President—Would it not be advisable for the Drainage Committee to formulate an explanation, showing that this on the face of it is something that is ambiguous and absurd, and lay it before the Commissioner of Crown Lands and ask him to have it remedied?

Mr. Ross—The opinion of the Drainage Committee was that we had better not ask or suggest any changes just now; that probably we would understand this Act a little better in a few years. We did not know exactly what some of it meant, and some of these cases I have referred to in my report may be decided, so we thought it better to make no suggestions at present. In the discussion last year there was not a member here who could say why "injuring liability" should be different from "outlet liability," and we recommended that "outlet liability" would cover the whole case. When drainage work is constructed I don't think any lands should be injured. It should be constructed large enough so that no lands would be injured, and I think that is the intention of the Act. That case I read from Mersea covers "injuring liability" very clearly. Of course, it is the lands that are assessed for outlet that pour water down on these lands that

are assessed for "injuring liability," but it is practically the same as "outlet liability" as far as I can see.

Mr. Gibson—For instance, in making half a mile or a mile of a ditch you make a large cut that separates one portion of a man's land from another; that is a direct damage or injury to that land, and he might appeal to the court as a matter of common law for redress.

Mr. Ross—Under the Drainage Act, you can provide for such things, construction of bridges and the disposal of the material excavated

Mr. Gibson—That is provided for under "outlet" and under the ditch itself, but my land might be damaged materially by putting a wide, deep ditch through it, and I say that is injury.

Mr. Ross—That does not come under "injuring liability."

Mr. Gibson—But I say it is common sense. If the ditch does me a damage I ought to be recouped for it. It should be put in that way.

Mr. Robertson—I think amongst surveyors up west it is very much as it is in other places: there is considerable difference of opinion with regard to assessing for "injuring liability" and "outlet liability." At the same time probably there is some reason for assessing for both and having them assessed separately. I think the intention of the persons who constructed the Act is this, that when you can describe an area that is injured by water being carried down by the construction of drains in higher land then you would assess for "injuring liability." For "outlet liability" you can go up stream on a natural water course for the construction of a ditch that carries water in that direction, as far as you like, even although there may be a certain amount of land along each side of that water course that might be injured more or less. I think the assessment would not come under the head of "injuring liability"; that would be "outlet liability" right to the head of the drain, with the exception of what you would assess for benefit. With regard to the section referring to the volume and flow of water, I think the intention is this: that if there is one water course that carries water from higher land into the drain you are constructing and assessing for with greater rapidity than another one that might come in in another direction through lower land with less velocity, the water that comes from the higher area will get down into the lower land in a greater volume in the same time than the same area draining in from another direction with smaller fall. In that case they should probably pay more.

Mr. Bowman—Have there been any cases under the new Act yet before the Referee?

Mr. Robertson—Yes, there are several cases. There was a case in the Township of Sarnia and Township of Plympton. The Township of Sarnia constructed a drain, some 27 or 28 feet fall, to

the town line, and I think one of the grounds of appeal was that the Township of Plympton should have been assessed for "injuring liability," while they were only assessed for "outlet liability." The Referee held that "outlet liability" was all right, and it was not necessary to assess them for "injuring liability."

Mr. Ross—Was the decision of the Referee that "outlet liability" covered both?

Mr. Robertson—No, but that it was only necessary to assess the lands under the head of "outlet liability." There was no assessment for "injuring liability."

Mr. Ross—I think myself that is the easiest way to get out of it, and I think your definition there is probably the right one That is the only way I can see it myself; but, of course, all the waters that come down from higher lands above would tend to injure the lower lands as well as water that comes down quickly from adjacent lands. Suppose you had a large area of marsh and 1,000 acres, say, bordering that marsh. There is, say, half a mile where the slope is pretty rapid, perhaps 15 or 20 feet in half a mile, and then up above that there is a gradual rise, would you assess the lands on this slope for "injuring liability" and the upper lands for "outlet liability."

Mr. Robertson—No; I would certainly assess them for both in that case. In my opinion the assessment should certainly be both for "injuring liability" and "outlet liability" where there was a lower level that was injured by it; that is, a defined area that could be described.

Mr. Ross—And this marsh would all be assessed for benefit?

Mr. Robertson—Yes; you would, of course, try to define your limit of benefit. As I understand it, drains are constructed from this higher land to the marsh, thus injuring it. It is necessary for the improvement of this marsh land, or land that is injured, to relieve it from the injury and to improve it; it is necessary to construct a drain The construction of that drain will benefit this low land; assess this low land for benefit and outlet. Up here we come to where there is no benefit by the construction of that drain, but still those lands pour their water down on this land. Then, what I maintain is this: that all this area should be assessed under two heads, for "outlet" and "injuring liability."

Mr. Aylsworth—What do you call "injuring liability"?

Mr. Robertson—For relieving this place of the water that they pour upon it; they have a right to help to carry it off.

The President—The only question is how to distinguish the "outlet" from "injuring liability."

Mr. Robertson—That is a matter of judgment.

Mr. Ross—You take a case, an acre of land in that marsh and assess it so much for benefit, say $5; how much would you assess it for outlet?

Mr. Robertson—Well, the "outlet liability" is generally in proportion to the distance the water has to be carried through the drainage work, and cost of that.

Mr. Ross—In that case there is a main drain made across that marsh to the upper side of it.

Mr. Robertson—It is a pretty difficult matter to put it in figures.

Mr. Ross—In what relative proportion would you make that assessment for "injury" and for "outlet."

Mr. Robertson—Well, of course, the proportion for benefit would have to be determined entirely upon the amount of benefit that was going to be received; and then all the land probably should not be assessed very differently from the same rate per acre if it is all using the same length of outlet.

Mr. Aylsworth—Supposing that upper plateau had not been drained at all—they just depended on the furrows in plowing and it naturally drained itself; could you then assess for "injuring liability"?

Mr. Robertson—I think probably then it would hardly be right to assess for "injuring liability."

Mr. Gibson—If the upper lands join in the petition for it, then they are in for it.

Mr. Ross—Here is another case from Mr. Baird: "At the reference it seemed to be difficult to draw the line between 'injuring liability' and 'outlet liability,' in which, in fact, I cannot see very clearly where the line could be drawn. It also seemed to be held that when a man was assessed for benefit that it should be equal to the value of the land when placed in a state of cultivation, which to me seems erroneous, and should only be to the extent that it would cost these lands to construct a sufficient drain." Can you explain that?

Mr. Robertson—My opinion is this: Supposing these upper lands were in a state of nature; if these lower people wanted to drain their lands, they should construct and pay for a sufficient drain themselves. But as soon as those people begin to pour their water down by artificial drainage, changing it from a state of nature, I think that they should contribute.

REPORT OF COMMITTEE ON TOPOGRAPHICAL SURVEYING.

Mr. President,—Owing to the fact that the members of this Committe reside at such widely separated points, it was found impossible to secure a quorum for the transaction of business, except on the first day of this Annual Meeting.

An informal meeting of surveyors interested in this work was held, on the invitation of the Chairma n, in Toronto on December 31st,

1894, to discuss the preliminary steps of procedure, at which the following surveyors were present :—

W. F. King, D.T.S., Chief Astronomer, Department of the Interior, Ottawa.
G. B. Kirkpatrick, O.L.S., Director Crown Land Surveys (Ontario), Toronto.
John Galbraith, M.A., Professor Engineering School of Practical Science, Toronto.
L. B. Stewart, O.L.S., Professor Surveying School of Practical Science, Toronto.
A. J. VanNostrand, O.L.S., Secretary Association O.L.S., Toronto
V. Sankey, O.L.S., President of Council O.L.S., Toronto
F. L. Foster, O.L.S. (of Unwin, Foster, Murphy & Esten), Toronto.

At this meeting, after several hours of earnest discussion, it was decided to ask each member of the Committee to communicate with some country where geodetic and topographic surveys have been made, and ascertain officially the *commercial* advantages that may be expected to follow, especially pointing out the benefit the agriculturist will reap therefrom.

On January 10th, 1895, a circular letter was sent out by the Chairman advising each member of the informal meeting and the conclusion arrived at, and each was requested to communicate with the country set opposite his name, as follows:—

Casgrain, J. P. B.	Montreal	France
Cozens, Jos.	Sault Ste. Marie	U.S. Lake Survey
Chipman, Willis	Toronto	U.S. Coast and Geodetic Surveys
Dickson, Jas	Fenelon Falls	Great Britain (Scotland)
Fawcett, Thomas	Ottawa	Sweden and Norway
Klotz, Otto J.	"	Germany
Ogilvie, William	(absent in Alaska)	
Russell, A. L.	Port Arthur	Spain and Portugal
Sankey, Villiers	Toronto	Great Britain (England and Ireland)
Stewart, Elihu	Collingwood	Russia
Tyrrell, J. W.	Hamilton	Austria

With few exceptions the members assumed the responsibility of seeking the information asked for, but to date replies have been received from the United States only. No doubt, full replies will be received from all shortly.

Your Committee recommends that the Association empower it to consult with the Ontario Government when convenient respecting the action to be taken after the data is received from foreign countries.

WILLIS CHIPMAN,
Chairman.

DISCUSSION.

Mr. Bowman—It seems to be recommended that the Committee immediately upon receiving this information interview the Government. It seems to me that would be a little premature; it would be better if the information were laid before the Association and the members thus informed as to the great advantages to be derived from a topographical survey, so that when the representatives begin to inquire throughout the province we will have a united opinion upon the matter.

The President—It seems to be pretty well settled amongst surveyors that they will unite. The thing is not to postpone it too long; it takes years to get the slightest movement in these cases.

Mr. Gibson—I think they have gone about this matter in a very excellent way, getting the data that is required. The Government wants facts before they take it up at all.

Mr. Dickson—I think the intention is to get all the data they can and then get together and formulate a report, and at some convenient season interview the Government. I don't think there is a single individual member of this Association but will heartily endorse the scheme, and if it is a feasible scheme it should be carried out. I think it should be adopted in Canada with the least possible delay.

Mr. Sankey—I would suggest that Mr. Chipman just give a short outline of the probable benefits to be derived from it. In that way I think the objection taken by Mr. Bownan, which I think is a good one, that the members of the Association should have as much knowledge regarding it as possible, could be met and the ground covered sufficiently at present.

Mr. Chipman—I might say, Mr. President, that the question of cost is well understood by all engineers and surveyors. It would depend upon the accuracy of the work and the amount of detail work done. The first thing to be done of course is the primary triangulation work, and it appears to be the opinion of the Committee that this work can be best done by the Dominion Government, and possibly the secondary triangles, but that the topographical work, all the detail work, must be done by the Provincial Government and by the municipalities. In the circular sent to the members, requesting them to communicate with the different foreign countries, it was specially stated that we did not wish any information respecting the cost or the benefits to be derived from a military standpoint or the advantages to be derived by navigation. We all know that it is patent to any one that this is not a military country, it is an agricultural country chiefly. The reply I have received from the United States Coast Geodetic Survey may be of some interest to you. (Reads letter in reply to letter of January 15th.)

I regret to say that is the only communication we have received, as stated in the report, but I have not the least doubt but that others will be received very shortly.

As to the remarks made by Mr. Bowman, the Committee concluded that it would be better to take the Government into our confidence at once. We believe that the members of the Government may require considerable enlightening on this subject, and it will take at least one year to enlighten them even up to our present plane of knowledge on this matter. It will take some time, but I believe if we once get them interested in it that we will have no difficulty in getting the work started. The primary triangulation of course must be done first, and if the Ontario Government would urge the necessity of it upon the Dominion Government it would probably be commenced, but we cannot ask the Ontario Government to go on with any work until the primary triangulation work has been commenced, that

is out of the question. We, therefore, decided to first interest the Ontario Government in the proposed work. We must not forget that the Commissioner of Crown Lands is one of the officers of our Association, and I think he should be consulted in this matter.

Mr. Dickson—I do not anticipate that when we go to the Government to ask them to do this that they will do it. It will take some time to work it up, and every member of the Association, and I think farmers as well, might be interested in its behalf. I think we might naturally expect even the Patrons to fall in with it. But I think it will be some time before we get either Government sufficiently interested to say that they will do it, so that we have got to keep at it until we get some substantial progress made.

Mr. Bowman—The explanation given by Mr. Chipman, I think covers what was wanting, and that is that the Ontario Government is not at present asked to make any outlay, only to communicate with the Dominion Government in regard to the advisability of commencing the primary triangles, and I think we can trust to the Dominion Land Surveyors at Ottawa to supply the necessary information there.

Mr. Aylsworth—I think that this survey is going to be a grand thing, even for the farmers themselves, and I think they are the ones we might start with first and educate them. If I understand this topographical survey scheme, it is a large topographical plan just the same as you get up for a sewer system in a city, shows the grades of streets, heights, etc , and it is going to show the water courses and all the depressions and elevations.

Mr. King—It seems to me that the main thing is to get in the information that Mr. Chipman has mentioned, and the Committee is already acting in that line to get information from all countries that have made such surveys as to what actual commercial benefits, etc., might be received from it. If you can get strong evidence in that line it would greatly strengthen the case in this country. As to the cost of triangulation or topographical survey, of course it all depends upon how much detail you put in. I believe a good survey can be made for $20 to $30 per square mile, that will be sufficient for general purposes in this country ; including plans and everything. I know you can spend a great deal more money on it if you please. The United States Coast Survey made a very full and complete survey of the part of the District of Columbia around the City of Washington which cost $1,500 a square mile. That goes down to very minute, detail, though ; gives contour lines of four or five feet. They made a little model of it and exhibited it at the World's Fair, and it gives a bird's eye view, as it were, of the district. That cost is of course apart from the cost of primary triangulation. In most surveys there are three triangulations, the primary triangulation which covers sides of thirty or forty miles long perhaps. Those are done with the great-

est accuracy. Then the secondary triangulation, which divides the area into smaller triangles of six to ten mile sides, and then the tertiary triangulation, which is a part of the topographical work, but the cost of that is included. When we say that topographical work costs so much per mile, that includes the primary and tertiary triangulation. The greater part of Ontario being flat, the sides of the primary triangles would be short, ten or twelve miles, and the topographical triangulation would be tied on them so that the survey would not be as expensive as the usual topographical and geodetic survey.

REPORT OF THE LAND SURVEYING COMMITTEE.

Your Committee beg to report as follows :—

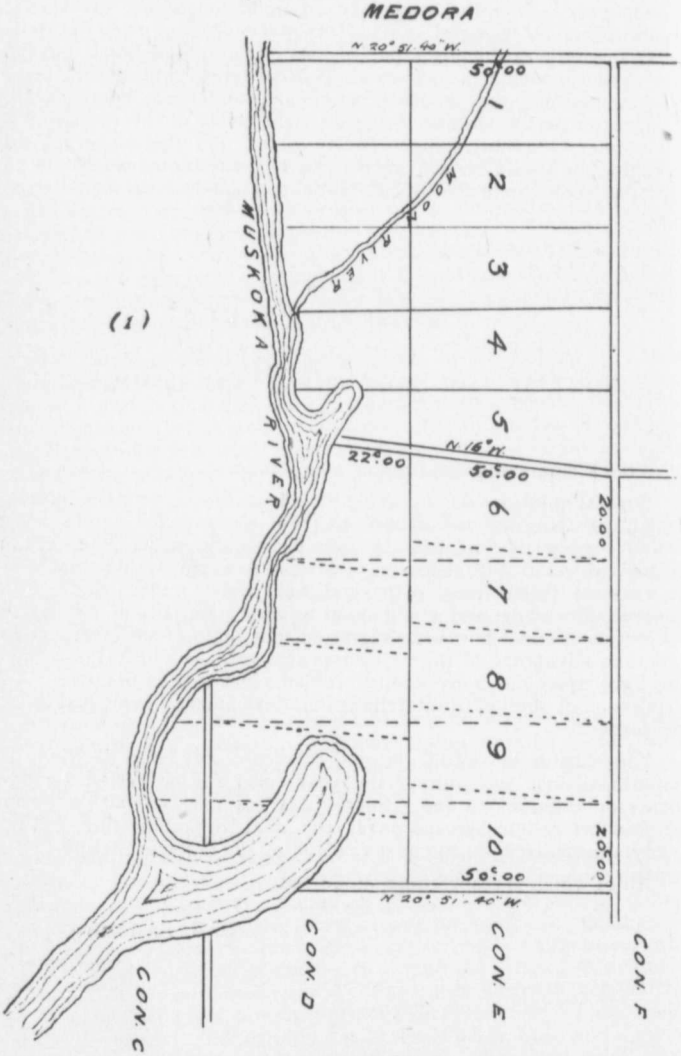
Several questions on surveying have been sent to your Committee, which questions and the answers to them are annexed hereto. We would suggest that members in submitting questions as to surveys in townships would state the name of township, as this would enable us to examine instructions, plans and field notes under which such surveys were made, and would assist us very materially in arriving at correct solutions. It is to be regretted that more of our members do not take advantage of the "Question Drawer" as a means of throwing light upon the many knotty problems met with in practice. An expression of opinion or interchange of ideas must be beneficial to all concerned.

Your Committee would be glad to receive any court decisions of importance met with during the year; also any suggested amendments or additions to the "Survey Act" of 1887, so that they may be laid before our Association at the next annual meeting, and be ready, if necessary, for the next revision of the Ontario Statutes.

All of which is respectfully submitted.

T. B. SPEIGHT,
Chairman.

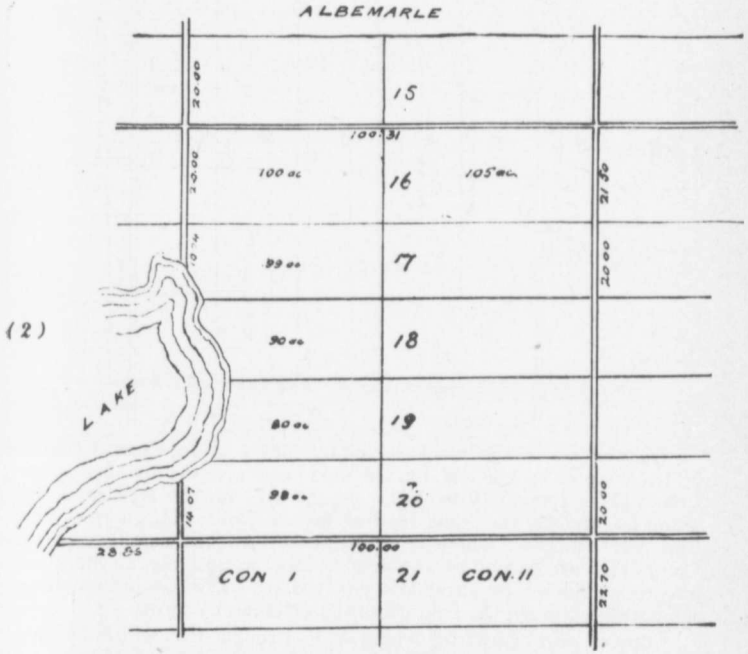
QUESTION DRAWER.



Question 1.—On which course should side lines of lots 6 to 10 be run?

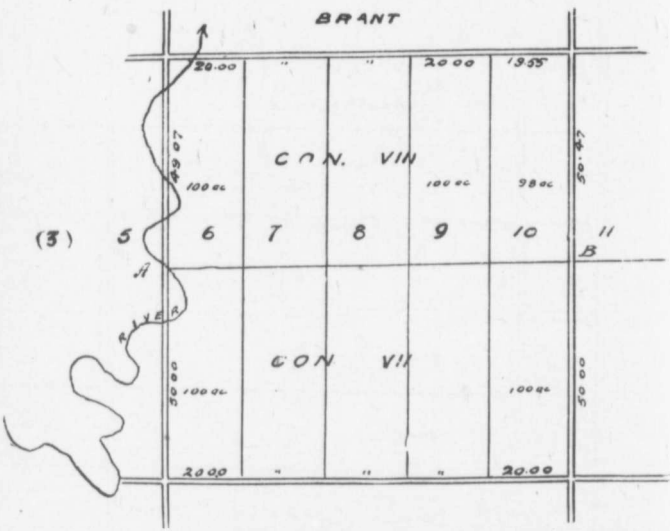
Original plan shows bearings of all side lines to be N. 20° 51' 40' W. Asty. Bearing of side line 5 and 6 as run in original survey is N. 16° W. Ast. This side road is plainly marked on the ground. The river is the south boundary of the township.

Answer.—On same course as line between Lots 5 and 6.—(Sec. 59).



Question 2.—In that block, including lots 16 to 20, Cons. I. and II., East Bury Road, there is a part of a lake on the fronts of lots 17, 18, 19 and 20, Con. I., as shown on the sketch. How would you run the lines between these lots, as there were no posts planted at the fronts, being in the lake?

Answer.—Divide widths of broken fronted lots proportionately by measuring along blind line.—(Sec. 54).



Question 3.—In the block including lots 5 to 10, Cons. VII. and VIII., the post at A is lost, but the field notes give the distance across Con. VII. as 50c. and Con. VIII. as 49c. 07l. on the side road, lots 5 and 6; and on the side road at lot 10, Con. VII., is 50c., and Con. VIII. 50.47. There is a post at B. All the lots except 10, Con. VIII., are deeded as 100 acres. How would you run the blind line in this block? or across lots 5, 6, 7, 8, 9? The concession lines are parallel, though the field notes show different widths.

Copy of part of instructions to A. P. Brough, P.L.S., 7th of May, 1850, to survey part of the Township of Brant: "You will proceed to subdivide the residue of the Township of Brant into farm lots of 100 acres each, in conformity with the accompanying projected plan, tracing all concession and side road lines in the centre of the road allowances, which are to be one chain in width, and planting the posts, duly inscribed with a marking-iron, at the distance of 50 lks. from your lines. The lots are to be 20 chs. in breadth by 50 in depth, with road allowances between each alternate concession and every fifth lot."

Original field-notes show blind line posts.

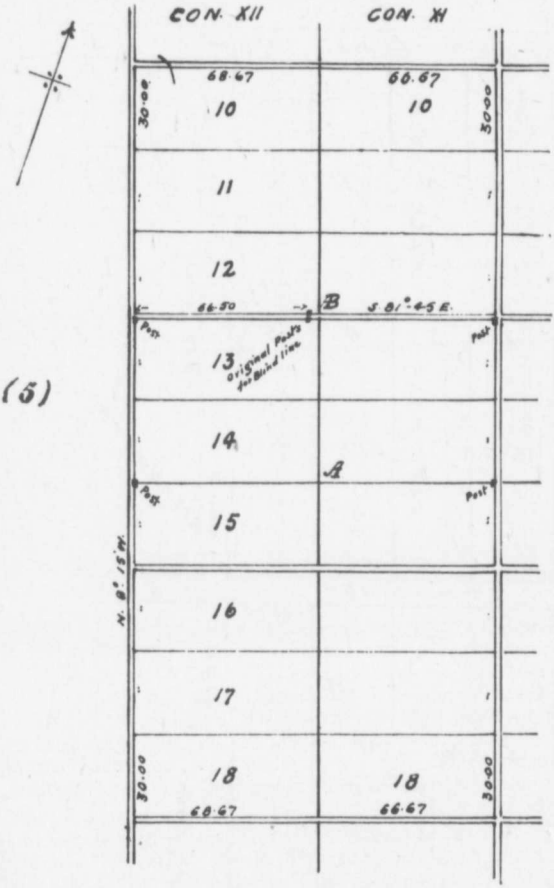
Answer.—For theoretical depths of Lots in Con. VIII, proportion plan depths on side roads. Use depths thus obtained in proportioning for blind line. (See Sec. 57 Survey Act; also pages 96 and 97 of 1888 Report Association, P. L. S.). Accept post at B, if evidence satisfactory.

Question 4.—How to establish A B ?

Concession line between V. and VI. has been opened and travelled on for the last fifteen years, statute labor being done on same during that period, Nothing on ground from A to B to fix line. Township surveyed in 1822.

Answer.—Fix point at A by dividing the four concessions proportionately between undisputed corners.—(See Sec. 60). Join A and B.

(5)

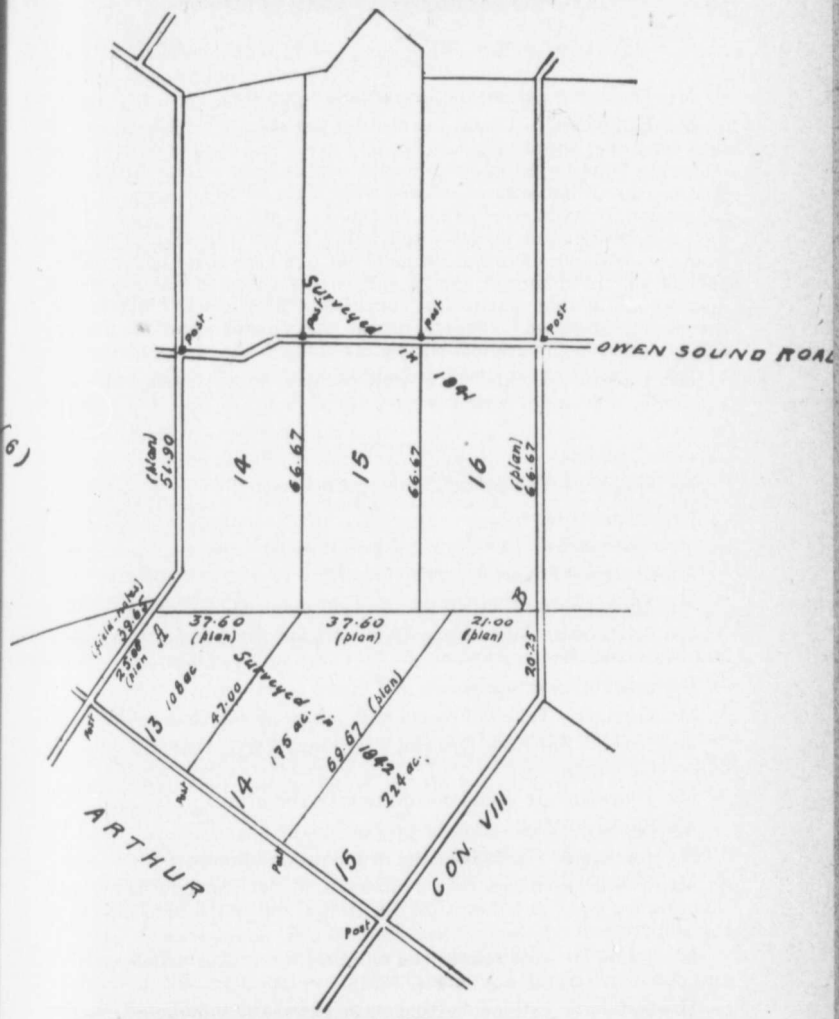


ARTHUR

Question 5.—How to establish blind line A B?

Side roads run originally parallel to north boundary, and lots number from same place. Every second side road run. Concession lines parallel to east boundary of township. In instructions surveyor was not told to plant blind line posts. In report or field notes there is no mention of said posts. Surveyed in 1842 by John McDonald.

Answer.—Disregarded blind line posts as not planted under authority.—(See Sec. 41).



Question 6.—How to establish A B?

Portion to west of A B surveyed in 1842; portion to east of A B surveyed in 1841, by John McDonald, P.L.S. Roads *colored* as laid out originally. In the instructions he was told to make his survey of 1842 fit with that of 1841.

Answer.—Proportion to fix points at A and B.—(See Sec. 57). No statute to cover the intermediate lot corners. For equitable survey join A B.

Question 2.

Mr. Dickson—I think the law is clear upon it.

Mr. Kirkpatrick—Under the old Act the clauses were so indefinite that when the Act of 1887 was brought in we had a good deal of manœuvering to find the word that would exactly suit. Some would say, just measure it out across, or some were inclined to get into the next concession, but you see there is no clause in the Act to go into the next concession, and it was often found in practice that if you ran from the second concession through--in one case there was a difference of 5 or 10 chains of a jog, and it was going to make quite an insurrection in that particular concession, and it was thought that that was the best way because it was the closest approach to what was intended in the original survey.

Mr. Dickson—I think it is well because it does away with any ambiguity that might arise.

Question 3.

Mr. Gaviller—You would divide it proportionally?

Mr. Speight—Yes.

Mr. Aylsworth—How do you divide it at A?

Mr. Speight—Divide it proportionally.

Mr. Sankey—In other words, the field notes as returned govern.

Mr. Aylsworth—Would you divide up for the blind line between lots 10 in concessions 7 and 8?

Mr. Speight--Certainly.

Mr. Gaviller—Take between 8 and 9, how would that be divided?

Mr. Niven—Take the mean of 49.07 and 50.55, that will give the depth at 8 and 9.

Mr. Bowman—It would not do to take the mean.

Mr. Sankey—Well, take the proportion.

Mr. Johnston—How about the original blind line post?

Mr. Gaviller—In this case I understood Mr. Speight to say that that original stake is not only on the ground but in the field notes in the Department.

Mr. Johnston—Sometimes you will find the stakes on the ground and not shown in the field notes.

Mr. Gaviller—I think in that case they are repudiated by the Crown Lands Department. I have known a case where a surveyor actually posted the line between the concessions and the posts were there to be found.

Mr. Dickson—Taking surveys like this the surveyors are especially instructed not to post the blind line.

Mr. Gaviller—That gives trouble, they put in posts when there were no instructions.

Mr. Chipman—Now as to the line from A to B.

Mr. Sankey—Isn't it possible from that drawing, to put the proportion on between 9 and 10, whatever it comes out; then you measure up on the ground between 9 and 10 in both concessions and divide proportionally.

Mr. Bowman—But that point is fixed by the stake B, and these measurements while shown there really don't govern as I understood.

Mr. Sankey—They don't govern on the line itself but they certainly govern the rest of the block.

Mr. Gibson—What is the length the line between 9 and 10 was intended to be in the original survey in the 8th concession?

Mr. Speight—As a matter of fact it does not show it.

Mr. Gibson—What were the instructions?

Mr. Speight—50 chains.

Mr. Gibson—Then if you want to find the line between lots 9 and 10 the Statute says you must give the proportion of that intended in the original survey. They were intended to be equal. Chain through then and take half and plant your stake. If you do the way you are proposing you might as well draw a straight line across between them. The law requires you to divide the concessions proportionally to what they were intended.

Mr. Speight—But if they were returned to the Department differently and accepted by the Department? That was shown on the original survey as 50.47.

Mr. Aylsworth—How would you divide up between 5 and 6, Mr. Gibson?

Mr. Gibson—I would chain through and give the north concession the proportion of the depth to what is shown in the original notes. It was intended to be 50 chains, but the notes show what they are on the ground exactly.

Mr. Gaviller—But Mr. Gibson has before stated what has been the rule of the Committee in former years, that is that they should be divided proportionally as intended in the original survey, half and half, and skewed in to the other point.

Mr. Sankey—You are making a difference between the original survey and instructions; it is correct according to the instructions but not according to the original survey.

Mr. Speight—When the Returns are accepted by the Department they are *ipso facto* in accordance with the instructions.

A Member—My impression at first was that it should be divided up proportionally, in the way you speak of; but I believe now, after hearing the matter discussed, that where we find the field notes and on the plan, as in the case at A, 50 and 49.07, then we should divide in

accordance with those figures, but where there are no figures on the plan as between 6 and 7 and the other lots, the instructions say that they are 50 chains, and it seems to me that we should divide on that basis.

Mr. Jones—Do you know what the chainage was on the ground for the east limit of lot 10?

Mr. Speight—I don't know what that was.

Mr. Jones—Because the question would come up again, while the instructions might have been 50 chains each the original survey might have been returned as 50.47, and then the question might come up, when it was chained on the ground it might be only 50 chains or 49½.

Mr. Chipman—What is the actual chainage from B to that concession line?

Mr. Speight—These figures are taken from the plan returned by the surveyor. On the ground the stake at B is midway between he fronts of concession 7 and 8. He says both sides are parallel.

Mr Aylesworth—I think that between 5 and 6 ought to be divided up in the proportion between 50 and 49 07.

Mr. Jones—He may mean by saying they are parallel that they are simply returned with the same bearings and intended to be parallel.

Mr. Sankey—You can't discard the post at B no matter where it is.

Mr. Gibson—Is that a double front concession?

Mr. Chipman—I understand that Mr. Gibson would run the line between 8 and 9, and make the line in the 7th concession the same length exactly as the one in the 8th when the original field notes show that the lines in the one concession are not the same as the other.

Mr. Miles—I ran a blind line like that in the County of Bruce and I made the length of the lots 7, 8 and 9 all equal.

Mr. Sankey—What is the proportion in depth intended in the original survey?

Mr. Gibson—If you take up the patents you will find it is 50 chains.

Mr. Gaviller—The question is, do the plan and field notes on record over-ride the instructions? I think there is no doubt about it. The surveyor was not instructed in the first place to make these broken distances.

Mr. Gibson—In the first place the instructions are that in laying out a section like this no blind line stakes should be planted at all, but they were planted by surveyors; I know when I was a boy we put down mere pickets. And in this case the surveyor is expected to go back and he divides up the proportion. The point B stays where it is because it is the original boundary passed by the Crown Lands.

Mr. Sankey—On the same principle you have got to adopt what the Crown Lands adopted in receiving that plan with various widths; one governs as much as the other.

Mr. Gibson—If you look up the patents you will find they are 50 chains each.

Mr. Speight—Suppose these lots are all shown 20 chains in breadth, except lot 10, 20.50 chains, how would you do?

Mr. Gibson—I would give that lot the proportion of the whole breadth; if there was a surplus on it I would give it a greater width, and the others proportionally.

Mr. Kirkpatrick—Supposing you are asked to describe this without going on the ground at all; you take that block or section and there are the distances. Now you are asked to supply distances. Could you commence at the north west angle, we will say, on No. 6, thence due east 20 chains, thence due south 50 chains, thence due west 20 chains to the sideroad, thence due north 49.07 chains? Is that the way you would describe that? Would you not calculate it in proportion? Take that 49 07 and 50.47 and supply on the paper on each sideline there the calculated distance. If you plotted that, it could not be 50 chains and a straight line because there is 49.07 at one end and 50.47 at the other. Now enlarge that to a very large scale and it won't be 50 between 6 and 7. I think you would put on the proportion as it is on the plan and field notes, then go on the ground and lay off the depths in that proportion.

Mr. Gibson—How do you know the concession lines are straight?

Mr. Kirkpatrick—I am saying without going on the ground at all. You are writing a description from the data that is there; would you make 50 chains there?

Mr. H. H. Gibson—There are none shown on the plan; why not just describe it without the dimensions at all, just describe it due south to the rear of that lot?

Mr. Chipman—I think if I were a surveyor and called upon to give a description I would begin at the north-west angle, thence along the front of the lot, then south to the rear of the lot so many chains more or less.

Mr. Sankey—By not giving distances you are just putting off the evil day.

Mr. Davis—What we want to know is how to run between 8 and 9?

Mr. Sankey—Is there any difficulty at all in calculating from the plan in the Crown Lands Department the lengths of the sidelines in concession 8? Is there any difficulty in getting the proportion of the length of each sideline between the east of 6 and the west of 10, as shown on the plan on record in the Department?

Mr. Davis—No.

Mr. Sankey—I would submit that the first thing a surveyor would have to do would be to supply these distances on the plan, then go on the ground and measure through on the sideline across 7 and across 8 and divide the distances you find on the ground in the same proportion as that plan gives. You are doing it equitably ; you are doing it as it was intended in the original survey and making all allowance for incorrectness in the lines between 7 and 8. It may not be correct, but you are giving the man the proper proportion he is entitled to.

Mr. Gibson—I have been speaking of the patent, what the intention was.

Mr. Kirkpatrick—You are giving one man 50 chains and giving him his 100 acres and you are not giving the other man his.

Mr. Gibson—If that is a double-fronted concession you would have to divide it on the principle of half and half anyway ; then you would take half the depth.

Mr. Davis—I see no reason why we should take the measurements at the east side of 10. It strikes me we must deal with that line by itself. If no distances are given in the plan or field notes, then we must take those that should have been there, or intended to be there. It is a question that comes up in nearly every surveyor's practice several times a year ; it is one of the most common occurrences in surveying. The way I have been doing it is this : I have chained through on the line between 8 and 9 without any reference to the other ends of the lot. That concession line might be crooked ; both of them might be crooked.

Mr. Sankey—Does not the Act say you shall divide them equally if so intended, and if not, then the proportion as intended. Does not that show that it was not intended, and was not in fact equal ?

Mr. Davis—No, it does not. That plan merely shows that the line between 10 and 11 is not equal ; that plan shows that the line between 8 and 9 is equal in the 7th and 8th concessions.

Mr. H. H. Gibson—The plan shows it was never a complete survey ; it is only just an outline survey.

A Member—I have a survey down in Ontario where I was instructed to put in these posts in that blind line, and I put them in under instructions.

Mr. Gaviller—Was that a re-survey ?

A Member—No, an original survey.

Mr. Gaviller—I think the Act has some extra wording in it so as to endeavor to make it plain. It says—" That is to the centre of the space contained between such alternate concession lines, if the concessions were intended in the original survey to be of an equal depth, or if they were not so intended, then to the proportionate depth intended in the original survey, as shown on the plan and field notes." Now the intention there would be the instructions issued to the surveyor, not what his field notes showed at all. I

don't think you can go outside of the instructions as far as intention is concerned. Then whatever these field notes show, the way we have ruled before is that that simply had reference to the side of the lot next the sideroad, and then divide according to instructions, that is the intention, and that is to the centre of the block for the interior lots. Chain it through and divide it equally, that is, between 6 and 7, 7 and 8, 8 and 9.

Mr. Sankey—How about between 5 and 6 ?

Mr. Gaviller—That is actually on record.

Mr. Dickson—I understood that he was instructed to plant that concession post.

Mr. Speight—No, there were no instructions given.

Mr. Dickson—Well, I would discard it altogether.

Mr. Gaviller—It is shown in the field notes.

Mr. Dickson—It is just one of these things that could be very easily overlooked, and I would discard it altogether if I found that he was instructed not to plant these posts.

Mr. Gibson—I would require an awful lot of swearing to prove that that stake was the correct one. I would not believe that was the stake unless I found the distances correspond exactly with it.

Mr. Dickson—Do the deeds show equal area ?

Mr. Gaviller—They are described as 200 acres.

Mr. Dickson—I assume that all the lots are 20 chains wide, east to west. On the plan do they all show it ?

Mr. Speight—Yes, they are all deeded 100 acres.

Mr. Chipman—How many here present would run the line between 8 and 9 and then divide equally between the two concession lines, or how many would do it in some other way ?

Mr. Gaviller—Suppose we confine it to the question of how the line between 8 and 9 shall be defined.

Mr. Dickson—I will move that the blind line at the point between 8 and 9 in the 7th and 8 and 9 in the 8th concession be located by ascertaining the distance between the two concession lines on the ground, and then dividing that equally.

Mr. Jones—I will second that.

Mr. Niven—I cannot vote on that motion until I know whether the surveyor was instructed to plant posts at B and A.

Mr. Speight—I have read the instructions and there is no mention in the instructions about planting a post any place in the whole township. (Reads instructions).

(The motion was then put—In favor of motion, 15 ; against, 11.)

Mr. Aylsworth—Now I would like to make a motion whether that post B would be accepted or not. I move that the post is not accepted.

Mr. Bowman—Before putting that motion I would like to speak in regard to the instructions. If I remember Mr. Speight's reading of them they were that the surveyor was to run this line in the middle of the road allowance and to plant his posts, properly marked, 50 links from this line. It does not say what post ; it covers that post at B as well as those on the front of the concession. His instructions plainly cover the planting of that post. Then that certainly would govern.

Mr. Sankey—I would move that the instructions do cover the planting of that post, and that that post at B was planted under instructions.

Mr. Bowman—I will second that.

Mr. Aylsworth—I say it should not be accepted I claim these are general instructions and the practice has always been not to plant a post there.

Mr. Gibson—But they were approved of by the Government and handed in.

Mr. Kirkpatrick—As a matter of fact those posts were found to be there on the ground ; it was found in practice that those conflicted and the change was made. They were told expressly not to plant those posts, because there would be the place between one end of the section and the other, the center spot ? If a man chains off 50 chains and puts down a post, ten to one when he gets to the upper end he is not 50 chains from it. Therefore that conflicted, and my impression is that the idea was that instructions were changed or made more perfect by saying, " Do not plant those posts."

Mr. Aylsworth—If that is the case I will change my motion, if there has been two sets of instructions made. I thought there was only one general line of instructions

Mr. Dickson—I am inclined, after hearing the instructions read over again, to think that it was certainly planted under instructions.

Mr. Sankey—The instructions as read by Mr. Speight would authorize the surveyor to plant that stake at B, and as far as that stake governs and that the surveyor is satisfied by information on the ground that that is the original stake, he will be bound to give it whatever consideration any post planted under those instructions is entitled to.

(Mr. Sankey's motion was then put—in favor of motion, 16 ; against, 2.)

Mr. Chipman—I think we should re-consider that ; at least leave it over till next year.

Mr. Aylsworth—I think that is a good idea, I would like to have those two sets of instructions Mr. Kirkpatrick talks about.

Question 4.

Mr Davis—I would produce the line.

Mr. Chipman—To my mind it would be perfectly absurd to join those two points along the town-line and divide it proportionally.

Mr. Gibson—Suppose there was only one stake there at the north-east corner of 5 in 6; the problem is to fix the south-east corner of lot 1.

Mr. Dickson—I had a case exactly similar to that. I was running out a concession line under instructions from the Crown Lands Department, and I found the post between 30 and 31, which should be about 46 chains. I remember the one concession was exactly the size and the other was some trifle over 80 chains; and I made an equal division of the property and skewed it across the last lot, and the accuracy of my survey was never questioned. It was confirmed in the Department, and the parties themselves concluded they would leave it where it was before; settled it by taking the old road where it was, and allowed each man to keep what land he had.

A Member—I had a case similar to that where the parties agreed to produce the line down to the boundary the same as it would be there between A and B.

Mr. Kirkpatrick—When I was serving my time we were making a re-survey of a whole township under instructions from the Department, and we found a post identical with the one mentioned there, B, and we found none on the south boundary, and my recollection is that we cut it off at an angle of 45°, and that road allowance is there to the present day. The surveyor I was with divided it up equally because the concessions were shown equal in the original survey.

Mr. Gibson—I can assure you that there are any number of cases which have been reported to the Crown Lands Department and approved on this principle, that if there has been an old established road between concessions 5 and 6, traveled and used and fenced, and if you can find the points, 1, 2 and 3, and C, B, and D, you have three points in the line and it is assumed that the line is not lost, when you have three points or two points. Again, the statute provides that the best evidence must be taken, and I would accept a straight line by production in a case like that. The best evidence is that there has been an established road there, and the presumption is in favor of the straight line. That is the practice of the Crown Lands Department; but if that is bush land I think the township council should close up the original and open a new one.

Mr. Speight—I will just read that clause about "the best evidence the case admits of." (Reads).

Mr. Gibson—The statute says that if "the whole concession line is lost," then you should chain through and divide proportionally. If two points can be found you join them, but if, as in this case, there is the end only of the concession line lost you will have to be very careful. In this case, the general practice in old settled sections is to produce the line.

Mr. Sankey—Has any gentleman ever had experience of a gold mine being on that little piece?

Mr. Gibson—Then you will have litigation decidedly.

Mr. Dickson—I would like to draw attention to the matter of how posts are now marked in Government Surveys. They used to be marked with a marking iron, but last summer, when inspecting Crown surveys, I found only one township where 12 posts were marked with a marking iron, the posts in the others being done with a pocket knife. Now I think they look very ugly: and in examining old posts I have heard the question asked, Is it marked with a marking iron? If it is, it is the original post; but if it is marked with a pocket knife, then discard it altogether. The instructions require it to be marked with a marking iron, but it is simply disregarded.

Mr. Niven—It is very difficult to get a decent marking iron; I have never come across a really good one. Somebody ought to invent one.

REPORT OF ENTERTAINMENT COMMITTEE.

MR. PRESIDENT,—Your Committee on Entertainment for this year have to report as follows:—

In view of the satisfaction expressed by members of our Association regarding the suitability of the rooms in the Canadian Institute occupied by us during the sessions of the last two years, they were re-engaged at the same rental for this meeting.

In answer to the usual queries regarding the annual dinner, replies to the number of thirty-four were received. Twenty of these were from members regretting their inability to attend, and but fourteen from those who accepted. In spite of this disparity of numbers, the Committee decided to hold the dinner as usual, as the acceptance of others not heard from could be counted on as usual.

We were not disappointed in this assumption, and at the time appointed for the dinner—8 o'clock p.m. on the 27th February—it was found necessary to provide for 40 people, instead of the smaller number that our replies led us to expect.

This number included six invited guests: Walter Beatty, Esq., O.L.S., and M.L.A. for Leeds; Mr. Aubrey White, Assistant Commissioner of Crown Lands; Mr. E. H. Keating, City Engineer of Toronto; Mr. Sims, representing the Engineering Society of the School of Practical Science; Mr. Wright, vocalist, and his accompanist.

Letters regretting inability to attend were received from Hon. A. S. Hardy, Commissioner of Crown Lands of Ontario, and from Capt. E. Deville, Surveyor-General of Dominion Lands. We were also disappointed at the absence of another invited guest, W. F. King, Esq, D.T.S., Astronomer of the Department of the Interior, who, though present at our meeting, was obliged to leave for Ottawa the day of the dinner.

After showing a due appreciation of the excellent menu provided by our host, the usual patriotic and other toasts of "The Queen," "Canada," "Ontario Legislature," "Engineering Societies," "Our Association" and "The Ladies" were honoured with the usual enthusiasm. Appropriate volunteer toasts were then proposed and happily responded to.

The excellent character songs given by Mr. Wright were well received and heartily encored. The list would have been longer had not the accompanist been suddenly called away by a message announcing serious illness in his family.

Several songs were afterwards volunteered between the toasts by members, which, though not comparable to our professional guest's brilliant efforts, were, no doubt, duly appreciated.

I have to acknowledge the able assistance of my fellow-committee-men, and beg to suggest the placing of the chairmanship in other hands as a change in this respect would, no doubt, be beneficial.

An account, showing the receipts and disbursements of the Committee, will be placed in the hands of the Secretary of the Association, which can be examined by any member.

Respectfully submitted in behalf of the Committee,

FRED. L. FOSTER,
Chairman.

PRESIDENT'S ADDRESS.

GENTLEMEN OF THE ASSOCIATION OF ONTARIO LAND SURVEYORS:

I have much pleasure in welcoming you to this, the Tenth Annual Meeting, the third since our incorporation.

We have lost by death one of our older members, during the past year, Mr. Willian Robinson, of London, who died on the 11th of October, at the advanced age of 82 years. He was a bachelor.

I learn with pleasure that our various Committees have had a considerable degree of success in the various duties assigned them. Our Biographical Committee has secured a lot of valuable data relating to our early Surveyors—data which would have been lost forever, had it not been for their efforts.

Our Polar Exploration Committee are bringing our Association before the geographical and exploration congresses of the world.

It may not be an unprofitable task if we glance backwards, and consider on this the anniversary of our first decennial period, what has been accomplished during our existence.

Our old Surveyors lacked *esprit du corps*. When two by chance met, usually on opposite sides in court, it was some such meeting as the emissaries of hostile camps, each regarded the other jealously and suspiciously. Thanks to the good feelings, brought about by our Association, in these meetings, we now meet each other as professional gentlemen.

During the past nine years we have furnished nine volumes of Proceedings of our own Association besides thirty-six volumes of the Proceedings of the various State Associations in the United States. Scattered in these forty-five volumes is a vast deal of extremely valuable data, such as cannot be elsewhere found, It is useless to search the text books, for they are written to enforce general principle. The paper usually has an exact case which helps us out of the hole we were in. Our Act was in a chaotic state ; we have had it very much improved. The Ditches and Water-course Act and The Municipal Drainage Act were also in a deplorable state. It is to this Association the credit is due of inaugurating a remedy for the defects and by the aid of its members has helped to place upon the Statute Book Bills which, while they may not accomplish all we hoped for, are at least a marked advance on what preceded them We may hope for more drains as the result, and better drainage means a healthier and more prosperous community.

And when we consider the changes being brought about with bicycle, electric motive power, and improved systems of transportation we see where the farmer's market for his horses, hay and oats have

gone to. Our Dairy interests to-day supply the Ontario farmer with ready cash for his various wants. But in the transitional stage from the old to the new, the country as a whole has suffered and it would be unreasonable on our part to expect that we alone should be exempt from the general dullness of business.

We shall have to study economy closely in any work which it falls to our lot to carry on. Do not spend one dollar that can be saved. In this way our public works may hope to earn a reasonable return on the capital invested in them.

In union there is strength—united we stand, divided we fall. These are troublous times in the commercial world, and it behoves us to do our part to protect ourselves and to seek to hold what we have gained. At the annual meeting of the Canadian Society of Civil Engineers this year, generous tribute was paid to the fact that the Ontario Association of Land Surveyors was a strong united and aggressive body, incorporated by Statute and therefore occupying a point of advantage they hope to reach.

We have yet much to do. Our Topographical Committee should submit a project to begin a Topographical Survey of the Province. Our various Committees are at present consulting Surveyors for the profession. More may be done towards assisting the younger members. Our Legislation Committee should have in mind improvements to our Act. Our examinations should be made broader so as to include Mechanics, Hydraulics, etc., working up gradually to the standard exacted for a Borough Surveyor in England.

In conclusion, gentlemen, I trust that the same spirit and harmony of good fellowship will be found in this meeting that has characterized those in the past.

PAPERS.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

A HANDY METHOD OF INDEXING OFFICE INFORMATION.

By D. D. JAMES,
O.L.S., C.E., Toronto.

THIS paper is presented with a consciousness of the fact that there are and have been many excellent methods of indexing office information all more or less peculiarly adapted to the circumstances under which they have been created. The author believes that the success of any system of indexing depends on its being adapted by its users to the particular circumstances under consideration, and that this adapting is a matter almost of mathematical calculation. For having our information of whatever nature duly designated, filed, and stowed away in a shape such that knowing the designation of any piece of information we can immediately turn it up, the problem is logically reduced to this. In any particular case the unknown quantity is the designating figure or letter, while the known quantity is some definite or indefinite knowledge of the information itself. Now, the index must be some method of arranging what will be the known definite or indefinite information in such a manner that we can obtain the unknown designating letters and figures from it.

Now, before going further, it will be necessary to dwell on the particular nature of the information for which the system about to be explained was intended. The information is, all information, of whatever kind, which an Ontario Land Surveyor collects in the pursuance of his duties as an Ontario Land Surveyor. To begin with, the Land Surveyor is required by Sec. 70 of the Act to "keep exact and "regular journals and field notes of all his surveys and file them in "the order of time in which the surveys have been performed, and "shall give copies thereof to the parties concerned when so required," etc. The filing in order of time here seems to be a hint of the method which the surveyor should employ to find the information when required to give a copy. But all surveyors know that to attempt to find the information this way, especially in a long established surveyors' office, would be attended with annoyance and besides wasteful of time just when time would be most valuable. Besides this the

surveyor wants back field notes himself to help him, in other work in the locality, and he has no idea perhaps of the names of clients or of the dates of surveys made there. So there must be some method of indexing this information so as to be readily turned up. Then, besides field notes, the surveyor must for his own benefit keep copies of all plans he makes and generally keeps copies of all plans on which he has had to make a survey at all. The reports also which are given by a surveyor in the shape of descriptions and sketches may be regarded by some as worthy of indexing along with the other information. Now, seeing that the information consists of Field Notes, Plans and Reports of Surveys, we must decide what element we shall use in making the Index. We have (1) Date of Survey or Plan, or of Report, (2) Owner or Agent concerned, (3) Locality of Property Surveyed, as probably known elements by means of which we expect to turn up our information. The best possible method of indexing will be one in which we can find any piece of information from a use of only one of the above elements providing that we can be certain in every case that we shall know that element. Take the first element mentioned, may we always expect to know date of survey in hunting for information? No, often not. Thus we see that the plan hinted at in the Surveyors' Act is not general.

Let us try the second element mentioned. Do we or our clients always know the name of the Owner or Agent for whom the survey we hunt for was made. No, we do not. This like the first is a mere incident of the survey. Now, lastly, do we or our clients always know the locality in which the survey was made. Yes, certainly; otherwise our clients could hardly know what they were talking about. So our conclusion is to have an index depending on locality. One way to do this is by means of streets. A large book like a ledger may be used, an account, as it were, being opened out to each street. On the right half of each page the cross streets, between which the information lies, are given and on the left half is the book, page, cabinet, drawer or file number needed to find the information. The entering on the pages is made as the information is gathered. This system is in use in at least one office in Toronto with regard to field notes, but why should we not use it for all information. Such is the method clearly outlined in "The Michigan Engineers' Annual for 1894" by G. M. Ames, where engineering notes of all kinds, profiles, and plans are all indexed promiscuously as far as anything other than locality is concerned.

Some surveyors depend on an index according to registered plan numbers to find their plans—but sometimes we have private plans on file which cannot be reached by such an index. This would not occur in the index spoken of above.

Now, a large plan would need to be indexed on more than one street, and so would extensive field notes, and if we have so much information under one street heading it will surely take time to single out the information we want, and it thus becomes necessary to further classify, especially in the case of a long street. This could

be done by allotting so much space for each block under the same street heading. The space needed would be probably proportional to the length of the block. We find, then, that our index has assumed more or less the proportions of a plan, and such we might make it only without depths shown. Or, if we have a plan on a large scale, it would make an admirable place to index all information. Such is the handy method which I wish to bring forward in this paper. This would suit well in some offices, for, perhaps, the surveyor has drawn up a plan of his whole district in the hope that he could put all his information on a large scale plan, and has found at last that he has no confidence in second hand information—*i.e.*, information put on the map from field notes or plans by some unreliable office boy or assistant—and so throws aside this plan, which could be easily turned into an index. An inexpensive method would be to use any atlas or compiled plan which has been published in the district, and if it were considered undesirable to mark up the atlas by index marks a tracing might be made inking in only the principal outlines and names of streets, etc., or tracing linen could be pasted by one edge over the plans in the atlas and the indexing could be done on the linen, the atlas plan underneath showing the locality to which the index marks refer. Goad's Atlas of the City of Toronto would do admirably for this purpose, and it might pay a surveyor here to have a duplicate copy solely for an index.

The method would require a plan wherever there was work done, but it is evident that a smaller scale would be sufficient the farther the survey were from the particular surveyor's headquarters. An atlas of Ontario would be the outside limit for an Ontario Land Survey. Then, perhaps, he could use his county atlas for nearer surveys and so on.

On the index map the information should be written with a fine pen and as concisely as possible, as, F.B., 1—21, for Field Book No. 1, Page No. 21. Registered Plan numbers and the corresponding office file numbers should be put together, the Registered number being distinguished by a circle or brackets. If the Registered Plan has not been drawn by the surveyor, but he has it copied in a sketch book, he can index opposite the Registered Plan : No. S.B., 1—81, for Sketch Book 1, Page 81. Then, if there are private or unregistered plans these can be indexed also. Thus, everything can be indexed in one and the same system.

When, in the course of years, an index plan gets pretty well filled a new one can be begun on a larger scale for that district, the index numbers being easily transferred, or the old plan may be used as an index for all surveys before a certain date, and the new one may be used only for new information. Recent surveys can be distinguished also by the higher designating numbers used, so that no fault can be found with the system in that old and new surveys and plans are mixed up.

Further, we can turn up plans without a knowledge of their registered numbers and an indefinite knowledge of locality will serve

to turn up any information in the office. The bare skeleton of this system then consists in an index map and the writing of a letter and the number upon it for each piece of information in the office. This indexing must be done very carefully and so as to indicate as well as possible the extent of the information, and the references may be thus entered sometimes twice or in large letters.

Of course a plan index, by means of which we can turn up registered plans from a knowledge of their registed numbers, would, perhaps, be convenient, in addition, and would serve a good purpose if there were errors in indexing on the general index map; but it would not be essential.

So also we may have an inventory of plans in the office, in order of time, as filed, so that we may be protected from loss of them. And with field notes also we may have an index in the back of each field book. It often proves useful in the field if we have lost the page in the book on which our information is. All these things, though, could be dispensed with in times of great pressure of work. Another thing worth mentioning is, that if it is thought necessary to have an index by means of which we can turn up information from a knowledge of the client's name we can accomplish it by means of the ordinary account ledger; for in it we can turn up the man's name and account and there find the order book page, entered there for that and other purposes. In the order book we can find the locality and hence the information from the general index map or we may have the field book references entered in the order book so that we need not go to the general map index.

In closing I would say that to me there is no question of the great convenience of the general map index; the only question seems to be that of getting a suitable map to index on, for if too small a map is used great slovenliness will no doubt result.

DISCUSSION.

Mr. P. S. Gibson—I think this is one of the most important papers we have to discuss to-day. In the cities you have your wards and streets, but with a country practice mixed up with a city practice it is quite a problem. My rule is to have a field book about 6x8 inches which I carry with me and make my sketches in the field, and write up the whole particulars. Sometimes I write the affidavits and enter them right in the field book too, so if I am called upon to give evidence in court, there I have a picture of the whole thing with me. Another advantage is when you do your work in the field and have it well worked up there you are sure it is right. An old surveyor once said to me, "Peter, the first thing you do when you are making a survey is to make up your notes as perfectly as you can and then sit down and explain to the farmers what you have been doing; and while you are doing so you will generally find you have made a mistake somewhere." I have the field books carefully tinted and written up so that I can distinguish the portions I want to work upon. I

write a full description of of everything I have done. If the parties give me instructions to do it as I please and mark everything, I put it down that way, but if they don't want to go to too much expense, I do it to suit them; and when I get to my office, may be some rainy day, I index these books, the township, the concession, lot, year, month and day, the pocket in which these descriptions go, the owner of the property and the surveyor, too, because sometimes I have field notes of other surveyors, and these I classify in the same way. I always copy my descriptions of property in my letter book; and I have an index in my letter book on which is entered up the concession and lot, the date and page. Now I have purchased about fifteen or twenty pretty large blank books, and I am going to index all my notes and all my father's notes, and copies of registered plans—and I have thousands of them. Every lot will be entered in these books, every survey, description and plan I have that relates to it goes right down on that one lot.

Mr. C. F. Aylesworth—As far as my practice goes, I have a large blank book, and I write down the different townships in that book, and then I go over the field books once every six months or so and enter under each township the work done in that township, the concession and lot. That is as far as country practice is concerned.

Mr. Chipman—I think the method I explained to this Association several years ago is, to my mind, the best yet brought forward; that is to keep the books exactly as they are kept in the registry office. Open one page or part of a page for a lot in a certain township, and index in that every note you have, plans and everything else. As soon as a field book is filled with notes, "post" it into your index book. You have then everything included in that, not only your notes, but all notes and plans in your office. I don't think the plan suggested by Mr. James would answer for ordinary country practice.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

FLOOD PREVENTION WORK AT BRANTFORD.

By C. C. FAIRCHILD,

Ontario Land Surveyor, Brantford,

DURING the winter of 1893-4 the low lying portions of Brantford were visited by two very severe floods, the first being on December 24th, 1893, and the second on March 5th, 1894. The latter, which was, perhaps, the more disastrous, owed its extreme height to the ice jam which took place at Two Fish Islands about a mile below the city.

The water at its greatest height stood at about 71.80 on the city levels at points above the dam, or about one foot heigher than the last severe flood in 1887, while, below the dam, it reached an elevation of 66.80 at points east of Market street, or about three feet higher than in 1887.

The City Engineer, Mr. T. Harry Jones, A.M., Can. Soc. C.E., reported to the Council on January 8th, 1894, recommending the construction of a dyke for the protection of West Brantford, which is situated above the dam. No action was taken on this report, but after the second flood of March 5th, the Council adopted a report of the Board of works instructing the City Engineer to prepare a report on the causes of the flood and to suggest remedies.

After careful surveys and taking a mass of evidence on previous floods and their causes, a report was submitted on May 14th, 1894, in which the matter was very thoroughly discussed.

In this report the causes were given as :—

(1) General.

(2) Local.

GENERAL CAUSES

Under this head it was pointed out that year by year the floods were increasing in volume and suddenness owing to the clearing up of the forests along the river and the construction of drains running through these cleared districts into the river. The river was also carrying down gravel and sand from its banks above and depositing it in the bed of the stream, thereby blocking the channel and causing diversions of the stream and thus lessening the discharging capacity of the main channel of the river. Again the thaws were more sudden in the open or cleared lands, thus causing the ice to break up more quickly and in larger blocks, and consequently enhancing the danger of ice jams which are often the most dangerous feature in a winter flood.

LOCAL CAUSES.

Under this head attention was called to the dam which is primarily the cause of the extreme height of water in West Brant-

ford. A new dam had just been constructed and the old one was still in position so that an increased obstruction was offered to the flow of the river. The difference in level above and below the dam during flood time corresponds with the difference in the levels of the river at its normal height, except in case of high water caused by an ice jam at some point below the dam.

The extreme depth of water in Eagle Place, which is below the dam, was owing in a great degree, to an ice jam at Two Fish Islands, at which point the channel takes a sharp angle, and is further obstructed by a number of islands covered with large elm and other trees, the whole forming a lodging place for ice which renders it a menace to the inhabitants of Eagle Place and other low lying positions of the city below the dam.

There are also two railway bridges across the river below the dam and to these the people of Eagle Place owe at least a part of their discomfort. Both the Grand Trunk and the Toronto, Hamilton and Buffalo Railway Companies have narrowed the channel, and in the case of the latter the elevation of their bridge is considerably below the extreme height of flood level.

Two natural courses were open for the prevention of further floods, viz.

(1) Deepening the channel of the river so that it would accommodate the waters at highest flood level.

(2) Raising the banks to a height above the highest flood level.

The idea of sufficiently deepening the channel was impracticable both because of the presence of the dam and of the expense incumbent on an undertaking of such magnitude, and it was accordingly decided to erect dykes or embankments along the margin of the river, and to take the material for the construction of these embankments from the channel of the river in as far as practicable, thereby making to a certain degree a combination of the two methods above suggested.

The West Brantford work was first carried out. This consisted of the raising and enlargement of an old dyke along the Western limit of the city, built a few years before for the protection of West Brantford from the overflowing of D'Aubigney Creek and the extension of this dyke to the river bank and thence along the margin of the river to intersect the G. T. R. Company's track. This old dyke, which was 1,730 feet in length, was raised one foot bringing it to an elevation of 73·00 on the city levels, and the balance of the work, when completed, was brought to the same elevation. The embankment is 8 feet wide on top with a slope of 1½ to 1, and contains 10,960 cubic yards, having a fall of from 3½ to 11 feet and a varying bottom width of from 19 to 38 feet. About three-fifths of the earth for this embankment was procured from a small island lying in the river opposite the dyke, the average haul being about 600 feet. This island was entirely removed and this removal alone will do much to alleviate the tendency to ice jams at this point, as the island was situated at a place where the channel is very shallow. The balance of the earth was procured from the bed of the river between the railroad bridges, the average haul being about 1,800 feet.

The total cost of this embankment was $2,480, or at the rate of about 22½ cents per cubic yard, the work being performed by the city and under the direction of the City Engineer and Overseer Howie.

Four cribs were erected along the river bank to assist this dyke to withstand the inroads of the river, the first being situated at the upper extremity of the embankment and the others at such points as it was felt they would be of most assistance to the dyke. Three of these cost $300 each and the fourth $200 They were sunk down below the bed of the river and raised to an equal elevation with the dyke being firmly imbedded in it at one side. These cribs were made of pine timbers 10 inches square fastened together with half inch drift bolts 18 inches in length.

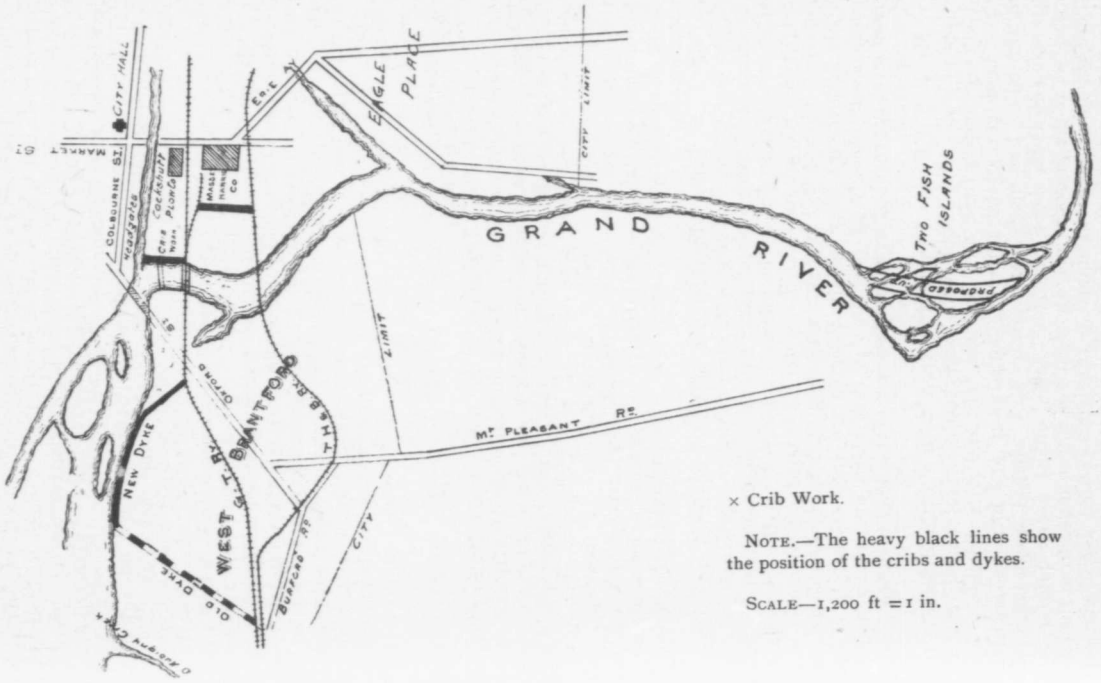
When this work was completed attention was turned to the headgates and cribwork below the dam and further dykes for the protection of Eagle Place. An embankment was built from railway to railway, but the raising of the T. H. & B. Ry. Companies' track and bridge has not yet been carried out.

The headgates were replaced by the Brantford Electric and Power Company according to plans and specifications prepared by Mr. H. K. Wickstead, M. Can. Soc. C.E., who also consulted with Mr. Jones on the work between the dam and the G. T. R. bridge, one-half of the expense for which was borne by the Electric and Power Company.

In the City Engineer's report it was recommended that this work be a solid faced crib raised to the elevation of 73·20 or about 12½ feet above the crest of the dam which is about 5½ feet above low water mark below the dam. Mr. Wickstead suggested that instead of bringing up the cribwork to this elevation that it be brought up to the level of the crest of the dam and from this to raise an embankment to be faced with loose stone. The work was carried out on this plan excepting that the back of the cribwork was raised 4 feet higher than the front which was brought to the level of the crest of the dam thus giving a slope of 3 to 1 to the top flooring of the crib, which was 12 feet in width The embankment having a top width of 8 feet was carried up back of the crib on a slope of 2 to 1, and was faced with stone procured from the bed of the river, while the face of the cribwork was protected by piling stone along in front of the crib. The timber used was hemlock below water line and pine above, all being 10 inches square with a flooring on top 3 inches in thickness.

The total length of this work is about 180 feet and the total cost $2,200. This crib is in a peculiarly exposed position, being just below the dam and on the side of the river against which the whole strength of the waters is thrown in flood time. During the last flood the water and ice swept over the banks at this point doing great damage to the large factories situated on the flats.

As an assistance to the dykes and to prevent further ice jams a cutting was recommended at Two Fish Islands, but this has not as yet been carried out. The efficiency of the dykes depends, in some measure, on this work, and it is to be hoped it will be carried out this



× Crib Work.

NOTE.—The heavy black lines show the position of the cribs and dykes.

SCALE—1,200 ft = 1 in.

summer. There was a question raised by the City Council as to their power to do this work, which is outside the city limits, without special legislation. There is some doubt as to whether the Drainage Act covers the case or not and it will be interesting to engineers when a settlement of the question is reached.

Other work not described in this paper has been done, the total expenditure being $6,600. The accompanying plan shows the location and extent of the work.

DISCUSSION.

Mr. H. J. Bowman—I suppose the necessity for works of this kind is increasing all the time. No doubt years ago the Grand river was comparatively a quiet stream. That is generally found to be the case, but with the opening up of the country the water comes down so fast in the spring that it necessitates these works. I know farther up the stream they are having difficulties; railway tracks are being flooded that in years gone by were always dry. The cause, I suppose, is the drainage of the country; the clearing away of the timber and swamps, and the water rushes through the larger drains into the river, causing the floods.

The President—In Belleville, at the mouth of the Moira river, the causes are slightly different. There the water used to freeze to the bottom of the river, it being very shallow, and the water would come down in a flood in the spring and the ice from above would keep piling up, so they have gone to work and dredged a deep enough channel for the water to escape under the ice. In that way, while they have not got over all their trouble, they have improved their condition very much indeed, though it has cost a lot of money, it being all rock excavation. They have also embanked the shores to some extent.

Mr. T. H. Jones—In reference to the flood level increasing in height year by year, of course that is a common experience. As Mr. Bowman says, there is much more extensive drainage year by year; and not only that, but as the forests are cleared up the frost strikes deeper into the ground, and the water is carried off so much more quickly. There I had evidence extending back thirty-five years that, apart from the ice jams, which of course are another feature in connection with it, only at one time in that thirty-five years had the flood level approached to within two feet of the height—it was during this last flood.

Mr. P. S. Gibson—I think I have a case a little different from either of you. The trouble with us in the County of York is that the rivers are digging their own bottoms out; and it is difficult to keep them from tearing the adjoining lands away and forming an island in the bay. For many years, away back when I was a lad, in the township of York, there were mill dams almost every quarter of a mile, but at the present time, for twelve or fifteen miles from the lake, there are only one or two dams, and they are carried away whenever there comes a crush of ice. Now I am called upon from time to time

to protect the banks, and my practice is to drive cedar piles down and fill in the bank with brush, gravel and willows—I plant a great deal of willow. The object of the brush is when the bed of the river is dug out year by year—and it goes from three to five feet sometimes—the brush settles down to the foundation, and we build on top then or drive the piles deeper. Another trouble I have is with the foundations of our bridges; when the bed of the river is lowered the foundation disappears, and the result is we have to give plenty of water way. As a rule, I put no cribbing in at all, but simply put in piles; and instead of attempting to retain the embankments I extend the ends of the bridges and give lots of water way. In the last sixteen or seventeen years we have not lost any bridges at all, so that my system of protecting the banks with cedar piles, brush, gravel or stone, and planting willows, is a good one. We find our cedar piles last a great length of time.

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EXPLORATIONS AND SURVEYS IN RAINY RIVER DISTRICT FROM 1717-1894.

By J. F. WHITSON,
O.L.S., Toronto.

In 1716 Vaudreuil, then Governor of New France, with a view of extending the fur trade westward, gave instructions to Lieutenant Noue to explore the country to the west of Lake Superior. Noue began by rebuilding the Trading Post on Kaministiquia River (where now stands Fort William) which was first built by Duluth in 1678. In the fall of 1717 Sieur de la Noue penetrated as far west as Rainy Lake (Lakemanigen or Lac la Pluie) on the west shore (north of Pithir's point) and build a trading post, the first established in Rainy River District. For several years following he occupied his time in extending the fur trade in the Rainy Lake region and bringing about friendly relations between the different Indian tribes. But the man to whom is due the most honor as one of the earliest and greatest explorers of this Western district is M. de la Verendrye, who in 1728 was in command of a trading post at Lake Nepigon, and who had for several years remained in obscurity as a trader in the region round Lake Superior, though his early life was a brilliant one, a victor in two campaigns, one in New England in 1704, the other in Newfoundland, 1705. As the discoveries with which Verendrye's name is associated are but little known, and although I cannot speak at any great length in this paper, I will mention a few occurrences which may throw some light upon their discoveries. With the hope of discovering a Western sea he laid his scheme before Beauharnois, then Governor of New France, who, after some delay, consented to the proposed western expedition, and, in order to meet the cost of the same, gave Verendrye the exclusive profits of the fur trade over the territory to be explored. On the 19th May, 1731, he entered into company with men in Montreal who advanced goods and equipments, taking with him his three sons and nephew and Father Messager as missionary, besides several French voyageurs. We will then follow them from Kaministiquia where they arrived from Mackinaw (Michilimakinac) in the spring of 1731. He found himself at the grand portage on Lake Superior, 10 miles south-west of the mouth of Pigeon River, westward bound on the 26th August, 1731. After many a struggle through lack of means we yet see their parties the same year successively pass through Rainy Lake (Lac la Pluie), at the outlet of which they established Fort St. Pierre about 1½ miles below the present H. B. Co's post at Fort Frances.

Thence passing down Rainy River, across Lake of the Woods (Lac Minitre or Des Bois), on the south-west shore of which, in Buffalo Bay, near the mouth of War River, they built Fort St. Charles

in 1732. They traversed and traded throughout the whole Winnipeg basin before 1750, after building forts on Rainy River and Lake of the Woods in 1731-32 and shortly afterwards on the Winnipeg Red and Assiniboine Rivers, taking possession also of the Upper Mississippi and Missouri to their source, they subsequently extended their forts on the lakes and rivers northwards to the Saskatchewan on which they and their successors had, up to 1755, built no less than five forts. They explored the Upper Missouri in 1742, and by the Yellowstone River reached the Rocky Mountains at the base of which they, in 1743, built a fort, thus commanding the whole trade of that vast region which they called the posts of the Western sea. One of these expeditions cost one of the sons his life, for a band of Sioux Indians massacred him with his whole party of twenty-one men in June 1736, on an island in the Lake of the Woods, near Rat Portage. Among the slain was Father Annean. Their bodies were discovered several days after the event. The bodies of the Frenchmen were placed on beaver skins, the greater number of them scalped. The missionary had an arrow in his head, his breast cut open. The explorer lay face down, his back hacked with a knife, a hoe buried in his headless body which they had ornamented with porcupine quills. The father, who was at this time in great destitution at Fort St. Charles, heard of the massacre of his son and the death of his nephew at the same time; but his devotion and courage, undismayed neither by misfortunes nor dangers, he continued the expedition, but it was only in 1743 that the eldest son and his brother reached the Rocky Mountains, returning the same year to Fort St. Charles on the Lake of the Woods, where they again joined their father, who, becoming discouraged at the unjust treatment he received from the King of France, returned to Quebec and died 6th Dec., 1750, leaving his two sons to carry on the work, which they did for several years in the Lac la Pluie region, and around the head waters of the Mississippi. The breaking out of the seven years war in 1757 ended their explorations and they re-entered the army. This war, which occasioned to France the loss of Canada, gave them both an opportunity of ending their lives nobly on the 15th Nov., 1761. They were both drowned on the wreck of the *Auguste*, and needed no longer to envy the death of their brother who was killed by the Sioux; but in viewing the misfortunes of their country they could say, "We die, but we die with it." Such is given as briefly as possible the unfortunate but not inglorious life of these brave explorers.

As to the Lac la Pluie District, it is a matter of history that from the period of its first discovery in 1717 the French traded and occupied the whole district, while the Hudson Bay Co. had, up to 1790, but one post on these inland waters, Cumberland House, on the Saskatchewan, built by Hearne in 1774, and up to this time no servant of the Hudson Bay Co. had set foot on these inland lakes. In 1790 the Hudson Bay Co. established a post on Red Lake trading into Lake of the Woods. The cession of Canada, 1783, caused many of the old French traders to return from these Western posts, but the same year

they formed themselves into the North-West Trading Co. with headquarters at Montreal. They soon rose to the position of formidable rivals of the Hudson Bay Co., and, in 1817, the district traded in by the two companies became the scene of animosities, feuds and bloodshed, involving the destruction of property and the demoralization of the Indians and the ruin of the fur trade; so much so that the Hudson Bay Co., who had, prior to 1800, been able to pay from 25 to 50% dividends were for the preceding 22 years only able to pay 3% per annum. The war between the two companies ended 1821, a union being arrived at under the name of the Hudson Bay Co., which company practically remained in undisturbed possession of the country between Lake Superior and Red River up to 1857.

By the Treaty of Paris, dated 3rd Sept., 1783, the Southern Boundary of Canada was defined, and later by the Treaty of Amity, Commerce and Navigation on 19th November, 1794, and still more definitely by the Treaty of Ghent, signed Dec. 24, 1814. By the 6th and 7th articles of said treaty Great Britain and the United States each appointed a commissioner, Anthony Barclay and Peter B. Foster, with David Thompson as surveyor to locate the boundary between the two countries. David Thompson was the first surveyor to receive official instructions to make a survey touching the District of Rainy River. He was born at Westminster, England, 30th April, 1770, entered the services of the Hudson Bay Company at Cumberland House, 1789, and spent the next eight years in exploring and mapping out the country traded in by said company and locating their different trading posts. In 1791 he entered the services of the North-West Company to perform a similar work; in Feb., 1798, he started with a dog team from Red River to explore the country between that river and Lake Superior; on April 27th he reached Turtle Lake, from which flows Turtle Brook, which he states to be the source of the Mississippi. Thus to this almost unknown geographer belongs the honor of discovering the head waters of that great river. From 1816 to 1826 he was engaged in surveying and defining the boundary line on the part of Great Britain between Canada and the United States. In August 17th, 1822, while on the survey of Lake Superior, he instructed his assistant, J. G. Sayer, formerly a trader in the service of the North-West Co, to explore the country between Fort William and the shores of Rainy Lake, and, on 29th August, Sayer started up the Pigeon River. The two following years Thompson was engaged on the survey of the different lakes and streams adjoining the boundary between Lake Superior and the west shore of the Lake of the Woods. On July 25th, and 26th, 1824 he planted the monument marking the north-west angle of the Lake of the Woods, being the south-west angle of Ontario. I am probably safe in saying that no other land surveyor has made so extensive surveys as Thompson, a survey extending nearly from ocean to ocean and from the Ohio River to the Hudson Bay. His deeds have never been trumpeted as those of some others, but in the northern and western explorations for the fur companies in their palmy days no man performed more valuable service

or estimated his achievements more moderately. He died in extreme poverty near Montreal, on 16th February, 1857.

In 1857 the Provincial Government, with a view of establishing suitable communication between Lake Superior and Red River organized an exploration party under George Gladman as Chief, Professor Hind as Geologist, W. H. Napier as Engineer, and S. J. Dawson as Surveyor. The primary object of the expedition was to make a thorough exploration of the country between Lake Superior and Red River. The party left Fort William on July 31st arriving at Fort Frances August 18th and at Fort Garry September 5th of the same year. The party continued their explorations through 1858. One of the results of this expedition was the building of the Dawson Route which served as the chief highway to Red River till the completion of the C.P.R. On March 31st, 1857, instructions issued from Her Majesty's principal Secretary of State, London, to Captain Palliser to explore the region between the west shore of Lake Superior and the Rocky Mountains, but more particularly between Lake Superior and Lake Winnipeg. In company with four other scientific gentlemen they arrived at Fort William en route up the Kaministiquia River on June 12th, and made a rapid exploration of the canoe route between Fort William and Rainy Lake, arriving at Fort Frances July 1st, and at Fort Garry on the 11th, collecting sufficient information on their rapid journey to enable them to form some idea of the resources of the country passed through, and taking numerous observations on the route, they arrived at the Rocky Mountains 1859.

The outlining and subdividing of Townships within this District was begun by the Dominion Government in 1872, and by the Ontario Government in 1888. Since 1872 twenty-eight townships, comprising an area of 493,000 acres, have been subdivided into lots of 80,160 and 320 acres, and along the banks of Rainy River into lots from 50 to 200 acres with a ten chain frontage on the river. No less than 775 miles of Base and Meridian lines have been run during that period, not including the outlines of the Townships subdivided, but including 126 miles of the eastern boundary of the District which is run due north through the most easterly point of Hunter's Island, crossing the C.P.R. east of English River Station. This boundary was established by an Act of the Provincial Parliament on the 30th March, 1885, when Rainy River was set apart as a District.

Within the District nearly 1,300 mining locations and islands have been surveyed under the Mines Act by private individuals. Extensive timber surveys have been made in the southern portion of the district. In 1890 and 1892, 370 square miles were sold by public auction for $254,600 bonus, or nearly $700 per square mile, besides stumpage dues of $1.00 per thousand, which, with the bonus, will amount to nearly $2,000 per square mile, from which we can form some idea of the value of the extensive pine lands in the southern part of the district. Tamarac, suitable for building and railway ties, spruce and poplar, suitable for pulp wood, is found in great abundance throughout the whole district. Between 1883 and 1893 the Geological Survey De-

partment of the Dominion made a geological survey of nearly the whole district lying south of the C P.R., making comparatively accurate traverses of most of the large lakes and main water ways.

Agriculture is, perhaps, one of the most promising of the economic prospects of the district, and will in this sense be largely determined by the facilities offered for the development of other industries such as its forests, mines and fisheries. Rainy River forms its source at Rainy Lake; to its mouth at Hungry Hall flows for eighty-five miles through a rich, alluvial plain, of the post-glacial formation, with clay banks rising on either side from ten to twenty-five feet high and an almost unbroken stretch of fine agricultural land on both the Canadian and American sides extending inland from six to twenty miles. The whole valley is covered with timber suitable for building, ties, pulpwood or fuel. From what I have seen of the Rainy River basin, I should say there is an area of no less than 800 square miles on the Ontario side, 65 per cent. of which is first class agricultural land, and the balance capable, when drained, of making good pasture land. It is entirely free from stone or rocks, well watered by small streams, and where settlements have been made well opened up with colonization roads. Many smaller tracts of flat lying land, probably old post-glacial lake bottoms, suitable for agricultural purposes, are to be found throughout the district. South of the Namekon River, along Rat and Big Turtle Rivers and many other streams, an extensive tract of the post-glacial formation, similar to that along Rainy River, extends along the Wabigoon River and around Wabigoon and Eagle Lakes.

The mineral wealth of this district, although hard to estimate, bids fair to be even greater than that of the timber and agriculture. The discoveries thus far establish the existence of unlimited deposits of rich iron ore along the Atikokan and Lime River; and, on the south side of Hunter's Island, gold has been found in paying quantities in several mines on the Lake of the Woods; while Rainy Lake and Lime River are having a gold boom at present which promises to assume considerable dimensions, and several stamp mills will be in operation before many months.

The Indians within the Rainy River District are Saulteux of the Ojibway nation. They derive their name from Sault Ste. Marie, from the neighborhood of which they originally immigrated. These Indians are embraced in what is known as Treaty No. 3, negotiated at the north-west angle of the Lake of the Woods in 1873, by Lieutenant-Governor Morris This Treaty ceded some 35,000 square miles to Ontario and settled any difficulties that had arisen out of the encroachments of Canadian settlers and surveyors on what the Indians had regarded as their lands. Most of them still cling to their Pagan faith, and the habits and customs incidental to their unconverted condition; and, although rather hostile to christianizing influences, are not deficient in many of the qualities that command respect. They are brave, fairly honest and active, and good workmen when kept at it, and among themselves very capable of self-government. The

bands on Rainy River and Lake of the Woods meet frequently in council, discuss their affairs very intelligently, and enforce sternly the rules necessary for their common welfare ; and, while mostly retaining the primitive wigwam and practising Pagan rites, they are in some instances far more thrifty, prudent and industrious than many of their race. Within the district the forests yield them abundance of game and the lakes an unlimited supply of fish ; the immense marshes produce large quantities of wild rice, while the more industrious grow maize, potatoes and other vegetables. Within the district there are no less than sixty Indian reservations surveyed, containing 540 square miles. Around the Lake of the Woods and north on English River and Lac Seul the Indian population does not exceed 1,900, of which about 600 trade into Lac Seul, while along Rainy River and around Rainy Lake and on the eastern part of the district there are about 1,000, or a total in the district of about 3,000 In 1877 there were 2,890, and but a few years prior to the year 1856, 3,150. These are known to the Hudson Bay Company as the Lac la Pluie Indians ; 1,500 of them traded at Fort Frances when David Thompson made his boundary survey in 1823.

The southern boundary of the district between the north-west angle of the Lake of the Woods and Chaudiere Falls at Fort Frances was settled by the commissioners appointed under the sixth and seventh articles of the Treaty of Ghent, December 24th, 1814. The southern boundary east of Fort Frances was finally defined by the Ashburton Treaty, signed August 9th, 1842.

The northerly and westerly boundaries were defined on the 3rd of August, 1878, by the award of five arbitrators appointed by the Government of Canada and Ontario.

The eastern boundary was established by an Act of the Ontario Legislature on 30th March, 1885.

The Report of the Judicial Committee of the Privy Council, establishing the boundary between Ontario and Manitoba, bears date July 22nd, 1884, and was confirmed by her Majesty in Council, 11th August the following year.

DISCUSSION.

Mr. Speight—I think we are much indebted to Mr. Whitson for his very able and interesting paper. It is very apparent that he has gone to a great deal of trouble and research in getting all these facts. One thing I noticed in the biographical sketches that we listened to this afternoon was that Mr. Thompson's name was omitted. I think a paper on the life and doings of this surveyor would be one full of interest and instruction to the profession. It is very apparent, also, that the surveyors are the pioneers of civilization. I have, therefore, great pleasure in moving a vote of thanks to Mr. Whitson for his able paper.

Mr. Dickson—In seconding the vote of thanks, I may say that I am personally acquainted with a limited portion of that country, and as far as I know, it quite bears out every word that Mr. Whitson has said.

This Association is not responsible as a body for any opinions expressed in its Papers by Members.]

THE EIGHTIETH MERIDIAN, CANADA.

By WILLIS CHIPMAN,
O. L. S., etc.

The object of the writer in presenting a paper on the above subject is to awaken an interest in our northerly heritage among the Land Surveyors, who are, as they should be, the pioneers in developing the natural resources of our country.

Few realize the vast extent of the territory north of the international boundary line. From Cape Breton to Vancouver Island, a distance of nearly 4,000 miles, Canada can be traversed by railway, and many books have been written on our potential wealth from the car windows. But the strip of territory that is well known, or that has been fully explored, is comparatively narrow.

In our own Province it may seem surprising to many to know that the trans-continental line of the Canadian Pacific Railway divides the Province into two parts of nearly equal areas. The northerly half of our Province, according to the above division, is probably as little known to-day as it was two hundred years ago.

The writer believes that when this territory becomes thoroughly explored and examined that it will prove to be a source of wealth to our Dominion, rich in minerals and in timber, and not without value to the agriculturist.

The impossibility of finding coal in northern Ontario has yet to be demonstrated. It is quite possible that some detached areas of carboniferous rocks may yet be found that may contain beds of merchantable coal. Quite recently an isolated area of Cambrian rocks has been found near Sudbury, and a small area of Niagara at the head of Temiscamingue.

In this paper the strip of territory described has for convenience been divided into four divisions and twelve sub-divisions

From the shore of Lake Erie to the shore of James Bay is a distance of about 570 miles, or as far as from Montreal to Windsor—all Ontario. This comprises the first division.

North of the Ontario division lies the great Hudson Bay division, about 792 miles in length, a vast region, the minerals and fisheries of which may be as valuable as those of Newfoundland, and their development will not involve us in any international disputes. Flowing into this great inland sea are many large rivers that drain about half of British North America, and a small part of the United States.

The third division, extending from Hudson Strait to the head of Baffin Bay, a distance of about 953 miles, is a region of ice, rock and water, probably of little value except for its whale and seal fisheries; but it is possible that the beds of coal that are found in several places might prove worth mining for whaling steamers, and for the smelting and reduction of the ores of economic minerals.

The fourth division of 955 miles from the head of Baffin Bay to the North Pole is a desolation of perpetual snow and ice, that will probably never be of commercial value until there is an amelioration in the climate.

The officials of the Meteorological Department give the latitude of the Observatory in Queen's Park, Toronto, as 43° 39'.4 North; and longitude as 5h 17 min. 34.65 sec. West of Greenwich.

Assuming the above as correct, the 80th meridian West of Greenwich will be about 30¼ miles west of the Observatory. The above calculation is necessary to fix the meridian, as, for the sake of clearness, (we will assume) the meridians and parallels of latitude are omitted from the latest maps of our Province issued by the Crown Lands Department.

We will now proceed with a description of the country along the 80th meridian.

DIVISION I—SECTION I.

On the banks of Lake Erie in the township of Walpole, County of Haldimand, the 80th meridian first strikes Canadian soil; following this meridian from the southward—the latitude of this point is approximately 42° 48′ north—Lake Erie has an elevation of 573 feet above mean sea level.

Running northward this meridian passes Hagarsville Junction, crosses the Grand River in Brant County, between Brantford and Caledonia. Ten miles further on, the Great Western Railway is crossed about a mile east of Capetown, and at the head of the great valley that extends westward from the end of Lake Ontario between the Dundas and Hamilton Mountains so called. The distance to Burlington Bay from this point is about 8 miles, the elevation of the bay being 246 above the sea.

The main line of the Credit Valley division of the Canadian Pacific Railway is crossed near Campbellville Junction. From Lake Erie to beyond the Great Western Railway, the rock formations are overlaid with drift, forming one of the richest agricultural districts of the Province.

Northward from the Canadian Pacific Railway, the country is elevated and broken, the rock of the Guelph and Niagara formations being exposed in ravines in the north part of Halton County and the east part of Wellington County.

The main line of the Grand Trunk Railway is crossed at Acton, 31 miles west of Toronto, northward from which the country continues broken, the meridian crossing the Credit River near the Forks, one of

the most picturesque points in the older part of the Province. Clinton and Medina formations are exposed in the gorges of the Credit.

The Owen Sound branch of the Canadian Pacific Railway is crossed a few miles further on, the drift again covering the rock except in the deepest gullies.

Orangeville is passed about three miles to the westward. The height of land between the streams flowing to Georgian Bay and those flowing to Lake Ontario is crossed in the south-east part of the County of Dufferin, where the hills attain an elevation of 1,700 feet above the sea, probably one of the highest parts of the Province.

Approaching the County of Simcoe, the deep valley of the Nottawasaga opens out to the eastward

The Hamilton and North-Western Railway is crossed near Lisle Station, the Northern Railway near Sunnidale, the Nottawasaga crossed only three miles from Georgian Bay and again crossed at its outlet. The meridian now corresponds very closely with the eastern shore of Nottawasaga Bay for 10 miles, crossing the Tiny Peninsula, entering Matchedash Bay, elevation 581 feet above the sea, in latitude 44°02′ north, and 141 miles from the shore of Lake Erie.

This ends the first section.

From Lake Erie to Georgian Bay the country is densely inhabited, this portion of the Province being well supplied with schools, roads, and railways; and its resources well developed by an intelligent and industrious population. All of this section is good farming land, the stratified Silurian rocks being overlaid with drift, with a productive soil.

In the southern portion peaches and grapes are grown, while the apple and the pear are grown in the northern portion.

The northern limit of the blackwalnut and the chestnut is passed near the Grand River and the hickory near Georgian Bay. The white pine has been removed from this area for many years.

By taking the Grand Trunk Railway train at Port Dover, thence by Hamilton & North-Western to Hamilton, Barrie and Penetanguishene the 80th meridian will be closely followed in this section.

DIVISION I—SECTION 2.

Crossing Matchedash Bay between the Giant's Tomb, with its historic ruins two miles to the west, and Prince Wm. Henry Islands to the east, the main land is struck a few miles north of the mouth of the Muskoka River. The Moon River is crossed at its mouth and the town of Parry Sound is passed, lying three miles to the westward.

North of Matchedash Bay the country is altogether different from what it is south of it. The Laurentian district is here entered, a great portion of the country being broken by rock exposures.

The Maganetawan is crossed at a point 200 miles from Lake Erie, and the French River near Lake Nipissing. The western part of this lake is crossed, the meridian running along the east side of McLeod's Bay west of Sturgeon Falls, the north point of which bay is touched by the trans-continental line of the Canadian Pacific Railway.

Lake Nipissing has an elevation of about 660 feet above mean sea level. This beautiful sheet of water has a length of 40 miles and a width of about 10 miles. French River, through which this lake discharges into Georgian Bay, is one of the most marvellous rivers in Canada owing to its numerous channels, its chutes, its cross-channels and its numerous rock-bound mouths.

Northward from Lake Nipissing the 80th meridian crosses the Sturgeon and soon enters unsurveyed territory, passing the southerly outlet of the great Lake Tamagamingue that forms one branch of the Sturgeon and thence along the easterly side of the main lake, crossing several bays, including the long north-east arm. This beautiful lake rivals the Muskoka lakes in size and excels them in beauty.

Passing onward, the Montreal River, a picturesque stream that flows to Lake Temiscamingue, is crossed, the head of which lake lies about 13 miles to the eastward. Temiscamingue has an elevation of about 620 feet above the sea.

The boundary line between the Provinces of Ontario and Quebec runs due north from the north end of the lake, and is about 19 miles distant from the 80th meridian, its longitude being 79° 18′ 58″ west.

Five surveyed townships are passed through on the headwaters of the Blanche River and the height of land crossed in latitude 48° 12′, about 370 miles from Lake Erie and about 215 miles from Matchedash Bay. The height of land has an elevation varying from 900 to 1,800 feet above the sea. This we will call the end of the second section of our line.

The Laurentian region near Georgian Bay is much broken with rock exposures, streams and small lakes. It is sparsely settled by a hardy class of people, who obtain a livelihood from lumbering operations rather than from farming. The hardier grains and all root crops are grown, and immense quantities of pine timber and lumber is still being taken from this area. North of Lake Nipissing, for a short distance, the land is much better suited for agricultural purposes and excellent crops of roots and oats are grown. It is cheaper to import Manitoba flour than to grow wheat, but this is now generally true for all Ontario.

The untenanted wilderness, without roads or paths, except the trails of the aborigines, is entered a few miles north of Lake Nipissing and there is not a white settler between this and James' Bay. Opposite the north-west angle of Lake Temiscamingue, however, it is only a few miles to a settlement.

A few miles south of Lake Tamagamingue the Huronian formation is entered, with its characteristic rocks—rich in minerals requiring capital and brains to develop and make richly remunerative.

Two or three "islands" of Laurentian are crossed in the Huronian area, north-east of Tamagamingue and at the head waters of the Blanche.

Nearly the whole district is overlaid, where there is a soil, with the "Algoma" sands.

Heavy clays are met with around the head of Temiscamingue, there being several townships there in which there are no rock exposures.

The underlying rock at the head of the lake is supposed to be of the Niagara formation, which forms the high, well-defined escarpment that passes around the west end of Lake Ontario from Niagara Falls, thence north-westerly across the Province to Georgian Bay, underlying the County of Bruce and forming the south half of Manitoulin Island. This outlier at the head of Lake Temiscamingue must, therefore, be 160 miles from the nearest Niagara exposure, unless the limestone found on the islands in the east part of Lake Nipissing is Niagara. North-west of Subdury, about 10 miles, is an area of supposed Cambrian rocks covering about 200 square miles.

The area passed through by this second section of the 80th meridian is now being operated over by lumbermen and by mineral explorers. It is not probable that it can ever become an agricultural district.

The northern limits of the Red Cedar and the Butternut are passed near Parry Sound; White Oak, Beech, White Ash and Ironwood near Nipissing, the Basswood south of Tamagamingue, the Hemlock and Red Oak, near the Montreal River, and the Sugar Maple is left behind at the height of land.

South of Nipissing the country can be examined by train from Midland to Barrie, then by Northern to North Bay. North from Nipissing the only route is by canoe up the Sturgeon to Tamagamingue, thence to Temiscamingue, thence up the Blanche, a chain of lakes and connecting rivers a few miles east of and parallel to the boundary line between Ontario and Quebec to Lake Abittibi.

DIVISION 1—SECTION 3.

The third section of the 80th meridian, in the Province of Ontario, commences at the southern edge of the watershed of Hudson's Bay.

The south shore of upper Lake Abittibi is struck 30 miles from the height of land. This lake extends about 30 miles to the east and 3 miles to the west, its width at the point of crossing being 6 miles, the average width being about the same. The upper lake has an elevation of about 850 feet above the sea.

At the eastern end of the upper lake is the Hudson Bay Co.'s post. Lower Abittibi Lake is connected with the upper lake by a river three or four miles in length. The lower lake is not quite so large as the upper lake, from the south-west angle of which the Abittibi River flows south-westerly, the westerly to a point about 25 miles from the lake thence northerly to its junction with its great brothers, the Missinaibi and the Mattagami, the three united forming the Moose River. The Moose River is doubtless the largest river wholly in the Province of Ontario, draining about 27,000 square miles of the Province.

The 80th meridian practically coincides with the eastern shore of the lower Abittibi Lake leaving the vicinity of the lower lake in latitude 49° North at 25 miles from the southerly shore of the upper lake.

From this point to the head of James Bay is practically a terra incognita, a distance of about 145 miles. The shore of James' Bay

is struck about 30 miles south-east of the mouth of the Moose River. The country along the meridian is probably very similar to that along the Abittibi River, the highway between Lake Abittibi and James' Bay, the river at no point being more than 65 miles from the 80th meridian.

Huronian rocks are met with about the south-west and north shores of Lake Abittibi and along the river banks for 80 miles below the lakes. Laurentian is also exposed north of the upper lake and east of the lower lake

Areas of Huronian and Laurentian rocks are reported alternating along the Lower Abittibi River, these areas extending to the eastward, the Laurentian predominating.

The northern limits of the Red Pine, the White Pine, and the Yellow Birch are passed in the vicinity of the Abittibi Lakes; the Black Ash and Banskian Pine between the Lakes and James Bay, and the White Cedar at the Bay itself.

The Province of Ontario,therefore, has a length from Lake Erie to James Bay on the 80th meridian of about 570 miles, of which distance 150 miles is an agricultural and manufacturing country densely populated, with its resources well developed.

The southerly 100 miles of the central 220 miles is sparsely settled and partially developed, and the northerly 120 miles,rich in forests and minerals, is unsettled.

The northerly 200 miles is in a state of nature, only partially known to the employees of the Hudson Bay Company, its aboriginal vassals and a few explorers from the Geological Survey Department.

From Toronto to the head of James Bay is about 520 miles, being the same distance as to the city of Quebec, and a less distance than to Port Arthur on Lake Superior. The Province has a frontage of about 150 miles on James Bay, a coast line not yet traversed by a Land Surveyor.

DIVISION 2—SECTION 1.

The Second Division includes James Bay and Hudson Bay.

James' Bay is about 150 miles in width, and from its south end to a line joining Cape Henrietta Maria on the west side and Cape Jones on the east side, the distance is about 300 miles.

The 80th meridian passes through James Bay about 50 miles from the east coast, Charlton Island and Solomon's Temples being on the east, and the Twins to the west.

On crossing the 55th parallel of latitude, Hudson Bay itself is entered, Cape Jones being due east.

This may conveniently be called the *Southern* or 1st Section of the 2nd Division.

The shore of James Bay has been fully explored, but there is no reliable map of it published since the British Admiralty map, issued before 1857.

Root crops are grown at all the Hudson Bay Co. ports, also hay and barley, the northern limit of the potato being passed at Cape Jones.

Around the bay the Hudson Bay Co have five posts—Fort Albany, Moose Factory, Rupert's House, East Main Fort and Fort George.

The south and west shores are low, muddy and strewn with boulders, and in places at low tide it is necessary to go beyond sight of the furze-covered land to obtain sufficient depth of water to float a loaded canoe.

Into this bay flow many large rivers in the following order, commencing at the north on the west coast: The Equan, At-tah-wah-pis-cat, Albany, Moose, Hannah, Nottawa, Rupert's, East Main and Big River. The last is probably the longest, being equal in volume to the Ottawa.

The At-tah-wah-pis cat, Albany and Moose, are navigable for great distances from James Bay by small steamers. The large inflow of fresh water into the bay makes it brackish. The east coast is also low, but the water is deeper than on the west side of the bay.

Devonian rocks underlie the western and southern sides of the bay, but are not exposed along the coast. On the east coast the Laurentian rocks are exposed, and as you proceed northward, the land rises. The northern limits of the Balsam, Fir, and the Canoe Birch are passed near Big River, and the Poplar near Cape Jones. The only remaining trees are the Tamarac, the Spruce, and the Balsam Poplar.

From records kept by the Hudson Bay Co. and observations of explorers, the summer climate of James Bay appears to be about the same as that of the north shore of Lake Superior and of the height of land. The mean winter temperature is colder, but more uniform. The climate increases in severity with the latitude and with the elevation above the sea. In this case the difference in latitude of two degrees is offset by the difference in elevation of over 600 feet. It is generally assumed that an elevation of 1,000 feet corresponds with a decrease of three degrees in temperature.

DIVISION 2—SECTION 2.

The Second Section of this division commences in latitude 55°, opposite Cape Jones.

The 80th meridian passes by the west of the south Belchers and the north Belchers, the latter being opposite Richmond Gulf, a remarkable harbor on the east coast.

Between Cape Jones and Richmond Gulf two large rivers, the Great Whale, in latitude 55° 16′ north, and the Little Whale, in latitude 55° 55′ north, discharge on the east coast.

The narrow entrance to Richmond gulf is 104 miles east of the 80th meridian, this being the most eastern point in Hudson Bay. This gulf is over 20 miles in length and 15 miles in width.

In latitude 56° 48′ the Nastapoka River enters on the east coast, opposite the Baker's Dozen or Committee Islands, just east of our meridian.

Passing northward the coast line approaches the 80th meridian. The south Sleepers Islands are to the west of the meridian in latitude 57° 35′.

Cape Dufferin, in latitude 58° 45′, longitude 79° 10′ west, is the most westerly part of the east coast north of Cape Jones This prominent point we will make the end of the second section in the second division.

Along the greater part of the east coast there is an elevated ridge forming a chain of narrow islands, between which and the main land is a channel varying from five miles to one mile in width.

Parallel to the coast, and about 100 miles to the westward, is a second chain of islands in groups; the Ottawa group, in latitude 59° 45′ and longitude 80, being the most northern.

Laurentian rocks are exposed all along the coast and in many islands. Between Great Whale River and the Nastapoka, the Laurentian formation is overlaid in many places with dolomitic limestones, and quartzose sandstones of the Devonian all being capped with trap and basalt. The inner chain of islands has a sharp descent towards the main shore, and a very gentle slope to the westward. All these islands appear to be capped with trap.

This part of Hudson Bay has been explored by Dr. Robt. Bell and Mr. A. P. Low of the Geological Survey Department.

A short distance north of Richmond Gulf the northern limit of forest trees is passed, the spruce being the last found. Inland the tree limit runs north-easterly to Ungava Bay.

The northern limit of the otter, the beaver and the black bear corresponds closely with the tree limit. All north of a line joining the outlet of Nastapoka River and the south end of Ungava Bay, may be called barren grounds, corresponding with the north-west side of Hudson Bay, north of Churchill. The reindeer and the wolverine are the only large animals to be found in this district, the musk ox not being found on the east side of Hudson Bay. The Hudson Bay Company has posts at the mouths of the Great Whale and of the Little Whale, the latter being the most northerly post on this coast.

Fort Chimo, on South River, about 30 miles south of the south end of Ungava Bay, is the most northerly post of the Company east of Hudson Bay. It is in latitude 58° 30′ north and longitude 63° 40′ east and about 320 miles east of the shore of Hudson Bay.

DIVISION 2—SECTION 3.

Northward from Cape Dufferin the east coast line bears north-easterly, then nearly north to Mosquito Bay, being fringed with rocky islands similar to the north-east coast of Georgian Bay.

The Ottawa group of islands, in latitude 59° 45′, is crossed by the 80th meridian.

The entrance to Mosquito Bay is about 20 miles in width, the bay itself extending inland more than 50 miles. The north shore of the bay extends westerly to about the same longitude, as Cape Dufferin.

The 80th meridian crosses the easterly part of Mansell Island, the north end of which, in latitude 62° 30′, we will call the end of the second division. Mansell Island is about 70 miles in length and 20 in width.

The east coast north of Cape Dufferin has not been accurately surveyed or thoroughly explored. It is reported to be a desolate, rocky country, probably Laurentian, with scanty vegetation, seldom visited by white men.

The north end of Mansfield Island is nearly opposite to Cape Wolstenholme, the most north-west point on the main land to the east. West from this cape on the outer Digges Islands is Port Laperiere, one of the posts established by the Dominion Government in 1884 for making meterological observations and observing movements of the ice The south-west shore of Hudson Strait extends south-easterly from Cape Wolstenholme, the width varying from 60 miles to 150 miles. From this cape to Cape Chudleigh, which guards the Atlantic entrance to the strait, is about 450 miles. Ungava Bay, with its tides rivalling those in the Bay of Fundy, is a southerly expansion of the easterly part of Hudson Strait, this bay being about as large as Lake Superior. The two observatory stations of Ashe Inlet and Stupart's Bay are situated on the north and south shores of the Hudson Strait, about half way between the Atlantic and Hudson Bay. Port Burwell is near Cape Chudleigh; in latitude 60° 27′ north and longitude 64° 37′ west.

Cape Farewell, the most southerly point of Greenland, is in latitude 59° 50° north and longitude 44° west, and is distant about 750 miles from Cape Chudleigh and in almost a due east direction.

DIVISION 3—SECTION 1.

Leaving the north end of Mansfield Island, the north-east end of Southampton Island is passed on the left, and Nottingham Island on the east, at the south-east end of which is Port De Boucherville, another Dominion observation station.

The five stations mentioned were established in 1884, and the observers withdrawn in 1886, two winters having been spent in this inhospitable region by our Canadian surveyors and scientists.

Bell's Island lies immediately west of the 80th meridian, a point in latitude 63° 35′ north nearly reaching this meridian. The axis of Chesterfield Inlet, a remarkably long arm, which extends westerly from the north-west side of Hudson Bay, if produced easterly would correspond closely with the south shore of Bell's Island and Southampton Island to the west of it. The east end of Chesterfield Inlet is about 350 miles west of Bell's Island. Southampton Island is about as large as the Province of New Brunswick.

Proceeding northward Fox Channel, one hundred miles in width, is entered, Southampton Island forming the south west shore and Cumberland Island the east shore. Southampton Island is separated from the main land of Melville Peninsula to the north by Frozen Strait and from the mainland to the west by Rowes Welcome. Repulse Bay, at the north-west end of Frozen Strait, is noted as being the wintering place of the explorer Rae in 1846, 1847 and 1853. The distance across the isthmus from the head of Repulse Bay to the south end of Committee Bay is only a few miles. The arctic circle is crossed near the head of Repulse Bay.

For convenience the arctic circle, latitude 66° 32′ north, will be made the end of this First Section in the Third Division. We are now only half way to the North Pole from Lake Erie.

In this Section the large whales are first found, and the musk ox ranges the west shores of Hudson Bay north of Chesterfield Inlet.

DIVISION 3.—SECTION 2.

The arctic circle passes through the narrow part of Davis Strait to the east, the entrance to Baffin Bay and skirts the north coast of the American continent, east of the Copperimine River.

The Fury and Hecla Strait, in latitude 69° 30′, separate the Melville Peninsula from Cockburn Island to the north. The east shore of Fox Channel, north of the arctic circle, does not appear to have been carefully explored, the channel being practically closed to navigation by ice.

Disko, on the east side of Baffin Bay, is in about the same latitude as the eastern entrance to Hecla and Fury Strait and about 650 miles distant in a straight course.

DIVISION 3.—SECTION 3.

From Fury and Hecla Strait to Ponds Inlet, in latitude 72° 30′, a distance of over 200 miles, the channel has not been visited by civilized men and it is only inferred from the movement of the ice that there is a continuous channel. Cockburn Island, which forms the western land, may prove to be two or more islands, but it is probable that the eastern land is continuous with Cumberland Island ; if so, this latter contains an area nearly as large as the Province of Ontario.

DIVISION 3.—SECTION 4.

Pond's Inlet is in the same latitude as Upernivik, the most northerly post occupied by civilized men in Greenland. From the 80th meridian it is about 100 miles to the line of the westerly side of Baffin Bay, and 500 miles to Upernivik.

North of Pond's Inlet the meridian we are following crosses an island about 80 miles in diameter, and enters Lancaster Sound near Cape

Hay in latitude 73° 50′. Passing the eastern entrance to Lancaster Sound, about 100 miles in width, the 80th meridian crosses the easterly end of North Devon, an island as large as the Province of Nova Scotia, then crossing Jones Sound, about 70 miles in width, strikes Cape Tennyson, the most southerly end of Ellesmere Land, in latitude 76° 15′,

Latitude 76° corresponds closely with the north-west end of Baffin Bay, Cape York being in this latitude and 225 miles east of Cape Tennyson. Melville Bay, and its eternal pack of ice, extends east of Cape York about 125 miles.

This section has been thoroughly explored.

Laurentian rocks are found along Pond's Inlet and form the east part of North Devon and the west part of Greenland in the vicinity of Cape York.

Silurian rocks form the land on the south shore of Lancaster Sound and the west part of North Devon.

DIVISION 4.—SECTION 1.

We now enter Division Four, this point being practically the extreme northern limit of navigation for whaling vessels and of safe navigation by experienced arctic mariners. The bay which converges uniformly to Smith's Sound is 130 miles in width in latitude 76½° north.

In latitude 78° 15′ north, Smith Sound is only 25 miles in width, Cape Isabella being on the west coast and Cape Alexander on the east. Cape Isabella is in longitude 75° east and 70 miles from the 80th meridian.

Between Cape York and Cape Alexander the east coast is very irregular, Whale Sound and Inglefield Gulf extending inland 60 miles.

Lt. Peary wintered in latitude 77° 40″ in 1892-93, making this his starting point for his wonderful march north-eastward across Greenland. He has spent two winters in that vicinity since then.

North of Smith Sound, the channel opens out into what was known as Kane's Sea, on the east shore of which is the wonderful Humboldt glacier. To the west a channel extends that may yet prove to divide Ellesmere Land to the south from Grinnel Land to the north. In latitude 80° 15′, the channel again contracts to about 20 miles in width, and is called Kennedy's Channel to Cape Baird where a narrow fiord extends south-westerly for 60 miles and another runs southerly from the opposite shore for about the same distance.

The first is known as Archer Fiord, off the north end of which is Lady Franklin Bay, in latitude 81° 44′, where Greely spent two winters, and where the *Discovery*, with Captain Nares' expedition, wintered in 1875-76.

The southerly bay is known as Petermann or South Fiord.

It should be stated that the average direction of the east shore of Ellesmere Land bears 35 degrees east of north from the vicinity of Cape Tennyson.

Northward from Lady Franklin Bay the channel is known as Robeson Channel which opens into the circumpolar sea in latitude 82° 15′ north.

The *Alert* wintered at the west side of the north entrance to this channel in latitude 82° 27′, longitude 61° 22′ E., in 1875-76 from which point the north coast to the westward was surveyed, also the Greenland coast to the north-eastward.

In 1881-82, Lockwood, of the Greely expedition, extended each of these explorations

The 80th meridian crosses Greely Fiord on the west coast of Ellesmere or Grinnell Land in latitude 80° 45′, from the head of which a chain of lakes and streams extends north-easterly to the head of Archer Fiord.

Hazen Lake is a body of fresh water (or ice) 50 miles long and from 5 to 10 miles wide, lying west of Lady Franklin Bay and 25 miles inland.

The 80th meridian strikes the north shore line of Ellesmere, Grinnell or Grant Land (as it is differently called) in latitude 82° 55′ and about 170 miles from Robeson Channel to the eastward. The westerly half of Ellesmere and Grinnell land is practically unexplored.

Musk oxen, wolves, hares, white bear, ptarmigan and other smaller animals and birds are found in Grinnell Land, and the seal to the north of this land, where large bodies of open water appear.

A small party could probably secure sufficient animal food by hunting to maintain itself in Grinnell Land.

DIVISION 4.—SECTION 2.

This section includes the unknown tract between the north coast of Grinnell Land, in latitude 83°, and the Pole, a total distance of 486 miles; not so far as from Toronto to James Bay.

Parry, in 1827, succeeded in getting as far north as 82° 45′ by sledges and boats north of Spitzbergen.

Between 1847 and 1857, a great number of arctic expeditions were sent out to rescue the Franklin expedition lost in 1846 after making the North-West passage. These different expeditions explored nearly all of the islands lying west of Baffin Bay and Dr. Kane advanced to Cape Constitution beyond latitude 80° on Kennedy Channel.

In 1860-1 Hayes reported as having gone as far as 82° 35′ by the same route, but it is more than probable that he did not reach this latitude. (*See* Greely's narrative).

Hall, in the *Polaris*, in 1872-73, by the same route, went as far as 82° 15′.

Parry's farthest north, 1827, was not passed until 1875-76 when Nares and Markham pushed through Robeson Channel with the *Alert*, and Markham by sledges went as far as 83° 20′ 36″.

The sister ship, *Discovery*, wintered at Lady Franklin Bay.

In 1881-82 and 1882-83 the Greely expedition wintered in Lady Franklin Bay, Brainard and Lockwood exploring the north-west coast of Greenland to latitude 83° 24′ the "fartherest north" to date, this point being 459 miles from the pole.

Peary in 1893 attained 81° 37′ on the north-east coast of Greenland.

The writer is of opinion that the safest and most certain route to the pole is by vessel to Lady Franklin Bay, thence by sledges over the Poleocrystic Sea, following the Greenland coast as far as possible.

DISCUSSION.

Mr. Chipman—I may explain to you that this map on the wall, which was drawn by Mr. L. B. Stewart, is on a projection which I have never seen described. The centre line is a straight line, representing in this case the 75th meridian. On that, commencing at the pole, were laid off the degrees of latitude; that is, the lengths were computed for each degree from some German table—I believe they were in meters, and reduced to English miles—and put upon this plan which is drawn to a scale of fifty miles to an inch. The total distance between the pole and this parallel of latitude was carefully scaled and the sub-divisions made afterwards, so that the errors were not cumulative. The circles are drawn with the pole as centre. Then the length of each degree of longitude was found from tables and the arcs calculated; these were laid off in the different parallel and subdivided. You can understand there was a great amount of work in this. This took Mr. Stewart some two or three weeks before he began plotting on the topography. The topographical part is the least part of the work. When you examine it you will appreciate the excellence of the work. The distortion will be found to be very little. Approaching the pole we found that in laying off the arcs on this circle, the distortion was so small that it amounted to about the width of a line only in a degree, so that it was not apparent to the naked eye. The map extends from the 40th parallel to the pole and then over the pole into Siberia. The object of this plan was to exhibit a strip of territory on each side of this meridian right up to the pole and beyond, all being on the same scale of fifty miles to an inch. The common maps that we have of our country are generally so distorted that they give you a very poor conception of the extent of territory that is north of us. This plan shows the territory from the Labrador peninsula practically to the Lake of the Woods country, and it is the same width throughout. On most maps the great area surrounding the pole is generally shown as being water, whereas it is not known what it is.

The President—I am sure we all feel indebted to Mr. Chipman for the industry which he has expended upon both this paper and

the report of the Committee on Polar Research, for I can assure you that so far as I am concerned, although I am on the Committee, I have done nothing towards the work and I think Mr. Chipman has done most of the work himself. He has gone to a great deal of trouble in preparing this paper, and he has given us a great many facts which I think most of us have never given any attention to, and they are certainly interesting.

Mr. Gaviller—I would like to ask as to the coal deposits in the very high latitudes, Baffin's Bay; have you ever found if they are in actual existence?

Mr. Chipman—I have seen photographs of them, that is the best I can say. There is a coal seam at Lady Franklin Bay, about eight feet in thickness above the water level. It is a good quality of lignite, about equal to that in our North-West.

Mr. A. R. Davis—I have travelled a little east and west and south and have always had to pay railway fare—or nearly always—but to-night we have been taken on an excursion to the far north and it has not cost us anything, and it has been very interesting to me. I don't know whether the members of this Association are all crammed full of information about the north or not, but I must admit that I am not very well informed in reference to that country. When my ship comes over, if it has one-tenth of the wealth aboard that I am hoping for, I will gladly equip an expedition to send Mr. Chipman up there. Seriously, I think the members of this committee are worthy of the praise not only of this Association, but of the whole community, for the movement they are making in this direction, awakening an interest in the unexplored regions of our own country to the north. It is hoped that our Governments, both Dominion and Provincial, will in the future take some interest in a financial way in the development of that country; and I am in hopes that this is only the beginning of future researches in that direction.

Mr. Tyrrell—I am sure we were all extremely pleased with the paper we have just listened to; I know I was at all events, and with the report of the Committee also, which I am sorry to have to confess that, though a member of the Committee, I had nothing to do with. There are so many points that I feel like speaking about that I scarcely know where to begin. I might mention a point spoken of in connection with the report as to the expense of an expedition into the north. Mr. Chipman spoke of the necessity of chartering a vessel, but I scarcely think that would be necessary. American and Dundee whalers are in the habit of going as far north as Smith's Sound annually and calling at a point, I think it is called Cape Jones, but not the Cape Jones in Hudson's Bay, of course; it is just to the south-western end of Smith's Sound. An expedition could easily be taken out at a comparatively small cost by one of these whaling vessels; in fact, I happen to know just now of an American expedition which has already made arrangements for conveyance to the shore of Elles-

mere Land by a Newfoundland whaler. I think the cost of a small expedition, of say twelve or fifteen men would scarcely amount to any such figure as $50,000. I know this American expedition I have already referred to, which has its headquarters at Washington, is only figuring on $20,000 to $25,000. Whether their estimate is too low or not I don't know.

Mr. C. F. Aylsworth—I must say that heretofore I have never been inspired with a very wild or savage interest in the aims and aspirations of this Association, but after listening to the way in which this subject was handled to-night I must admit I have been endowed with a new interest in it. I think the Association is to be congratulated on having members who are capable of grappling with such a problem as this. I think the fact of this Association taking hold of this subject is going to give it a standing it has not heretofore had.

Mr. Chipman—The object in preparing this paper was to awaken an interest, as I stated, among the members of the Association in our northern land. I believe that there is a great future for that country. We cannot, of course, expect that it will be developed as the southern territory is, but I believe that men can make fortunes there if they will only make up their minds to stand the hardships for a few seasons. It is unreasonable to think that a large territory such as that is a land of desolation, that there is nothing there. That the coal on the north of Hudson's Bay will be available here, of course, is out of the question, but there is a possibility that there is coal south of Hudson's Bay, and while that possibility remains we should not rest until it has been fully explored. I stated in my report that we now know less of that territory than was known two hundred years ago. Some may take exception to this statement, but I think it is literally true. As evidence of this, you will find in the corridor outside of this hall a cannon brought here from the north shore of Hudson's Bay. Others were found in the same vicinity, some four I think, and one was brought here. Up to this date we don't know when they were left there or for what purpose. We know nothing whatever about them. And it is so all through that territory, evidences of former visitants are continually being brought to light. Probably the Hudson Bay Company know something of this.

As to a Polar expedition, a great many people laugh at us, but we must just stand their ridicule. If I were only a more robust and younger man I don't think I would rest until I had set my foot beyond the 80th parallel; and I hope that, if any members of this Association at any time have an opportunity of joining in an expedition, they will do so as members of the Association, at least that they will connect the Association with their expedition or with their position in some such way that the Association of Land Surveyors of Ontario will be benefited thereby. It will not detract from the honor that will fall to them and it will be of perhaps great assistance to us.

Mr. Speight—I think the Association would be very glad to hear a few words from Mr. Stuart Jenkins. He is one who has taken quite an interest in that northern country and is here to-night.

The President—We would be very glad indeed to hear him.

Mr. Jenkins—I feel very much honored by the request, but I assure you I came here to-night to learn and not to teach, and Mr. Chipman has so thoroughly exhausted the subject that I don't think there is anything left to say.

Mr. Aylsworth—I would like to hear Mr. Chipman state what he claims to be the object of this expedition. I have been reading a little about the subject lately, and I have been discussing it a little too. Of course I am heartily in favor of it, but I would like to get the real, practical, scientific reason for it.

Mr. Chipman—I think I stated in my report that we will not argue the point with a strict utilitarian. We cannot argue it; it is out of the question. But for a scientific man I am sure the objects are sufficient. One object is to know what is now unknown; that is really the great object. There is a tract of territory there that we know practically nothing whatever about, though it has been theorized about for two hundred years.

Mr. Aylsworth—Is that scientific or sentimental?

Mr. Chipman—Well, it is both.

Mr. Bowman—Are there not certain observations that may be made there that cannot be made other places?

Mr. Chipman—Yes. Of course, the first thing to be done will be to find a practical route there; after that, scientific observations will be made. There is no doubt that if the trip be once made it will be repeated. In every difficult work undertaken that has been the rule. Take the scaling of the Matterhorn in Switzerland; it was not scaled until Whymper did it, but since then it has been done every season, and it will be the same with the North Pole.

There is one other matter I did not touch on. Perhaps you are not aware, as I was not until I thought it over, that probably this Canada of ours contains a larger area of unexplored territory than any other continent in the world. That is something, I think, Canadian surveyors may take home and think about.

BOOKS AND REPORTS CONSULTED IN PREPARATION OF THE PAPER.

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Greely.....Three Years' Arctic Service,
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Report of Select Committee House of Commons on Navigation of Hudson's Bay. (Blue Book, Ottawa, 1884.)

Reports on Hudson's Bay Expeditions in 1884, 1885 and 1886. (Reports Department of Marine, Ottawa.)

Report of Select Committee of the Senate on the Mackenzie River Basin. (Blue Book, Ottawa, 1888.)

Report on Basin Moose River (Borron). (Department Crown Lands, Toronto, 1890.)

SUMMARY.

	Sections.	Latitude.	Miles.	——	
First Division.	1	42°48′	000	North shore Lake Erie	Ontario.
		44°02′	141	Matchedash Bay	
		44°58′	200	Maganetewan River	
	2		244	C.P.R., Lake Nipissing	
		48°12′	373	Height of land	
			400	Abittibi	
	3				
		51°03′	570	South end James Bay	
Second Division.	1	.....	700	Solomon's Temple	James Bay.
		55°00′	843	Cape Jones	Hudson's Bay.
	2	56°48′	926	Richmond Gulf	
		58°45′	1102	Nastapoka River	
		60°00′	1189	Cape Dufferin	
	3				
		62°30′	1362	North End, Mansell Island, Hudson Straits	
Third Division.	1				
		66°32′	1643	Arctic Circle	Fox Channel.
	2	69°30′	1848	Fury and Hecla Strait	
	3	72°30′	2055	Pond's Inlet	
	4	73°50′	2150	South shore Lancaster Sound	Baffin's Bay.
		76°15′	2315	Cape Tennyson	
Fourth Division.		78°15′	2455	Capes Alexander and Isabella	Grinnell Land.
	1	80°15′	2593	Cape Calhoun	
		80°45′	2645	Greely Fiord	
		83°00′	2784	North Shore Polar Sea	
	2	83°24′	2811	Furthest north by Lockwood, 1882	Polar Sea.
		90°00′	3270	Pole	

TABLE OF TEMPERATURES.

Place.	Location.	Latitude North.	Longitude West.	Three Warmest Months. Absolute. Max.	Three Warmest Months. Absolute. Min.	Three Warmest Months. Mean.	Three Coldest Months. Absolute. Max.	Three Coldest Months. Absolute. Min.	Three Coldest Months. Mean.	Mean Temp. of Year	Years.	Authority.
Toronto	Ontario	43°39′	79°24′W	[1]99.2	28	64	[2]70	[2] −26.5	+24.55	+44	1841–94	Meteorological Dep't.
Ottawa	Ontario	45°26′	75°41′ "	99	29	64	55	−33	+15	+43	1872–94	" "
Mattawa	Ontario	46°17′	78°42′ "	95	22	63	51	−43	+ 9	+37	1890–94	" "
Quebec	Quebec	46°48′	71°13′ "	96	22	61	49	−34	+14	+38	1876–94	" "
White River	Ontario	48°20′	86°20′ "	92	19	55	53	−70	− 2	+31	1887–94	" "
Port Arthur	Ontario	48°27′	89°12′ "	96	21	58	63	−40	+ 6	+35	1877–94	" "
Winnipeg	Manitoba	49°53′	97°07′ "	98	19	61	47	−46	+ 2	+32		" "
Moose Factory	Ontario	51°16′	80°56′ "	94	26	56	53	−47	+ 3	+31	1878–94	[4]H. B. Co.
Prince Albert	Saskatchewan	52°55′	106°0 "	94	14	55	57	−60	− 1	+29	1886–94	"
York Factory	Hudson Bay	57°0	92°26′ "	106	23	53	44	−53	−13½	+21	1842–83	"
Fort Churchill	Hudson Bay	58°43′	94°10′ "	84	30	45	39	−45	−18	+14	1885–86	"
Fort Rae	Great Slave Lake	62°39′	115°44′ "	78	28	53	26	−48	−24	+22	1882–83	H. P. Dawson.
Average Observing Stat'ns	Hudson Strait	63°	75° "	68	27	39	30	−40	−16	+12	1885–86	Dominion Gov't.
	Bothia Felix	69°59′	92°0 "	.....	14	38	....	−56	−26	+ 2	1829–32	Jno. Ross.
Point Barrow	Alaska	71°15′	156°35′ "	66	20	36	....	−52	−25	+ 9	1881–83	Ray.
Upernivik	W. Greenland	72°45′	55°30′ "	.....	....	48	....	−47	− 7	+13		
Port Bowen	Prince Regent Inlet	73°25′	89°0 "	.....	23	37	....	−47	−27	+ 4	1824–25	Parry.
Bay of Mercy	Banks Land	74°0	118°0 "	.....	....	35	....	.....	− 6	+ 2	1851–53	R. L. M. McClure.
Sabine Island	East Greenland	74°32	19 "	.....	....	..	....	−41	−11	....	1869–70	Koldeway.
East of Griffith's Island	Cornwallis Island	74°45′	94 "	.....	....	36	....	.....	− 9	+2½	1850–51	Jno. Ross.
Winter Harbour	Melville Island	74°47′	111 "	.....	22	37	....	−50	−28	− 1	1819–20	Parry.
North Star Bay	West Greenland	76°34	69 "	.....	22	38	....	−54	−26	+ 5	1849–50	
	Northumberland Is'd.	77°0	97 "	.....	....	31	....	.....	−12	− 1	1852–53	E. Belcher.
	Franz Josef Land	79°51	59 E	.....	13	33	....	−51	−21	+ 3	1872–74	Payer & Weyprecht.
Discovery Bay	Grinnell Land	81°44′	64°40′W	46	16	33	....	−71	−37	−4½	1875–76	Nares—*Discovery*.
Fort Conger	Grinnell Land	81°44′	64°45 "	53	....	35	....	−66	−39	− 4	1881–83	Greely Expedition.
Floeberg Beach	Grinnell Land	82°27	61°22′ "	50	18	34	....	−74	−36	−3½	1875–76	Nares—*Alert*.

[1] 24/8/54, [2] 10/1/59. [3] 19/3/42. [4] With a break of four years—1885-88.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

THE DAWSON ROUTE.

By W. A. BROWNE,

O. L. S., Toronto.

The Dawson Route derived its name from S. J. Dawson, C.E., who, with a staff of surveyors and Indians, had been employed by the Dominion Government for several years previous to the year 1867 in making surveys and explorations between the head of Lake Superior and the Rocky Mountains to find out the best route to reach the great North-West, and, after spending several summers and winters on the work, reported to the Government that Thunder Bay would be the best point to start the route from, and which was adopted by them, and in the year 1867, the Ontario Government sent a large party in charge of Mr. Bridgeland, P.L S., to Thunder Bay, who commenced exploring, locating and building the road from Thunder Bay (now Port Arthur) to Dog Lake, and built about six miles that summer. In the year 1868 I was employed by the Dominion Government, under S. J. Dawson, in making further surveys and explorations to find out if the line adopted by the Government could not be improved and shortened. I had a party of Indians with me who could speak very little English and I could speak very little Indian, but by making a good many signs I made them understand what I wanted, and we ran a great many lines in different directions, plotted them, and reported to S. J. Dawson, who reported to the Government, and it was decided to change the line from Dog Lake to Shabandawan Lake, and in June, 1869, I was sent up again to Thunder Bay and having engaged a party of half-breeds at Sault Ste. Marie on my way up, as soon as I arrived I made explorations to locate the line between the part built by the Ontario Government and Shabandawan Lake. By the next boat a large party of French Canadians arrived to commence building the road, and another by the next boat, and I had to work my party of sixteen men from daylight till dark to get enough line located to keep them at work. I set them at work building shanties at different points so as to give me time. But after the first month we had an easier time and kept going backwards and forwards between the different parties and so kept them at work. We had four shanties or divisions and built about twenty miles of road that year besides getting out timber for bridges, etc. In the winter of 1869 and 1870 I started with a party of three white men and nine Indians to make a traverse of all the lakes, rivers and creeks on the proposed route, between Shabandawan Lake and Fort Frances, traversing about 500 miles to find out which were the most available, viz., with

the longest water stretches and shortest portages. Having travelled about 1,500 miles on snowshoes of course this was a compass traverse, and we did not take all our provisions with us, but *caché* them at several central points (what I mean by *caché* is: we packed down the snow and then put logs and brush on top and put our provisions on and covered them up with oilcloth, bark and brush), and I plotted most of my work as I went along, but, as you can imagine, it was pretty rough work, being done in a shed tent and a toboggan for a drawing table, and sent it down to S. J. Dawson at Ottawa whenever I could, who, after consultation with the Government, decided on the line, and in the year 1870 the Wolseley expedition, to suppress the Riel rebellion, took place, and I was sent word in March by special messenger that the road, water stretches and portages would have to be ready for them and that 1,500 men would arrive on the first boats to assist me. I immediately returned to Thunder Bay and engaged all the men I could and started locating road, pushing up provisions and locating points for the different shanties. I had a party of twenty-five men and it kept us on the jump all the time to get ready for them. We did the best we could, which was not very much, on account of the country being so rough and broken. I saw afterwards many places where it could have been improved if we had had the time. But I divided up the parties and laid out some for one, and went ahead and laid out some for another, and so kept them at work, and when the military arrived we made use of them in construction. The regulars were very anxious to work and kept bothering me to give them work, as we gave them the handsome sum of twenty-five cents a day extra. But the volunteers were not so anxious, but tried to get off. And when I got them all well started, I went ahead and laid out the portages between the different lakes, and built channels in the creeks and rivers by digging out the mud and stones with our hands, wading in the water, and made canals so as to allow the boats to pass. It was no child's play, standing in the water above your knees, and sometimes up to your waist, and digging out mud and stones, and building a wall on each side, forming a regular canal for the boats. The line that was adopted was the Dawson road to Shabandawan Lake, forty-five miles, through that lake and creek dug out as before described, and then portage of about half a mile to Kashaboiawigamok Lake, then portage of about one mile to Lac. Des Mille Lacs, Baril Bay and portage to Baril Lake, nine miles, Brulé portage one quarter of a mile, Windegoostegoon Lake, twelve miles. French River, on which we built canals, by taking the stones out of the bottom and building a wall on each side to allow the flat boats to pass, and in some places building dams to raise the water, so as to overcome rapids. Then French portage, two miles, a very stiff portage, on account of the high and broken solid country, being all rock. Then through French Lake and river to Lake Kagassikok, fifteen miles, to Deux Riviere, portage two miles, Sturgeon Lake, twenty-seven miles, Island portage one-eighth of a mile, Lac La Croix, Tanner's Lake and then Rainy Lake, the longest stretch of water, to

Fort Frances, which was the principal Hudson's Bay post for this district. We met a great many Indians there and had the pleasure of meeting a medicine man, and seeing a white dog feast, which they kept up for three days, and you would think Bedlam had been let loose, what with the tom-toms, dancing and shouting. We joined in some of the dances, much to the amusement of the Indians. The men and women dance separately, but we joined in with the women and had a good time. And then we resumed our journey, making a short portage to avoid the falls (which are very pretty) into Rainy River, and then down the river to Hungry Hall at the mouth, where we were visited by about twenty-five very fine, tall Indians, and we had to be very civil to them, as they all had guns and tomahawks with them and were anything but civil to us. They threatened to rob us, but we gave them some provisions and kept them quiet, so as to give time to a party of about fifty, who were following us, to arrive. I felt anything but comfortable. We had two military men with us, but they took their rifles and went off into the bush and stayed there till the others arrived and then said they had only been off hunting. Then through the Lake of the Woods (120 miles, river and lake) to the north-west angle, and then a waggon road of ninety miles to Fort Garry (now Winnipeg). I have tried to give you a general idea of the route, but being so long ago, I have forgotten a great deal, and especially the Indian names of the lakes.

DISCUSSION.

Mr. Chipman—I would like to ask Mr. Browne to draw on the blackboard a rough sketch showing the forty-ninth paralled, and explain to the Associaton how it was that the American Government claimed that little territory up there called the North-west Angle north of the forty-ninth parallel.

Mr. Whitson—At first it was supposed that it was on the forty-ninth parallel.

Mr. Kirkpatrick—Buffalo Bay is about on the forty-ninth. Then you go north quite a piece and then there is a line down, which leaves a tract, I suppose of three or four townships in the States, which has really no access to it. It is north of the forty-ninth parallel.

The President—Is there not a natural boundary there?

Mr. Kirkpatrick—No.

Mr. Chipman—I would like an explanation from some member of the Association how that occurred; how it happens that the United States territory extends north of the forty-ninth paralled.

The President—I think it is somewhat similar to the way Maine and Michigan happened to come into the United States.

Mr. Sewell—I believe that the principle in fixing the boundary was to follow the Hudson Bay water shed, commencing from Pigeon River as the northern boundary of the United States. From thence they were to go to the north-west angle of the Lake of the Woods, and then there were two disputes. One was with regard to Hunter's Island, as to whether the boundary line should go south or north of the Island. That was decided in favor of Canada; and then on a kind of reciprocity basis the "north-west angle" was yielded. From thence to latitude forty-nine, they had to go south.

Mr. Miles—It has always been my impression that it should have read the south-west angle. That there was a "clerical error" made in the draft of the treaty.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

FARMERS' LEVEL AND DRAIN GRADIENT INSTRUMENT.

By ALLAN ROSS DAVIS,

C.E., O.L.S., Napanee.

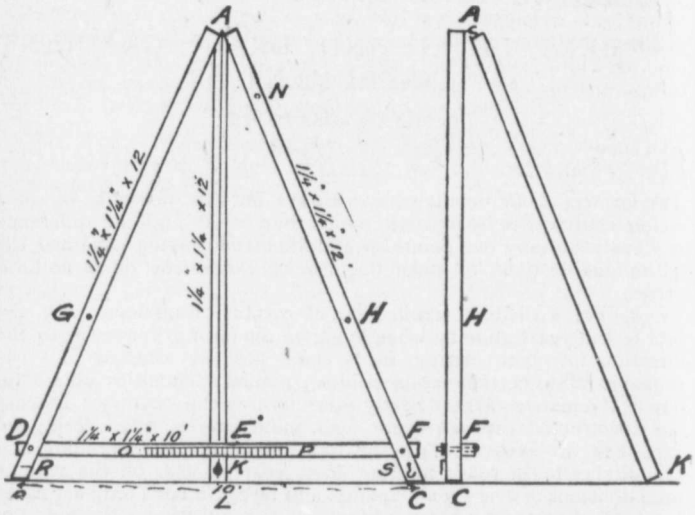
The farmers of our country have always felt the necessity of some simple contrivance by means of which they could find the difference in elevation of any two points on a drain; and having obtained the fall to enable them to make the desired excavation on a uniform grade.

I have a distinct recollection of certain discussions with my brothers in years gone by when living on the farm in reference to the direction in which certain fields could best be drained and the probable fall to certain outlet points. Similar difficulties obtain to-day in the management of nearly every farm in the country. Ditches are constructed through every field, main drains, often deep and expensive, are excavated, tile sub-drains are made, road grading and side ditches to the roads continue from year to year on the various road divisions of every municipality, and rarely in such ordinary cases is a level of any sort whatever brought into requisition. If legal proceedings be instituted under the provisions of "The Drainage Act," or "The Ditch and Water Courses Act" an engineer or surveyor is usually employed to take the levels and establish grades. These are the more important drainage projects, however, where several owners, as a rule, are interested, where expensive rock excavations are frequently necessary, and where the drains, extending over several farms, demand careful instrumental work. For all such projects it will be necessary in the future, as in the past, for owners of land to employ engineers or surveyors to perform the work.

For the ordinary drainage purposes of each individual owner of lands, where it is customary to construct ditches or drains "by guess," I have constructed a simple, cheap, light instrument, which cannot get out of adjustment, which does fairly accurate work, and which can be manipulated by any intelligent school boy, who understands simple division, and can see out of at least one eye.

While engaged in drainage work in the county of Lennox and Addington last summer, the idea occurred to me that if a plumb line, suspended, would always assume a position in the vertical plane, it should not be a difficult task to obtain a true horizontal plane at right angles to the former. A symmetrical triangle was immediately suggested with a plumb line suspended from the apex. While considerable time has been spent since in obtaining suitable proportions and making

various experiments, the simple idea first suggested of a triangle and plumb line still forms the governing principle in this farmer's instrument.



Referring to the accompanying plan Fig. 1 is a front view of the level and Fig. 2 is a side view.

Two white pine legs B A and C A $1\frac{1}{4}$" square and 12 feet long are hinged together on the inner side at A. The legs are opened until the distance B C between their extremities is 10 feet, centre to centre.

An arm D F $1\frac{1}{4}$" square and 10 feet long is bolted on the legs at a distance of 1 foot from their extremities.

At a convenient height for the eye of, say, $4\frac{1}{2}$ feet from the bottom a small hole is bored part way through each leg at G and H, equally distant from H. A beveled cork is inserted in each of these holes, projecting out, when firm in place about $\frac{1}{4}$ of an inch.

Fine steel needles are placed in the centre of each cork, perpendicular thereto, projecting beyond the corks about 1 inch. These are the sights and may be made as fine as the eye will allow. Care must be taken to place these sights equally distant from the centre of the hinge H. The hinge rivet has an eye projecting out from each side in one of which—that corresponding with the side of the arm D F, the plumb line is fastened, while a hook at the end of the brace A K, passes through the other eye of the hinge rivet. The lower end of the brace A K is provided with a sharp brad, or grapple, which projects some two inches. A plumb bob is attached to the line so as to swing below the arm D F. The instrument is now erected to the perpendi-

cular, when if the surface B C be level the plumb line will cover the centre part of the arm D F at E. If by reversing the position of B and C, the line covers the point E again, the triangle is true and G and H, two fine sights 7 feet apart are level.

If the instrument be set in this position about equally distant between and in line with two points whose difference of elevation is required, the foot of the brace is brought in until the plumb line swings close to the arm. One leg, B or C, is then raised until the plumb line A K covers the centre of the arm. Then sending a man with a rod, a square piece of white paper and a pencil to one side of the field, the man at the instrument sights over the two needles and directs the assistant in marking his rod at a point in line with the sights. The assistant is now sent to the other end of the drain pacing the distance between the two points.

The same operation is performed there. The difference between the two marks is the difference in elevation of the two points on the ground. Measure this distance in inches, and divide by the distance between drain extremities in hundred feet. If the fall be 20 inches and the length four hundred feet, the grade will be 5 inches per hundred feet.

Having found the fall and the possible grade of the bottom of the drain the more important step of running such grade now becomes neccessary. This is done by means of a graduated brass scale, screwed to the centre of the arm D F. The zero mark of the scale O P is at the centre E and the graduations thereon are made by elevating one leg B $^1/_{10}$ inch at a time, revolving the whole triangle around C, and marking the corresponding points covered by plumb line on the scale for each $^1/_{10}$ inch elevation of B until B is raised 10 inches.

To graduate the left end of the scale C is raised, revolving around B in a similar manner, a mark being made on scale for each $^1/_{10}$ inch elevation of C. The marks on the scale are extended into lines graven deeply in the brass about an inch long and are numbered consecutively from 0 to 100 on each side of centre of scale.

The distance B C being 10 feet, each graduation on the brass scale denotes $^1/_{10}$ inch in 10 feet or 1 inch per 100 feet.

Consequently when one leg is lowered so that the plumb line covers the fifth graduation from the zero mark, the feet B and C stand on the grade of 5 inches per hundred feet, that required for the case in point. Placing B at the lower end of the drain, we raise C until the plumb line covers No. 5, left of zero, B and C are on grade. The point C is preserved and after the section is excavated, the grade of another section is obtained by placing B on the point C, and again making plumb line correspond with No. 5. Thus each section is excavated if shovels be used. Should plows and scrapers be utilized, a more convenient way would be to make the excavation for a considerable distance approximately and then run grades over the bottom of the drain by setting up instrument in centre of field and elevating one leg until plumb line denotes the required grade on scale. There

the needle sights being on grade make the bottom of drain parallel to the line of sight over needles. Thus the instrument will not require moving until drain is completed. When the leg B is raised to the highest point, viz., 10 inches, the base is not 10 feet and therefore theoretically the grade would not be $^1/_{10}$" for 10'. Practically, however, it does not appreciably affect the scale since the inclination to the horizontal is but 29 minutes and the length of the base is 9.999644 feet.

I have made several tests of the work done by one of these farmer's levels made by myself, not as carefully as may be done, and found the work to correspond very closely with that done by my level. I am convinced that when due care is exercised in their construction that levels sufficiently accurate for distances of about 200 or 300 feet on either side of the centre, may be taken, and the grades run with but little variations from the true grade. The County Council at its last session in Napanee adjourned one afternoon for a time to witness the operation of the level and expressed hearty approval of its simplicity, cheapness and necessity. When not in use the bolt D is withdrawn and the arm swung around until the bolt is placed through the leg at N. B and C are then drawn together and secured by a hook and eye, R. and S. The sights are removed and in a compact shape the level may be laid away.

The feet B and C are covered with a thin sheet iron plate to preserve them from abrasion.

DISCUSSION.

The President—It appears to me that this instrument will not interfere in the slightest degree with the engineer, as some might be inclined to think. We should remember that anything that we may do that will lead to the benefit of the farmer will benefit every man in the country. We, to a certain extent, depend upon the farmers for our living, very largely so in fact. And I think that if you can help the farmer to dig his small ditches he will not attempt anything larger. Of course if he were to undertake to carry out larger works, the inevitable result would be that the farmer would bungle the job and would throw away Mr. Davis' level in utter disgust and go and consult an engineer. In that way it seems to me it might do the farmer much good, and if it does it benefits us. It certainly cannot do us any harm.

Mr. Sankey—I quite agree with the remarks just made. I think that there is another point, though, that is probably worth considering. I have not myself had a great deal of experience amongst farmers in this country as to drainage, but before I came to Canada, I had a good deal of experience in that way—I refer now to the North of Ireland—and it was generally found that some farmer had a rough and ready way of draining, and the farmers in his neighborhood, when they saw that he got a good result from what he did, would get him to do it for them on their own farms. Then the result of all this

draining was that they accumulated so much water in the water courses outside that larger works had to be undertaken in order to carry off the water. Now I am not down on the Ontario farmer at all: he is a good, shrewd, hard-working man, and does not mind spending money if he can be sure that he will get a return for it. When he drains one field and sees the result he will go to another, and perhaps his neighbor will take up a field or two, and so on, thus making themselves better able to bear the assessments that will come on them for a large draining scheme. I understand from information lately received through a friend here in Toronto that there are a great many more thousands of acres in Ontario susceptible of drainage than even the surveyors know anything about, and I hope that some member, who is conversant with drainage matters will write a paper on that subject for next year, with any statistics he may be able to get during the year to show the enormous number of acres lying idle and useless in this province to-day for want of drainage. In the North-west they have been making some surveys for irrigation work in the neighborhood of Calgary, and it has astonished even the engineers themselves to find the large amount of land that is brought within the limits of a supply of water. I think the same thing would apply in the reverse direction here, that is we would be astonished to find the great number of acres that could be drained with comparatively small cost. The instrument seems to me to be a suitable and handy instrument. I was going to ask whether there was any means of elevating or depressing the legs?

Mr. Davis—There could be an extension leg.

The President—I think it would be just as well to confine it to the simple form. I am thinking of putting this into the hands of a farmer in some work I have to do to guide him in laying his tile drains. It is somewhat similar to the English boning rod.

Mr. Fawcett—I have seen ditches of some ten miles or more laid out with an instrument like that in British Columbia. It is used by Chinese and others for constructing ditches for irrigation purposes. They generally go along and just move the front leg of the instrument until they get the grade they want. In using an instrument like that they get their ditches constructed in a very good shape, so that the principle seems to have been already adopted out there.

Mr. Gibson—I suppose I am the only farmer present, and it strikes me as being important to know in the first place what the cost of the machine is.

Mr. Davis—It need not cost more than $3.

Mr. Gibson—Well, it is within the means of "us farmers" anyway. You are probably aware that there are men who make it a business, almost a profession, throughout the county of York, to do drainage work, and there is always a little trouble about getting their levels. Now this instrument is one that cannot get out of adjustment and can be handled by anybody, the hired man or the roughest man

you can get hold of Not only that, but it would encourage men to drain their lands and get rich, so I think it is a very excellent idea. I am much pleased with the machine.

Mr. Robertson—Up in our section of the country, where crude methods of farming are carried on very extensively in the shape of draining, the open drains are usually constructed first. The farmers do a great deal of tile draining, and, as Mr. Gibson says, there are tile drainers who do a great part of the work. A great many of the farmers, however, get an engineer to take the levels first, then they get this professional tile drainer to come on, and they have an instrument—I have not seen any like this, but this would answer the purpose very well—and they come on with it and complete their work with the stakes set by the engineer. In that way the drainage is chiefly carried on up there. Of course there are some who put in their drains without any instrument whatever, but in many cases they might as well bury their money as their tile in that way.

Mr. Ross—I think it would be to the advantage of the Engineer to have this generally adopted, because a man working with this would carry out his work in a good manner. The open drains would have an even grade and the water would run nice and smooth, and the engineer would get the credit; people would say he knows his business. There was a discussion on that matter last year in reference to a case where the tiles were very improperly laid, and the engineer got the blame for it, but with this, all work of that kind would be properly done.

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THE ANEROID.

By OTTO J. KLOTZ,

O.L.S., D.T.S., Ottawa.

In the following notes no attempt will be made to give any theoretical exposition of the theory of barometers—mercurial and aneroid—but simply to give results obtained in the field, compiled from observations by members of the Staff of the Alaska Boundary Commission, 1893-1894.

The object of the Alaskan survey was for the purpose of obtaining the topography of the country. For this end the photographic method was used. The triangulation necessary for orienting the photographs was made with 3-inch Troughton & Sims transits, reading to minutes in both horizontal and vertical circles. The trigonometric height of mountains was obtained with this instrument also. Each party was supplied, too, with several aneroid barometers, for convenience of knowing by simple inspection the approximate altitude. The final altitudes of all points, however, rest on the trigonometric determinations and those obtained from the photographs based thereon.

The aneroids were by H. Hughes & Son, London, and were of three sizes—2″, 3″ and 3½″; the first two had an attached thermometer, and the smallest a movable footscale. The 3-inch ones were found to be the best. Systematic and simultaneous readings of the aneroid, at camp and on mountain, including those of temperature, were not made by all the parties. In the following results, of course, only such were utilized. Nearly all the mountains were climbed directly from the sea; and the ascent and descent were made mostly in one day. The altitudes climbed range from 2,000 feet to 6,000 ft.

Mr. Edward Whymper, the noted traveller, has made elaborate experiments with the aneroid, and from his investigations has arrived at certain conclusions, among which may be mentioned:—

1. That at low pressures (high altitudes) the aneroid is very unreliable; the difference of readings of mercurial and aneroid may amount to two inches.

2. That difference of height at low pressure may be obtained with considerable accuracy.

3. That from aneroid readings, mountain heights are almost invariably too great.

4. That the difference of level obtained in ascending is generally greater than in descending a mountain.

5. That all aneroids, without exception, lose upon the mercurial barometer when submitted to diminished pressure, and recover a portion of the previous loss when pressure is restored.

6. That index errors are seldom or never constant.

7. That the method of examination of aneroids at Kew Observatory is faulty, and the deduced corrections for various pressures (30 to 15 inches) incorrect.

These conclusions cover a wider ground than the experience in Alaska afforded; however, some of the foregoing conclusions have been corroborated.

The most marked is—That aneroids almost invariably lose upon arrival at the summit of a mountain, that is when the aneroid is read on reaching the summit, then again after several hours (after taking the angular measurements and photographs) it will show a diminution of pressure, that is an apparent greater altitude. This difference of reading, for a range of about 6,000 ft. of altitude, fluctuates between 0 and 5 hundredths of an inch, or say from 0 to 57 feet. From this observed fact it becomes evident, that if an aneroid and mercurial be placed under an air pump, and within a short space of time (an hour or so, as is customary) comparisons be made at various pressures, the results are erroneous for application in the field. The aneroid has constitutional properties and peculiarities, and even idiosyncrasies, the latter being a measure of our ignorance.

From comparisons which I made in 1893 and 1894 of the same aneroids, with a standard mercurial, I find that the index corrections are not constant. However, it is not essential that, for obtaining altitudes by difference of barometer readings (foot and summit) the index corrections be known, for unless it be large, the ratio of the uncorrected readings will practically equal that of the corrected ones. For example: Suppose the readings to be 30.15 in., and 24.72 in., indicating an altitude of over 5,000 feet, the index correction be +.05, the difference between the two deduced altitudes is less than 10 feet.

With reference to the difference of level obtained in ascending and descending a mountain, the Alaskan observations of 1893-1894, on 43 mountains, give the following results:—

Altitudes deduced without applying temperature correction—29 were greater from readings of ascent than of descent, the difference aggregating 1772 feet; 12 were less from readings of ascent than of descent, the difference aggregating 600 feet; 2 were equal from readings of ascent and descent.

When the temperature correction is applied, and this correction is a very important one, and should be well observed, that is the temperature of the atmosphere, and *not* by means of the attached thermometer which some aneroids carry, but a thermometer swung in the air, then it was found that 21 were greater from readings of ascent than of descent, the difference aggregating 1239 feet; and 22 were less from readings of ascent than of descent, the difference aggregating 1316 feet.

From the latter, which are of course the ones to be utilized, it would appear that the probability of the altitude deduced from readings of ascent being greater than that of descent, is equal to the probability of being less.

Furthermore, the mean difference is ± 60 feet.

Mr. Whymper's experience that, from aneroid readings, mountain heights are almost invariably too great, the Alaska observations give the following results :—

HEIGHT.		DIFF.	HEIGHT.		DIFF.	HEIGHT.		DIFF.
Mean of Aneroid.	Trigono-metric.	A – T	Mean of Aneroid.	Trigono-metric.	A – T	Mean of Aneroid.	Trigono-metric.	A – T
ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
1796	1781	+15	3827	3893	– 66	4558	4719	– 161
2412	2478	– 66	3886	4026	– 140	4702	4774	– 72
2457	2470	– 13	3901	4052	– 151	4710	4812	– 102
2930	2971	– 41	3942	4072	– 130	4764	4836	– 72
3009	3059	– 50	3967	3983	– 16	4773	4766	+ 7
3134	3173	– 39	3967	4070	– 103	4842	4982	– 140
3258	3322	– 64	4063	4092	– 29	4847	4881	– 34
3353	3340	+13	4065	4098	– 33	5009	5175	– 166
3380	3452	– 72	4108	4156	– 48	5097	5159	– 62
3427	3493	– 66	4182	4220	– 38	5137	5268	– 131
3479	3557	– 78	4185	4209	– 24	5390	5533	– 143
3654	3670	– 16	4219	4233	– 14	5731	5917	– 186
3748	3684	+64	4357	4440	– 83	5748	5913	– 165
3766	3850	– 84	4399	4492	– 93	5802	5913	– 111
3774	3851	– 77	4470	4483	– 13			

It will be seen in the 44 comparisons of aneroid (mean of ascent and descent), and trigonometric height, only four show a greater height by the barometer, and the difference only averages 25 feet, whereas 39 show a marked less height. From the 44 comparisons we obtain a mean difference of 70 feet for a mean height of 4,200 feet. That is, the barometric height is too small, and is in error somewhat less than 2 per cent.

This is contrary to Mr. Whymper's observations; but it must not be forgotten that his results are obtained, I think, exclusively from very high altitudes in the Andes, and hence not strictly comparable, as the loss of the aneroid on the mercurial is not a direct function of the height.

Johnson, in his valuable "Theory and Practice of Surveying," says (p. 136) :—" * * * to stop at a number of stations during the day for a half hour or so, reading the barometer on arrival and on leaving. The difference of these two readings shows the rate of change of barometric readings due to changing atmospheric conditions, and from these isolated rates of change a continuous correction curve can be constructed on profile or cross-section paper, from which the instrumental corrections can be taken for any hour in the day."

From the experience gained in Alaska, as also that of Mr. Whymper already referred to, the above conclusion appears faulty, for if while stopping at a station ascending a mountain the atmospheric conditions be constant, then we would experience a fall of the

aneroid, indicating apparently a change in the atmospheric conditions. This has been noted time and again where one barometer was read hourly at camp and another one read on ascending and descending mountains. From the former we could see the change in the atmospheric pressure.

The formula used for the determination of heights by the barometer was

$$Z = \log \frac{h}{H} \; 60384.3 \left(1 + \frac{t + t' - 64^\circ \text{ F.}}{900}\right)$$

In the use of the aneroid for determining difference of altitude, it is very essential that the temperature of the air at top and bottom of mountain be carefully read, not for the purpose of making any correction to the barometer readings, for the change of temperature alone of the air does not affect the barometer, at least not that at sea level, but for the purpose of correcting the constant, by which $\log \frac{h}{H}$ is multiplied. This constant represents the height of a column of air of uniform density, and at a temperature of 32° F. Consequently, when the mean temperature is greater than 32° F. the volume of air becomes greater, the density less, and the height consequently increased. The correction for temperature has, in some instances, amounted to over 300 feet.

Conclusion. Read the barometer carefully at ascent and descent; hold in same position, preferably horizontal; note by a good thermometer (not attached to aneroid) the temperature of the air, and the mean of the deduced altitude will give a very fair, say within two per cent., value of the difference of height, or absolute height if one station is at sea level.

Among the data obtained are some from which an approximate value of the relation between temperature of the atmosphere and altitude may be obtained. The thermometer readings were not taken with this end in view. This relation varies with the condition of the atmosphere, the most potent factor being that of humidity. As is well known, one of the manifestations of solar energy on the north-west coast of the American continent is the reception of humid thermal currents—the Japan current—from the south-west, whereby the climatic conditions, due to latitude, are greatly ameliorated. The drier the atmosphere, the greater is the difference of temperature in ascending or descending a mountain. The greater the humidity of the air, the less is the difference of temperature dependent on elevation; this is due to the latent heat given out by precipitation of the moisture. This property of the atmosphere makes itself apparent in our Chinook winds along the Rocky Mountains, and in the Foehn of Switzerland. To illustrate: Suppose a moist, warm current from the Pacific to strike the Cordilleran range of mountains in British Columbia. Let its temperature be 60° F., and the rate of cooling be 1° F. for every 350 feet of height; suppose it to be carried to a height of

7,000 feet, its temperature will then be reduced to 40° F. Precipitation will have taken place, and the latent heat of the water given out. The current proceeds onward, eastward, and descends to a valley of say 1,600 feet elevation; that is, it descends 5,400 feet, but now as a comparatively dry atmosphere, and for which the rate of cooling due to elevation is 1° F. for about 180 feet difference of altitude. We would then have the current warmed 30° F., and this added to its temperature when beginning the descent would give us a "Chinook" with a temperature of 70° F. This is an ideal case, but the principle involved is the one that explains the Chinook and Foehn.

The result arrived at, that is the equivalent in altitude for a difference in temperature of 1° F., is obtained from 21 determinations, ascent and descent of mountains. Due to difference in the humidity of the atmosphere and other causes (unknown), there is a considerable range for the value of altitude, due to change of 1° F. in the temperature. The minimum value obtained was 141 feet, and the maximum 863. The arithmetic mean of all gave 376 feet ±25 feet.

Jordan gives the mean value for Middle Europe as 365 feet.

Bauernfeind in his investigations has found that the temperature of the air decreases in arithmetical ratio with the increase of altitude, and is proportional to the sixth root of the barometric pressure, the temperature being reckoned from the absolute zero.

DISCUSSION.

The President.—The last experience I had with an aneroid was when it brought out a hill about 300 feet high which I was on, below the swamp I started from.

Mr. Chipman.—We used the aneroid this summer on some work between here and Georgian Bay, and excepting on windy days we found the results quite satisfactory. On a windy day we did not rely on it at all.

Mr. W. F. King—What was the difference in height?

Mr. Chipman—I suppose you mean the difference between the extreme elevations measured. The error did not generally exceed five feet in a distance of one mile, the difference in elevation being 200 feet.

Mr. King—This table that Mr. Klotz gives shows that there is a good deal of irregularity in the results with the aneroid. The average is about 2 per cent., but there are many cases in which the error runs a great deal over that. I am inclined to think that if the observations were analyzed it would be found that the average error increases with the height. I think in measuring small heights, as Mr. Chipman says, you will get pretty close results, but when you run up to a certain point the aneroid seems to fail. I have noticed that myself in a small way in many years. I have made exploratory surveys on prairie where the differences of level were not very great, and used the aneroid and found it gave me very good results generally, that is, I would measure a hill and the result would come pretty near what I would guess it to be. I did not find any case where the top of the hill was lower

than the bottom. In one case I was driving to the Cypress Hills, where the ground rises gradually for a long distance,something like 40 or 50 miles, and I took careful aneroid readings all the way. We occasionally dropped into a deep valley of probably 150 feet, and it would record all right. The ground kept rising and rising until I got up to an elevation very nearly 4,000 feet above the sea, 3,500 anyway, that is a difference of perhaps 1,500 feet between that and the level of the prairie at the point I began the readings from, and so far it had recorded everything apparently right. Then I dropped into a valley of about 300 feet, and it showed that 300 feet, the depth of the valley, a great deal less than what it evidently was. Then we got from that up a steep hill on to the plateau of the Cypress Hills, about 4,000 feet, and the barometer absolutely failed to work; it showed the top of that hill to be at the same level as the creek below. I see in the first part of the paper, giving Mr. Whymper's results, he says (No. 4) "that the difference of level obtained in ascending is generally greater than in descending a mountain." Then these aneroids seem not to be tested or made accurate beyond a certain point, and if you get up near that point your aneroid is ruined by being strained. I remember on the old boundary survey of the 49th parallel, somebody taking an aneroid barometer up a mountain, and when it got up 4,000 or 5,000 feet above the sea the thing stopped, althought the maker had graduated it to show a height of something like 12,000 feet. I may say in defence of the Alaska survey, that, though you may think these are wild results given in this table, the accuracy of the survey is not involved in these aneroid readings. It is merely an auxiliary reading used principally as a check upon the other work, and is taken out as an alternative instrument in case the triangulation work should fail. Two years ago when we started the Alaska survey, we knew nothing practically as to the climate of Alaska except that it was very wet and very cloudy, and we thought it would be impossible, perhaps, to apply the triangulation system with photographs, so we took aneroids and a lot of other rough instruments, for the sake of having something in case we could not get any photographs. But these aneroid readings do not enter into the results at all; the results are made complete by the very full survey we succeeded in making by means of the transit and camera.

Mr. Lumsden—I have done a good deal with the aneroid and I cannot say much for it.

Mr. Sankey—Is it found that the aneroid on returning from a high station returns to its normal condition and will register afterwards, or is it likely to be out of adjustment?

Mr. King—Well, it is likely to be out of adjustment, they say. We had about 12 or 15 aneroids on the survey, and half a dozen of these had to be returned for repairs. They seemed to work loose and got out of kilter. I don't know whether it was the extreme moisture that caused it, or the difference in level.

Mr. Chipman—Did you carry a mercurial barometer for checking it?

Mr. King—Yes, which was always kept at the sea level.

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TRIANGULATION WORK ON TOPOGRAPHICAL SURVEYS.

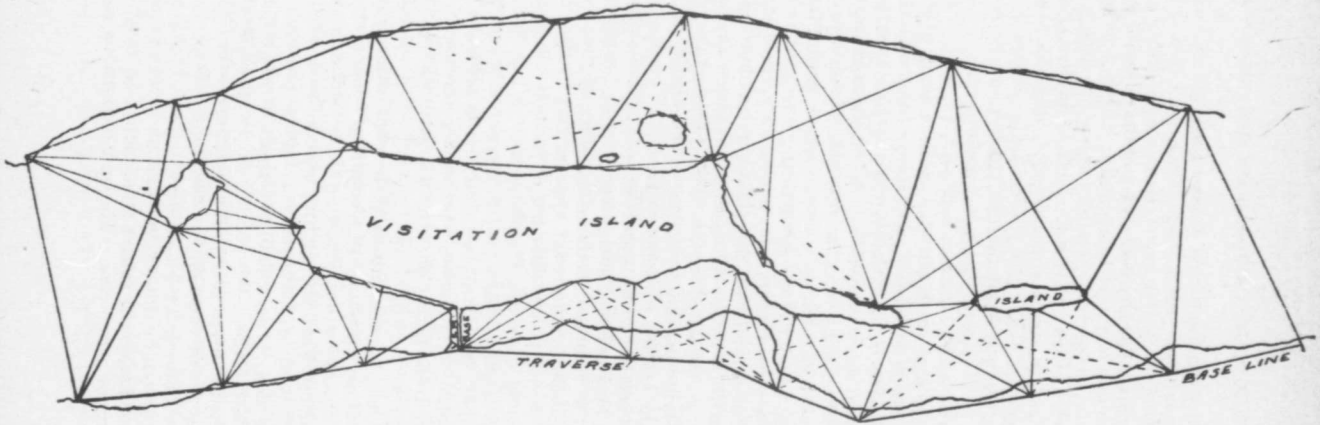
By HENRY K. WICKSTEED,

O.L.S., Cobourg, Ont.

In the circular of the society dated Dec. 24th, among the subjects suggested for discussion is that of the above title, and the writer having frequently had recourse to the system under somewhat unusual conditions thinks that a few remarks may be of some value. He has found the method of peculiar value in the case of surveys of broad rivers, with thickly wooded banks, where the traversing of both banks would entail a large amount of chopping through tangled under brush, and consequently a strong party of axemen. By the triangulation method, a base being established, the chain can be done up and the survey can be carried on by the surveyor and assistant with two men and two canoes, at a rate much in excess of traversing, and varying from 2 to 4 linear miles per day according to the lengths of the sides of triangles, and the amount of detail desired.

It has always been the writer's practice in such surveys to mark the station points by a pole cut in the woods, and having two cross bars fastened to it at right angles to one another, so that from whatever distance it is looked at it always appears as a cross. When the angles are to be read the pole is lifted out of its hole, and the instrument set immediately over it. Plumbing over a hole 2 inches in diameter in a mud or gravel bank may not appear to be a very accurate method of proceeding, but it will be found that in ordinary work with an instrument reading to minutes the probable errors are very much less than it is within the power of such an instrument to detect and record.

A few months ago, upon a railway survey, the writer had occasion to run a traverse along the shores of a couple of long river-like lakes in order to block out a location, following them as closely as possible. Being very shorthanded and the country covered with wind falls and scrub the average progress had been only about one mile per day. He conceived the idea of triangulating, with the result that the rate of progress was doubled and one-third of the party were employed running supplies forward without any loss to the working party. The average length of side was 700 or 800 feet, and the result was of considerably greater use in determining the location than a traverse would have been. The area covered by this survey was some three square miles and the cost $60.00, or $20.00 per square mile, including only the rough plotting necessary for camp work. The only conditions necessary in



Skeleton Plan of Triangulation

H. K. Wicksteed, O.L.S.

choosing the station points were that at least three points, two behind and one in front, should be visible from it and that the subtended angles should not be less than 30° or more than 120°. All these angles of each triangle were invariably measured and the sum was expected to lie between the limits of 179°58′ and 180°02′, the angles being laid down on the paper with an ordinary protractor. Any less error was not considered worth looking up, but it was very seldom that the sum did not come within one minute of 180°. Another survey, of which a plot is given, was made of a portion of the Ottawa river. The area comprised was something less than one square mile, but the amount of detail was considerable. The measurements were carried over a traverse eastward for one mile or more along a side channel of the river with a number of subsidiary triangles in order to determine the widths at different points. The last line on this traverse was used as a base from which a chain of main triangles was carried westward up the main river for two miles and then back along the side channel to the first line of the traverse as a verification base. The resultant error was less than $^1/_{10}$ of 1 per cent. and was probably due to the imperfect chaining of a raw hand employed. The entire cost was $20.00, and the time occupied two days. Only one assistant and, for a portion of the time, one laborer were employed. The ground on each side of the traverse was elaborately levelled and contoured necessitating a chained line of some sort as a basis for cross sections, otherwise a chain of triangles throughout would have been equally serviceable, and more rapidly measured. The writer believes it to be customary in such surveys to mark the two ends of the base line by permanent stone monuments which can be readily picked up at some future time in case it is required to extend or check or amplify the survey. Stone monuments are expensive things, iron bars are not quite proof against being stolen or moved, and the writer has found that the location from the base line of two or more existing permanent objects and the determination trigonometrically of their distance from one another (and bearing) answers every purpose, and that these objects need not necessarily be accessible In the case under discussion a church spire and the iron stack of a mill formed two convenient points of reference by which to tie on any future work in the neighborhood. The writer believes that a survey of this kind, where correctness without any extreme precision are all that is required, as in filling in between the angular points of a precise triangulation, or in the case of a survey of a limited area for a special purpose, can be carried on with very much greater rapidity and cheapness than in any other way. As each triangle is complete in itself and is proved as the work proceeds, the surveyor is freed from the constant dread of errors due to careless chainmen and picketmen, which the writer, for one, always feels when running a long traverse to a closure.

DISCUSSION.

Mr. Gaviller—There is one point mentioned in this paper, the cost of triangulation, which has been inquired about, but this only

covered a very small area. I think it would be hardly proper to base the cost of a large triangulation upon the figures given here. Still, it is a very good paper, a practical paper, and one that I think would apply on the triangulation here, because it was mentioned by Mr. King that where the principle triangulation would take place in Ontario is level country, and being such, there are not very many prominent elevations to locate as permanent points and the lines would be consequently much shorter than they would be in a more hilly country.

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CO-EFFICIENT OF REFRACTION.

By OTTO J. KLOTZ,

O.L.S., D.T.S., Ottawa.

As a good many reciprocal zenith distance readings between mountain summits were taken in Alaska last season by Canadian members of the staff of the Alaska Boundary Commission, for the purpose of obtaining the heights of the mountains, it was thought that the data might furnish, too, an approximate value of the co-efficient of refraction. It must be remembered that the instruments used were 3-in. transits—Troughton & Simms—and reading to minutes on both circles. Hence the degree of precision is not comparable with that of primary triangulation. However, it will furnish a comparison to those engaged in similar work and under similar conditions. It is well known that the humidity of the atmosphere in Alaska is high. The mean temperature was about 56° F. for the season.

In the theoretical investigation for refraction the path of a ray is supposed to be concave towards the earth. Observation shows that this is not always the case. Simultaneous observations between two stations are made under the assumption that then the path of a ray is a circular arc, while if not so made—that is at different times—the circular arcs will probably be of different curvature, and the correction for refraction at each station not equal. By co-efficient of refraction is understood the ratio of the correction for refraction, to the angle at the centre of the earth, subtended by the distance between the stations, or, more accurately, to the angle between the normals.

For an exhaustive treatment of the subject the reader is referred to Helmert's "Hoehere Geodaesie."

If z = observed zenith distance at one station.
z' = " " " " other "
dz = refraction correction to z.
dz' = " " " z'.
m = co-efficient of refraction.
C = angle at centre of earth subtended by distance between two stations,

Then, $z + dz + z' + dz' - \pi = C$

Assuming $dz = dz' = F$

Therefore, if $z + z' > \pi$

$\therefore$ $C - 2F$ is positive (C is always positive).

$\therefore$ either $2F$ is positive and $< C$.

Or, $2F$ is negative and $> < C$.

If $z+z' < \pi$

$\therefore$ C – 2F is negative.

$\therefore$ 2F is positive and > C, and hence m positive.

The co-efficient $m = \frac{F}{C}$ will be positive for all positive values of F.

2F, *i.e.* F, can only have a negative value when $z+z' > \pi$, and hence m negative only for same condition.

We find, therefore, that when m is negative that the path of the ray is convex towards the earth.

When $z+z' < \pi$ we infer a compound curve—convex and concave—for the path of the ray.

An astronomer once said to me in Washington, "Results alone should not be published, but always accompanied by the observations, so that the reader can draw his own inferences." This is very true, but this is essentially an age of "time is money," and most men say with *Boz*, "What we want is facts;" how they were obtained is to them immaterial. There is a limit however to "boiling down." Even if all details are not given, yet, in a "paper" presented to a society of professional men, enough of the method, instruments and conditions should be stated, that a fair estimate can be obtained by the reader of the value of the results given

I may state that in compiling the reciprocal observations only two observations were discarded, and these showed palpably errors of sighting to the wrong peak in the reciprocal reading. By discarding largely divergent values, of course, the probable error of the resulting mean could have been materially reduced. The observations have all been reduced for an assumed uniform height of instrument.

From the subjoined observations we find the mean value of m to be .0793 ± .009. The value of m = .078 for the sea horizon is given by Lee as determined by the U. S. Coast and the Geodetic Survey in the New England States.

From the mean of 144 values of m determined from the observations of the Ordnance Survey, it appears that the mean co-efficient of refraction is .0771. The co-efficient is somewhat greater (about 10%) for rays crossing the sea. From Jordan's "Handbuch der praktischen Geometrie," we quote the following:—

Extreme values of m.

Delambre finds—

Maximum m = .2977.

Minimum m = . – 0035.

Geodetic Survey, East Prussia—

Maximum m = .0769.

Minimum m = .0632.

Precise levelling, Swinemünde and Berlin—

Maximum m = .1334.

With calm air and pleasant temperature.

Minimum m = .0415.

With strong winds and low temperature.

Gauss gives—

Maximum $m = .1039$
Minimum $m = -.0571$.

Coast Survey of Baeyer has—

Maximum $m = .1938$.
Minimum $m = .0478$.

Fuss, Sawitsch and Sabler found, in the determination of the differences of level between the Caspian and Black Sea, even greater deviations, which, however, from the shortness of the distance, may be attributed to errors of observation.

The observed zenith distance is dependent upon the pressure, and hence variable. Temperature, too, affects the observed angle of elevation or depression; in short, the co-efficient of refraction is a function of the temperature and atmospheric pressure.

The angle of depression, irrespective of refraction, should always be numerically greater than the angle of elevation. There are instances (as we had) where two stations whose difference of level is not great, and distance apart considerable, mutually show angles of depression, but never both of elevation.

For a simple approximate rule, and one easily remembered, may be given :—"One seventh the number of thousand feet between two stations gives the difference in minutes of the reciprocal readings."

From this we know at a glance whether there is anything abnormal or any bulk error in the readings.

To determine the height of a mountain with a fair approximation to the truth is, with proper instruments and care, not a difficult matter, but to obtain accuracy within a few feet for high mountains is, from the nature of the problem in its present state, impossible.

COMPUTED VALUES OF M FROM RECIPROCAL ZENITH DISTANCE READINGS, NOT SIMULTANEOUS, WHERE $m = \frac{F}{C}$

Distance.	m.	Distance.	m.	Distance.	m.	Distance.	m.
FT.		FT.		FT.		FT.	
22903	.0342	43572	.0245	70640	.0040	102051	.1478
26420	.0615	45079	-.0593	70651	.1331	103636	.1667
26905	.0729	45885	.2190	74961	.1761	108238	.1116
28340	-.0587	47580	.0386	75769	.0590	124076	.0882
31614	-.0873	54631	.1236	84025	.0506	124930	.0794
31839	.0626	57433	.0705	87155	.0493	126925	.2414
36032	.1223	61351	.0268	89856	.0809	142990	.1115
38983	.1977	63612	.1387	93195	.0465		
42395	-.0273	64270	.0715	94792	.1184		

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REMARKS ON THE CRADLE THEODOLITE.

By JOSEPH M. O. CROMWELL,
O.L.S., Perth, Ont.

I HAVE observed that the only figure of an English-made surveying instrument appearing in the annuals of the Association, is that of a cradle theodolite, and I am aware that a number of those instruments have long been and are yet in use, for all purposes, among our practitioners, and, while appropriate papers have appeared in the annuals relating to the transit theodolite, I have observed nothing relating to the cradle. I propose, as briefly as I can, to supply what appears to me to be requisite, mostly with reference to that instrument. I may, incidentally, refer to the English transit in passing.

The English cradle theodolite, especially the five inch, is a handy, portable instrument, sufficient for almost any work in surveying in the settled portions of this country, and for sub-dividing in original surveys, if in as exact adjustment as its construction admits, but, as supplied by the makers and vendors to the profession, it is not, so far as my experience goes, adapted for astronomical work at all. I speak whereof I know, in saying that more erroneous astronomical bearings have been recorded in Canada, owing to its use than from all other causes. How is it that, although most, not all, of its individual parts are well made, and the graduations equal to those of other instruments, material parts are so attached to each other, as to render it, for astronomical purposes, worthless?

The principal objections to those instruments are, that the standards, as usually made, admit of no adjustment for leveling the vertical axis, and they are seldom of equal height. I never found them so; and the Y's are screwed or otherwise so fastened on the Y plate without any attention as to whether they carry the optical centre of the telescope or line of sight, at right angles to the vertical axis, also the time and patience necessary to rectify those displacements.

I will, at the risk of taking up too much space, give an illustration or two, I could give many, by some results flowing from the use of those instruments in their usual form. In 1853 I was sent for to establish side-lines in two concessions in the vicinity of Ottawa, reputed to be 100 chains in depth, each, and, as there had been conflicting surveys in the two concessions, to save what was believed to be unnecessary costs, and end contentions, I was informed it had been mutually agreed to run the lines on the astronomical bearings of the governing boundaries, then lately ascertained by a

very reputable surveyor who was leaving the profession for more remunerative employment (then only $4.00 per diem), which I declined to do, and took the bearings myself, using an eight inch English transit with two telescopes and illuminating axis and a mercurial false horizon. Both governing lines were well defined throughout, and we differed in our recorded bearings in both concessions, 0° 17′ 0″, and 0° 22′ 25″, respectively, both in the same direction. He informed me he had taken his observations on polaris at its greatest elongations, with a false horizon, at two places on each concession, and we both came to the conclusion that the most likely cause of the difference was, that he used a cradle theodolite, whose line of sight was, probably, not at right angles with the vertical axis, something that had not previously occurred to him. Where a farm survey of his came in contact with one of mine, the difference on the ground was very much less than the difference between our recorded bearings, *i.e.*, the cradle, under similar circumstances, gave approximately similar results.

In 1858, for the two townships, I made a survey of the town line between Nepean and March, extending the depth of four concessions, in Nepean, from the Ottawa river. It had previously been surveyed under instructions from the C. L. Department, and stone monuments planted on the original line where it intersected the concession lines by another surveyor who used a cradle theodolite. With my transit and a false horizon, I took the astronomical bearings of three of the four of the governing boundaries on it of Nepean. Afterwards I ran side-lines in those Nepean concessions, fronting on the Ottawa, one of which resulted in a costly law-suit, and the plaintiffs' attorney procured copies of the field-notes of the surveyor who placed the stone boundaries on the town line, which stones represented the front and rear ends of the lines governing the courses of the side-lines in Nepean, when, to our horror, it was discovered that his sworn astronomical bearings differed from mine 3° 27′ 00″ on the concession in question, 3° 37′ and 4° 02′ 7½″, respectively, on the other two concessions. The differences were all the same way. Under these circumstances they deemed it advisable to employ another surveyor to take the bearing of the boundary in question, to test mine, which was done. He used a fine Troughton & Simm's cradle theodolite, with two telescopes and a false horizon, and took his observation on the greatest elongation of Polaris, and we differed in our bearings about 0° 7′ 00″, which was the nearest coincidence between the transit, in adjustment, and the cradle, as it came from the maker I had known, and was sufficient for our purpose. I suggested to the old gentleman, that, as he had not tested his instrument, which was nearly new, for that emergency, it was possible that the collimation of his instrument, owing to displacement of the Y's, might possibly be a little off, and, if so, it would describe a curve, and not a perpendicular straight line in passing from the star to its reflected image, and he enjoyed a hearty laugh at my expense, remarking, that "boys might be expected to give vent to nonsense like that."

The adjustment of those instruments is a tedious process, occupying several days. In unfavorable weather I have spent a week or more, at one. I have felt something akin to the old elder who always went to prayer before commencing to put up stove pipes. The first requisite is to adjust the collimation in the optical centre of the telescope. If the tubes are not accurately fitted to each other, the inner one will not travel in a straight line, and every movement of it is liable to change the collimation, and, in that event, the adjustments of the other parts become more difficult—it is something that cannot be remedied, and is hardly less objectionable than eccentricity, and is too frequently found in other classes of instruments as well as in this one.

The next thing is to make the vertical axis permanently level, which can best be done by the aid of an observation on polaris, which gives a perfectly vertical line of indefinite length. The instrument being accurately leveled by the levels, and made to cut the star, the deviation from cutting its reflected image in the false horizon will indicate which of the standards is to be raised (the bearings of those instruments which are champered cannot be lowered), thin slips of brass or copper are to be placed under the feet of the shortest standard,—they may be got from cartridge shells with very little alteration,—which is then replaced and fastened by its screws, and the operation repeated till the spider line cuts the star and its image. As the ends of the vertical axis of those instruments are not cylindrical, care must be taken in replacing the standard that the tops are the exact width of the axis, or chafing will result.

There are two sources of error in collimation peculiar to the instrument in question, viz., that of the lines in the telescope, and that of the Ys. I have already referred to the former, the latter is the most important, as already shown.

It is evident that if the collimation or line of sight is not at right angles to the axis on which it revolves, a small, and not a great circle of the sphere, will be described on its surface, and if the telescope is elevated and depressed on a horizontal axis (not a perpendicular straight line), but a curve will be described on a perpendicular plane surface, at right angles to the line of sight, the convex side of which curve will be opposed to the inclination of the line of sight. In other words, if the error in collimation be to the right, the error on an observation will be to the left, and *vice versa*.

TO ADJUST THE Y^{S} FOR COLLIMATION.

As the telescope cannot be revolved on its axis as on the transit, I have found the following to be the easiest method, viz: Hang from the gable of a building of at least two stories, the higher the better, as fine a plumb line as can be distinctly seen with the telescope, and of a different color from the building, to which fasten at about on a level with the telescope when the instrument is in position, a small block of wood with a card tacked on it at the back of the line, the

block to be just sufficient to let the card touch the line when taut, and when the twist is out and the line at rest, secure the exact place of the line by a perpendicular pen and ink mark on the card, set the instrument at right angles from the building and opposite the line sufficiently distant to bisect with the spiders lines, the top of the plumb line at an altitude of from 40 to 45 degrees, level the instrument in the usual way, and adjust the focus for distinct vision of the line. About half way from the card to the top of the line, place a false horizon in position to show the reflected image of the top of the line, and with the leveling screws, make the spiders lines bisect the line at top and its image in the horizon, and its deviation on the card will be the error in collimation, resulting from displacement of the Y's. And the operation must be repeated by detaching one of the Y's and removing it sideways on the Y plate and re-fastening it so as to throw the line of sight to the right, if the error, as shown on the card, was to the left, and *vice versa*.

After the telescope is focused for short distance, it should again be examined for collimation so that the Y may not be moved owing to a mistake as to where the error in collimation lies.

The tubes of a surveying or engineering instrument ought to be as truly fitted to each other as the spindle is to the cone, otherwise the object glass will not travel in a straight line, and every movement of it is liable to change the collimation, causing endless loss of time and worry and vexation, especially in inclement weather or amid a horde of mosquitoes.

It is an advantage peculiar to this instrument, that, as there are no attachments to the telescope it can be reversed in the Y's for transiting with little or no need of disturbance of the instrument, but it can be more easily and safely done if the telescope is given more room to pass in and out of the Y's, which can readily be done by filing something off the heels of the clips to enable them to turn back, and moving that one of the Y's a little lengthwise on the Y plate, which may have to be moved for collimation, so that the flanges of the telescope will not necessarily impinge on the Y's. The collars being segments of one and the same cylinder there can be no objection to giving them sufficient play room on the Y's. I prefer the English cradle to the English transit for the production of straight lines.

Many years ago, in London, I remonstrated with a leading optician against sending out those instruments in the state I have indicated, his answer was, "it is not intended for astronomical work." That being so, it should, for Canadian surveyors, be either "mended or ended."

I may add a few remarks intended to relate to the English transit.

I know of no reason why Y, instead of circular bearings are made for the telescope to revolve in, except for reversing the axis in the Y's, nor is there any reason for reversing the axis at all, except to avoid the error so often found in collimation, and even if the collimation is all right, another difficulty is climbing in the Y's, and what I have found

to be the best and easiest way to avoid that, in so far as it can be avoided, is to soft solder plates of brass on the under sides of the ends of the clips so as to raise them sufficiently to admit a small slice of firm leather fastened with two small screws with deep threads, coming in from above and having two milled thumb-screws on each clip, instead of one milled and one common screw, by which to give the clips just sufficient pressure to secure the axis firmly without impeding it, and without a screw-driver. Also, if the shoulders of the axis fit close to the Y's, as they usually do, it will be difficult to reverse it in the Y's without disturbing the instrument, which may be largely prevented by extending the distance between the Y's just sufficient to let the axis pass in without grazing. As I have stated in reference to the cradle, it can be done by loosening the screws under the feet of one of the standards just enough to admit thin, narrow slips of brass, to be inserted under the inside edges of its feet, a very little lateral play to the cylindrical bearings can do no harm. My work has been all local, and I have always, on comparatively level ground, produced my lines with a pocket telescope and plumb-line, as I could in that way be up with my men and make better headway, with quite as much accuracy as in using the transit. I preferred reversing the axis in the Y's unless the collimation was exact. It requires considerable practice to picket correctly and rapidly with the pocket telescope. In transiting, I left the attachments of the telescope at home to facilitate reversing it in the Y's.

My practice of over forty-eight years, has all been local, almost exclusively astronomical. I never went on government surveys. I have preferred the five inch English transit (it comes cheaper here than the best foreign instruments), with perforated axis, and axis level reading to 20″. I have discarded the English case and re-packed it in a longer, narrower case, about two-thirds of the cubical dimensions of the English case, with the telescope attached, which makes a much safer and more portable case. I have taken my astronomical observations on polaris, at nearly all hours of the night, when the stars could be seen—on the greatest elongation, when early in the evening —otherwise, on it in conjunction with any one of the other principal circum-polar stars. Sometimes, when I had surveys in several localities, miles apart, I took the observations at them all the same night, to avoid stopping over for a clear sky at either place. My eyes have not, for many years, been sufficient for day observations. The perforated axis is much to be preferred; it affords a constant, steady light, so desirable in hazy weather or floating clouds, and avoids the aberration caused by the flickering of a light held by an assistant, in windy weather. It is especially preferable when two stars are being used in conjunction with each other, as nearly as possible at the same instant of time. Also, the axis level, if properly constructed with vertical and lateral adjustments, is to be preferred to the false horizon, as it gives less trouble, and it is hardly possible to have the mercury packed in the case without particles of it getting on to the graduations, and it requires a rather dangerous heat to

evaporate it. As the axis of the cradle theodolite is not made to receive a level, the horizon is the only alternative, in astronomical observations, but there is no reason why its bearings should not be cylindrical and extended beyond the Y's to receive a level, except that it would be leaving the old rut of the makers.

In conclusion, it is not so vital the kind or size of the instrument, as the perfect adjustments of every part of them. An exceedingly small defect in the tripod or graduations, or the exact placing of the verniers, etc., etc., will more than counterbalance any advantage to be gained by a larger or differently constructed instrument. For example, I have had several instruments, in every other respect faultless, in which one or both of the verniers were a very little too near or too distant from the centre of the vernier plate, so that, although their zero lines were exactly opposite to each other, or 180° apart, on the vernier plate there was less or more error in the readings from them as they were taken from some division on the vernier less or more remote from its zero end. I have frequently had to detach a faulty vernier and replace it so that its lines at both ends would exactly coincide with the two divisions on the limb it was intended to embrace. Twenty or thirty seconds of error, resulting from the foregoing defect alone, would make all the difference in the results between a six inch instrument reading to 20" and a five inch reading to a minute.

DISCUSSION.

Mr. Abrey—There are a good many errors in this paper, as printed, that perhaps ought to be corrected before it goes in the report. When he says "false horizon," I suppose he means an artificial one; he even uses the word "vertical" where he means "cross" or "horizontal." And by "levelling the vertical axis," I suppose he means adjusting them. There are a good many errors like that all the way through.

In reference to the adjustments for placing the "Y's" at right angles to the cross axis, it is not always made so that that is easily effected. I got a transit made some time ago and I had the telescope made to revolve through Y's so as to give a chance of placing the collimation in the centre of the telescope. Then it became necessary to place the axis of the telescope at right angles to the cross axis and I got the Y's placed with adjusting screws so that that might be done. It was for the purpose of solar observations I got it made, and there are some advantages in having it revolve in that way as well as to revolve on standards.

I must say I am surprised at the amount of error he found in taking observations, "three or four degrees." I presume that the cause of error was simply because the telescope was not at right angles to the cross axis; there seems no other reason for it, and such a large amount is most surprising. Then, in taking astronomical observations, as he refers to here, of course there ought to be a pair of observations made. The north star is so elevated it becomes necessary to always

correct the error of the level of the cross axis so that in all cases I think that the observations should be made with a striding level.

In reference to what he says about producing lines with the theodolite, I think perhaps he is correct, that in careless or hurried work the theodolite produces lines better than the transit; it is less liable to get far astray. It does not matter much whether it is adjusted or not if the ground be comparatively level.

Mr. Gaviller—Another difficulty is a little ice getting on the Y's and swinging it off to one side.

Mr. Aylsworth—Do you suppose frost would affect the Y's?

Mr. Abrey—It should not.

Mr. Aylsworth—One cold morning, when I struck out to run a line with my transit, I took hold of the end of the telescope and it seemed to move in the Y's. I just put in a little piece of paper for that day, but I never saw it move that way afterwards.

[*This Association is not responsible as a body for any opinions expressed in its Papers by Members.*]

HIGHWAY BRIDGES.

By PETER S. GIBSON,

O.L.S. and C.E., Willowdale, Ont.

When the capital invested in these structures as well as the necessity of them is considered, we may well express surprise that more skilled and professional attention is not given to them.

1. At an early period of the settlement of our country, before our timber lands were cleared off and our swamp lands overrun by fire, our rivers and streams required very simple structures for bridging them, whereas at present, with our drainage systems and clearing up of our forests, high, violent and sudden floods are the rule.

My practice in constructing bridges in about 1858 on the Government Colonization Roads was to build King and Queen Post Trusses from 40 to 120 feet spans in the clear. The long spans were necessitated to facilitate the running of logs in the valley of the Ottawa River.

In the western part of Ontario short spans only were required, which for want of saw-mills were nearly all constructed of hewn timber, the plank alone being sawn lumber, and that, in some cases, whip-sawed at site of bridge.

The prices for such bridges were usually about, for hewn timber, 10 cts. per lineal foot; sawn lumber, about ten to fifteen dollars per thousand; board measure, iron from about 10 to 20 cts. per lb; stone in cribs, about $1.50 per cubic yard—all to be furnished by the contractor, and paid for at these prices complete in the work. The price of the iron seems very large, but the transportation to site of bridge added materially to cost.

2. The sub-structure of these bridges was usually of timber piers and abutments connected by double dovetail joints, and pinned at angles with white oak or rock elm pins. Sometimes the piers required to be sunk in water from 10 to 20 feet in depth, and were sunk by filling in with stone in false bottoms of thin boards, which were broken through by the stone filling, which was not only intended to add weight to the piers; but, in case of the foundation or bed of river being uneven, or foundation of piers being undermined by currents in the river, the stone filling, usually of round boulders, would run from the piers into any holes about the base, and thus form a good foundation.

I have known of bridges having similar piers sunk in deep water, but with a timber bottom, which could not be broken, nor was intended to be broken by the filling in of stone. These bridges very

soon failed on account of the foundations of the piers being washed out.

3. In about the year 1867 I commenced building highway bridges in the County of York, where there were plenty of saw-mills and lumber reasonably cheap, so cheap that plank roads about up to that time were constructed in many places.

I found the old bridges which I was called upon to rebuild usually King and Queen Post Trusses. The main braces, straining beams, chords, joists, and needle-beams, all of heavy timber, from 10 inch to 12 inch, and 12 inch to 14 inch sections. These bridges did not usually last over 12 to 14 years.

These bridges had sub-structures, piers and abutments of heavy timber, or bents of similar timber, which did not usually last as long as the superstructure. Some of the bridges had masonry piers and abutments with poor foundations.

4. After examining these structures I recommended the councils to adopt a different system in building the bridges. To have the superstructures composed of built beams, the main braces, straining beams, chord timbers, needle beams, to be of two pieces for short spans, up to 66 feet, to be bolted together with oak blocks between, 3 inches thick, and joints lined with sheets of galvanized iron, and that heavy joists should not be used.

5. I also recommended that cribs of timber should not be constructed either for piers or abutments—not only on account of the liability to rot, but on account of the cost—but that pile piers and pile bents should be constructed for sub-structures, and especially that the old fashion abutments, whether of timber or stone, should not be constructed, but that an additional short span or spans should be built, as much less expensive, and also to give additional water-way for the sudden high floods, loaded with all kinds of rubbish and timber, which often blocked the water-ways and caused a new bed to form for the river.

6. Another recommendation was, that the superstructures should not be bolted to or built into the piers or bents, as in case of a jam of timber and rubbish forming at the bridge it would be much better to have the superstructure carried away readily with the floating materials than resist it till by its great weight it would either crush through the bridge or cut around and form a new bed.

It may seem strange to make provision for such cases, but not when it is borne in mind that for about the last 25 years there has been a gradual abandonment of water-power, and that it has been the regular thing for the mill dams to be carried away with the spring freshets, carrying timber, trees, and large blocks of ice and other materials, which no river-bed would accommodate.

I found that such bridges readily separated into their component parts and usually lodged near the site of the bridge, and that no very great expense was required to replace the superstructures on the piled substructure, which usually was not much damaged.

7. I found that such bridges could be cheaply built as the timbers were light, and so easily handled, and also required very little skilled labour, as the chord timbers were made up of short pieces, secured together with iron straps or plates and bolts, and no tenons or mortices were allowed in the structure.

8. I also suggested that painting of new bridges should not be done until the woodwork was well seasoned, as the combination of fixed and volatile oils of linseed and turpentine, with metallic salts and oxides and other materials, usually formed a crust or coating, that prevented the woodwork from properly seasoning, and thus produced a dry rot. I also objected to the use of coal tar, and similar substances often applied to woodwork before it is seasoned, especially when applied to heavy or large timber.

I have found that good paints are hard to get, and that even the best, when exposed to the weather, requires renewing in three years or less, and as bridge timbers are not always dressed for painting —and should not be painted without it—that the dressing and painting is quite an expense, and, also, as wood-work requires protection to keep from checking while seasoning.

9. I have adopted the plan of covering all the upper surfaces of the important members of the superstructure, including the needle-beams and sometimes the joists, with galvanized sheet-iron, which I specify shall have the sheets neatly lapped upon each other and extend down the sides not less than half an inch, and to be secured to to the timber and each other with flat-headed wire nails, all to be done in a neat and workmanlike manner so as to protect the timber from the wet. This, with the above-mentioned lining of all large joints, is a much better plan and less expense than painting or sheeting in the trusses with some thousands of feet of inch boards, and also presents a neat and finished appearance to the structure, and gives facility to inspection and repairs if necessary, and tightening as the structure gets seasoned or may require.

10. I also provide that the railing shall be so constructed that the parts shall have snow-boards to keep the winds from blowing the snow off the roadway of bridge in the winter, as when bare in sleighing time the teaming is very hard on the structure.

11. I have the planking of bridge so arranged that there shall be a space between the ends of the plank so no filth or dirt shall run upon the chord timbers. If the roadway is to have 14 or 16 feet plank I have the space between chords made four inches wider and have alternate plank abutted on opposite sides against the chord timbers, thus leaving a two inch space on opposite sides for the slush to run off.

12. I find that bridges constructed as above-mentioned last a long time, and that the joints lined with the galvanized sheet-iron protects them, so that in bridges with joints so lined when taken apart after being constructed over 12 years or more, show the ends clear and white as just after being cut with the saw or chisel.

I have now many bridges which have been built over 16 years and show very little signs of decay.

13. Of late years I have found considerable trouble in securing a good quality of pine lumber, lumber merchants being anxious to include in the bill as much Norway pine and top lumber as possible. In one case, when constructing an iron bridge over 350 feet in length and about 90 feet high, I had to condemn a large part of the bill of lumber and have it removed from the site on account of Norway pine which had been shipped. This class of pine does not answer for bridges whether cut thin or thick, and does not last over 10 years, and, if heavy timber, less. Lumber cut from the tops of trees is very objectionable, as it may be said to be nearly all sap wood. It looks neat and clean and sound, and has small knots but soon decays, and should not be used in bridge works.

14. In building wooden bridges I prepare a plan, specifications, bill of materials and estimate of lumber, etc., and cost, and guarantee to the contractors who tender for the work that the bill of quantities of wood and iron, etc., is correct, and fix a price for each which will be paid for extra materials, if ordered. The contractors can thus prepare lump tenders with very little trouble, as they know that the lumber, iron, cedar and stone can be bought and put into the work all complete at about $22.00 per thousand, board measure, for lumber, and cedar piles at about 25 to 30 cents per lineal foot, and iron bars, or spike and nails at about five cents per pound, and stone filling for piers at about $12.00 per quarry toise. With such facilities for tendering, the tenders are often very close to each other, and on account of the simplicity of construction tenders are often very low.

15. Of late years all long spans of important bridges are built of iron and steel on masonry abutments and piers, but for ordinary country roads, wooden bridges with spans up to 60 feet in the clear, are preferable when constructed as above mentioned. In case of steel and iron bridges, whether constructed with pin, screw or rivet connections, they have a fine appearance, and it is a pleasure for an engineer to construct them, and if properly cared for, may be said to be permanent structures. But especially in case of the rivet connections, these bridges do not receive the attention as to cleaning and painting, etc., they should. The idea seems to be that when an iron bridge is built it requires no care. I know now large iron bridges which I may say are actually "rotting down," as they have not been re-painted for many years and the rust now hangs in scales from them. They are all thin plates connected with rivets. I am afraid these bridges will not have long lives.

16. In 1878 I had a large number of highway bridges to build, and with a view to economy I decided to take tenders for iron as well as wood. In one case the main span was to be 60 feet in the clear, and, as I do not build abutments at ends, but short approaches, I had one 20 foot approach at north end and two short spans, 20 feet each, at south end. I received a tender for the main 60 feet span, the superstructure only, for the sum of about $1,000, to be of iron trusses, etc., and for the whole wooden bridge, including two heavy pile piers and pile bents for short spans, $800. So I concluded to build the

wooden bridge, which has now been standing about 16 years and has had very little repair except re-planking, and only presents the appearance of being well seasoned.

17. I had intended entering into the consideration of the relative cost of bridges of wood and iron under the various circumstances and conditions in which they may or have been built, but find it would extend this paper to an objectionable length.

DISCUSSION.

The President—This is a very important subject to the county engineer, and I am sure it will be of considerable value to most of the members. In determining the area of waterway for bridges, a very good rule—I think it was announced by Mr. Myers some years ago—is to take the square root of the number of acres in the watershed and consider that the number of square feet for area and multiply by from two to four, depending upon the character of the soil. If it is agricultural soil, two is all right, but if it is a flat rocky area, four gives about the right figure. I have followed this rule for some years, and in no case have I had any structure flooded. He very properly points out that dove-tail joints for piers are a thing of the past. It is a mistake; it adds very greatly to the cost of putting up a pier and it is not as strong as a crib built in log-cabin fashion. I have tested them practically with a dredge, trying to tear one of these piers apart and I found I could not do it. As to the oak blocks, I would like to ask whether oak blocks placed in connection with pine do not produce mutual rot between them?

Mr. Gibson—No, because I line them with galvanized iron.

The President—Then about paints; for iron work there is no question about red lead paint stirred up with linseed oil being best. It is necessary, though, to keep one man stirring while one man is painting. In dealing with ordinary white lead, we asked some Montreal dealers recently to submit samples and prices of the best white lead paints. After we received them, each one of which was of course the very best white lead, guaranteed commercially pure, we submitted them to a simple little test with a blow pipe to see how much metallic lead was in each sample of paint. One proved itself to be nothing more or less than baryta there was not any lead in it at all. That is the paint that all the painters in that part of the country liked. If it were good lead it would settle to the bottom, and therefore they didn't like it. In the second, we could find some minute particles of lead scattered through the baryta, and the one that the painters condemned absolutely was pure lead. So that a simple test like that, taking only about fifteen minutes with a blow pipe, will determine whether you are getting white lead or whether you are getting baryta.

The only other point I would like to touch upon is whether concrete sub-structures cannot be used more largely than they have been. All through this northern region, where there are extensive drift deposits, there are numerous gravel beds which could certainly be had

very cheaply. During the past year I constructed myself about 400 or 500 yards of concrete piers, using one mason only to see that it was properly mixed and rammed. It cost us $5.75 per cubic yard in place. Some of it required excavation under water; that included foundations, cribbing and everything complete, and not only that, but the piers were of a peculiar form to cut the water, not unlike a plow-share. I took some trouble to get that shape, for in these places it is a fight between the strength of the ice and the strength of the masonry. I saw a test made a short time since of a block of ice 12 x 16 inches, and it required 120,000 pounds to crush it, so since seeing that test I have had more respecr for the strength of ice than I ever had before.

Mr. Gibson—In building bridges I make point of pier curved and nearly vertical, and the ice passes around it. If point of pier is made sharp and sloped the ice slides off the point and breaks off the masonry by catching in the joints, and is likely to lodge in the pier. "Ice breakers" for points of piers do not often break the ice.

The President—In regard to the comparative cost of wood and iron, during the past year the Indian reserve down at Tyendenaga were about to build a bridge across a creek, and they wanted to build a wooden one. I prepared a plan for what I believed to be a good wooden bridge for the cost, but they were not satisfied. Then Mr. W. R. Aylsworth, of Belleville, thought of the fact that you can buy iron beams delivered to-day, rolled beams up to 20 and 24 inches in depth, weighing 80 pounds to the lineal foot, suitable for spans of 40 feet, for $1.75. The result was that iron came very much cheaper than wood. He stayed them up very simply and cheaply, and put on a plank floor of cedar, and in that case the iron beams were quite a considerable saving on the cost.

Mr. Gibson—The great trouble we have with bridges in the County of York is that we are so near the lake the floods are very high and the ice jams and sweeps the bridges away, unless you go to great expense in putting up very heavy piers and abutments and very high bridges.

Mr. Davis—I have had some experience in the line of bridge building, though not very expensive, but I find there are very many points touched upon by Mr. Gibson in this paper that will be valuable in the future. The necessity seems to be as great to-day as ever for this smaller class of bridge all through the country, and the old ones are tumbling down. I find threshing machines are making sad havoc among the bridges in our county. A short time ago, when I came to take the measurements of a bridge, I found a farm engine keeled over and the bridge in a general state of demoralization. But we put up a bridge there that we are quite satisfied no steam engine will break down in future.

Mr. Ellis—I would like to ask whether you have had any experience with concrete bridges altogether, anything in regard to the cost of these?

The President—No, not yet. I think if you take pure concrete I have no doubt whatever that they can be built at a cost not exceeding $7 per cubic yard. That is for arches.

Mr. Ellis—It has always been a surprise to me that it has not been adopted before in this country. It is the only material that improves as it grows older. Wood deteriorates, whereas concrete improves, and I believe that they can be built quite as cheaply as iron bridges. Of course, you would have to use a certain amount of iron in the structure.

The President—That would be adopting the "Melan" system that they are now pushing very strongly in the United States and Germany. Mr. Ransome has published a very interesting book in which he describes how he puts his rods of iron into some machine and twists them into spiral form and then puts them in so that the concrete grips the iron and you get the benefit of the iron upon the tension side of the arch. There it adds to the cost of the concrete, but compared to the iron it is more permanent no doubt.

Mr. Gibson—In the case of iron bridges adjoining Toronto, long and high structures, built upon the rivetted system, we find that the rust is attacking them fearfully.

The President—It is due to bad painting.

Mr. Gibson—Yes, but the trouble is to get good paint. Lead is the only thing you should use, but they use iron oxide, and that is actually plastering rust on the bridge to start with.

A Member—I would like to ask Mr. Gibson what he generally uses for flooring.

Mr. Gibson—White pine; I find Norway pine will not last more than five or six years; it is no use at all.

Mr. De Gursé—I had occasion to look into the matter in connection with the Michigan Central Railway bridge in the city of Windsor. They proposed putting in two thicknesses, the first three inches of white pine, and placing upon that three inches of oak. I suggested that they put in cedar in the bottom and use white oak instead of black or red, as they were intending to do. They adopted my suggestion very readily, and I imagine that would be one of the very best floors, because white oak will resist the wear well.

Mr. Gibson—The trouble is you can't get it here very readily. I have a bridge now that has to be re-planked about 300 or 400 feet; it was constructed with two-inch plank in the bottom and three inch on top, and it is a mass of rottenness. I think they better put on a four-inch single plank if they want thickness.

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GOOD STREETS.

By HERBERT J. BOWMAN,

Town Engineer, Berlin, Ont.

A GREAT movement has arisen during the past few years for "Good Roads." It is the purpose of the writer in this paper to touch upon the kindred question of "Good Streets," keeping in view, more particularly, the needs of the villages, towns and smaller cities of Ontario, and it is hoped that the discussion by the members of the Association will contain much valuable experience gained throughout the province.

LOCATION.—A few of the older town-sites were laid out by the Government usually where, at the time of the survey of the district, a considerable population had gathered. In this way the Town of Niagara (formerly Newark), at one time the seat of the Government, came to possess its broad and well located streets. Later on the Canada Company, when sub-dividing its wild lands in the Province, also laid out sites for future towns, that on which the City of Stratford now stands being one planned by their surveyors. However, a great many of our present centres of population have never had the advantage of any well considered plan for the location of their streets. At some water privilege a grist mill was perhaps first built, soon to be followed by a blacksmith's shop, a general store, a hotel and a few dwelling houses, located on a more or less direct trespass road leading to the nearest Government road allowance. This road has probably for years been all that the hamlet required till the advent of a railway brought a demand for more building lots. Some enterprising owner of adjoining lands then decided to supply the demand and located new streets as he thought best, to enable him to sell his lots. Fortunately, during the last forty years, our laws have required that before deeds of these lots could be registered, a plan, prepared by some provincial land surveyor, should be filed in the Registry Office. Thus the land owner had the assistance of a more or less competent man, whose advice, however, he was free to follow or disregard. Usually the owner's object has been to get the greatest number of lots out of a given area with little consideration for the future, and so we often see new streets laid out without any regard to existing streets, or to future extensions and without any examination as to grade or drainage. It is high time that this lack of system be remedied and the writer would suggest that all plans be assented to by the Municipal Council before they may be filed, and not, only those showing streets of less than standard width, as the law now is.

WIDTH.—The Registry Act now requires that all plans with streets of less than the standard width of 66ft. must be assented to by resolution of the Municipal Council, but this assent is far too easily obtained by any influential land-owner. A By-law of the Council should be required to be carried by a two-thirds vote at its third reading, before any plan showing new streets is filed; and where the width is less than 50 ft. it should be confirmed by the County Council, as is now required when a Township or Village Council opens up a street less than 66ft in width.

A greater width than 66ft. is seldom required even for a busy city street, and for residential streets 60ft. is an ample width and probably 50ft. is sufficient in most cases, as the tendency in the country towns is to allow the untravelled portion to become overgrown with grass and weeds. However, with streets as narrow as this, a "building line" should be laid down on every plan, say 25 feet from the street line, so that the rows of houses would really be 100 feet apart on a 50ft. street. Where comparatively narrow streets are laid out, the owner of the property can afford to dedicate an occasional square or gore as a public park, and as years roll by these will be the "lungs" of the future city.

CROSS-SECTION.—A business street should have sidewalks from eight to twelve feet in width slightly inclined towards the gutters. At the edge of the walk there should be a nearly vertical curb separating the walk from the carriage-way which occupies the balance of the street surface. A residential street unless calculated for street car tracks, does not require more than twenty-four feet between the curbs for the carriage way and from four to six feet will be wide enough for the walks, while the remainder of the street surface should be sodded. In some cases the walk is placed along the property line and separated from the carriage way by the sodded portion, while in others the walk is placed along the curb, and again in some few cases the walk divides the sodded portion into two parts. When the walk is placed along the curb, the sodded portion really becomes, to all intents and purposes, a part of the adjacent property and as such will undoubtedly have better care taken of it, and if a row of shade trees is planted between the walk and the houses, no unsightly fences will be required, and in addition the trees will not be damaged by being used as hitching posts for horses. However, the chief advantage is that in streets having a "tilted" cross-section it is much easier to fit in the street grade to suit the properties, and it is also easier to arrange streets intersections when the walks are along the curb lines.

GRADE.—In very few of our towns is any attempt made to fix the grades on streets; hence a person about to erect a building is unable to form any idea of the proper elevation at which to put the ground floor so that it may conform with the finished surface of the street, and it is a common occurrence to find buildings too low and others set ridiculously high in order to be out of harm's way. Every village, town and city should have the grades of its principal streets fixed by By-

law, as this power is apparently given to every Municipal Council by the Municipal Act (Sec. 550), which provides that Councils "may pass by-laws for opening, making, preserving, improving, repairing, widening, altering, diverting or stopping up roads, streets, squares, alleys, lanes, bridges, or other public communications, and for entering upon, breaking up, taking or using any land in any way necessary or convenient for the said purposes; for setting apart and laying out such portions of any such roads, streets, squares, alleys, lanes, bridges or other communications, as the Council may deem necessary or expedient for the purpose of carriage ways, boulevards and sidewalks, or for the improvement or beautifying of the same!"

SIDEWALKS.—Wood has until recent years been the usual material used in the construction of sidewalks, although expensive stone flagging has been used to a limited extent in the larger cities. A mixture of coal-tar and gravel, erroneously called asphalt, has been tried in a number of places but usually with poor results. However, since the general introduction of Portland Cement, it has become possible, with the addition of sand and gravel only, to make artificial stone walks that are satisfactory in every respect, and the cheapest of all walks when the lifetime is considered. A harder and more durable walk is made with crushed granite, instead of sand, in the wearing surface, but it has the disadvantage of being very slippery under certain conditions.

CURB.—On gravelled or macadamized residential streets cedar planking forms an inexpensive curb, but where a more permanent roadway is to be constructed, stone curbing should be used. The writer, however, sees no reason why artificial stone curbing of superior form and capable of being laid with closer joints, could not be made at half the cost of cut stone.

ROADWAY.—In the majority of towns having good gravel close at hand this material continues to be used for the surfacing of all except the busiest streets, as a good gravel road-way thoroughly tile-drained can be made for 25 cents per square yard. For streets having more traffic a good macadam roadway with stone foundation can be laid for less than 40 cents per square yard provided suitable stone may be obtained within 50 miles by rail. Wood as a paving material for roadways is now practically out of the field. In our larger cities there is a demand for a roadway with a minimum of dust and dirt and a smooth surface. A concrete foundation is the first requisite and on top of this the surfacing material is placed. Asphalt at the present time is very popular, but the cost is great being from $2 to $2.75 per square yard according to specification. Vitrified brick is used very largely in the Western States; but as all brick is now imported, it has not been used to any great extent in Canada, and on a concrete foundation is no cheaper than asphalt. For the heaviest traffic of a city street granite setts on concrete foundation are used, costing about $4 per square yard.

PAYMENT OF COST.—Before much progress can be made in any town towards good streets the Local Improvement System must be

adopted, and to avoid any chance of trouble in the future a By-law should be submitted to the people providing that all street improvements shall be paid for by special assessment on the property benefited and according to the frontage thereof.

CONCLUSION.—If the farmers condemn the ignorance of the pathmaster and lament his inability to build good country roads, surely his methods should be excluded from the towns and cities where streets should be constructed according to the best engineering practice and with competent supervision.

DISCUSSION.

Mr. Gaviller—There is one point here that is a most important one, that is the establishment of the building line. Of course, as we all know, one of the great elements in streets is their width, and in country places where a small village cannot afford to have an efficient fire service, it is a great protection to have a good wide street. The law provides that in certain cases streets shall be laid out only of a proper width, but when the farmer, as we all know, stakes out village lots, his great idea is to get as many dollars for a square foot as he can for his land, and he does not consider the convenience of anybody. This is generally the case where a new village is commenced. It ought to be established by law, and this building line, I think, is one of the most important points in the paper.

Mr. Campbell—Can you oblige a person to build back to the line you establish ?

Mr. Gaviller—Certainly ; that is your idea isn't it, Mr. Bowman ?

Mr. Bowman—Well, in regard to that, of course if a building line is shown on a plan and especially mentioned in the deeds made according to that plan, no doubt it would be binding, but at present there is no provision by which a municipal council of a small town may prescribe the lines up to which houses may be built. But as to cities, there is a section in the Consolidated Municipal Act, 545a, which reads in this way:—" The municipal council of any city, having a population of 50,000 or more, may pass a general by-law prescribing the minimum width of streets, lanes, alleys or other public places within the municipality wherein dwelling-houses may be erected or occupied, and the minimum area of vacant land to be attached to and used with any dwelling-house hereafter to be erected, as the courtyard or curtilage thereof, and the mode of erection of buildings occupied or intended to be occupied as dwelling-houses.'

Now, it seems to me that there is no valid reason why that population limit should be placed there. It should be the council of *any* city, town or village should have that power. It is not likely they will exercise it to the detriment of the community, so that if the town council prescribed the distance from the centre of the road at which buildings might be placed on different streets there would be some uniformity.

Mr. Gaviller—I think that could be safely put in the hands of a township council and allow them to use their option in the matter, because we all know there is generally a pretty good vote in the villages and it is a vote that goes pretty solidly together, so that it is not likely the council would bring in an oppressive measure and kill their chances with the village vote. If that were extended to all villages it would be a very good idea.

Mr. Chipman—It is always a pleasure to read a paper of Mr. Bowman's. He writes so concisely that we can get at the points at once, and I think the Association is to be congratulated in having papers such as this presented. There are one or two points I would like to mention not touched upon in the paper. in respect to filing plans with township councils. I am of the opinion that these plans should be subjected to the supervision of some competent authority before being adopted. The plan itself does not show everything. I have known streets to be placed upon the most inaccessible rock, that could not be made accessible from other portions of the town without the expenditure of thousands of dollars. I have also found streets laid out along a running stream, the stream being zig-zagging across the street itself. In the town of Galt, where I am now putting in a sewer system, we find streets of considerable length, some 1,000 feet or more, without any cross streets, and the centre portion between the ends ten or fifteen feet below the ends, so that there is no possible outlet for drainage except by the purchase of lots. Now if proper profiles were filed with the plans or the elevations marked upon the plans themselves it would not be possible for these blunders to occur, which must be rectified at some time at the cost of the town at large. In Galt it is quite probable that new streets will be required. In the town of Brockville, in putting in a sewer system, we opened out a new street for several blocks, which was not required except for sewer purposes, but it was cheaper to do that than to purchase a right of way.

Another point I might mention is in regard to the width of the streets. In the east I know it was a common occurrence for the owner of a property to lay out streets half the proper width adjoining either one boundary or the other, he assuming that his neighbor when he laid out his property would give the other half. In this part of the Province I have known it to be the custom for an owner who is sub-dividing his property to lay out a street adjoining one limit of his property but leaving a small strip of one foot in width between the street and his neighbor, thus preventing his neighbor access to the street without paying for the privilege. Both these systems should be condemned. The men who are selling their properties should provide proper streets of the full width. You cannot get them too wide, but that remark I do not mean to apply to the travelled portion of the street. Mr. Bowman is quite right when he says that the travelled width of the street need not be more than twenty-four feet in width ; in fact, I think a less width than that would do on a residential street. It is a great mistake to lay out a roadway of any great width. I know of a town where they laid out a roadway half a

mile or more in length, grading it very nicely, and it was really a beautiful looking street, but two years afterwards at least one half the width of that roadway was grown up with weeds, and the travelled roadway was a zig-zag across the street.

As to the question of cost, I will leave that to Mr. Ellis to speak about, but the question of sidewalks is one I have had some experience with. I am not satisfied that the concrete sidewalk is the proper one for any width more than five or six feet. By concrete I mean the concrete mentioned here, Portland cement, sand and gravel. Concrete of that kind being made in squares to resemble stone, I don't think its utility has been proven yet; we don't know how long it may last. Another difficulty is, that there is some trouble in putting in sewer connections and water pipe connections underneath it, especially for the business portions of the street. In the town of Belleville last year they put in, I think, nearly two miles of concrete sidewalks on the business portions of the streets. It looks like a good job; I hope it may be, but in that city the rock is only a short distance from the surface of the ground. They have their water connections in, but their sewer connections are not in, and you can imagine what expense and difficulty there will be in the future. It is a very foolish piece of business, which, I was surprised to find, some of the aldermen admitted. In Guelph they are doing pretty much the same thing, but there is no rock there to speak of. Brantford, wisely I think, put in flagging instead of concrete on the business streets, using concrete only on the residential portions.

Respecting the use of tar asphalt, or coal tar and gravel, it has usually given very poor results, I believe. I found at London it was disintegrated in a short time, and when I was there a very few years ago they were then taking it out with picks and carting it away and replacing it with wooden sidewalks, planed, using wire nails. The object of the planing of the upper surface was that poor lumber was more easily detected, not from any superiority in its wearing qualities. The extra cost of planing was more than off-set by the better lumber secured and the ease of inspecting. As to this tar asphalt, the case I have mentioned is one where it was very poorly laid or very poor material used. In Barrie, where we put in a sewer system in 1892, it appears to wear unevenly, but it is not disintegrating to any extent.

Mr. Gaviller—It is a little too hard there; they have petitioned against it; they said it wore their boots out.

Mr. Chipman—Yes, the gravel projected through the tar, and it was really a cobble stone pavement, but there was no objection to it from disintegration. But in the town of Galt they have put in many miles of that sidewalk, and I must say it is about as pleasing a sidewalk as I ever walked upon. It is exceptionally well laid; there is very little of it disintegrating, and they are putting in every year a larger amount. There is no other town in Canada where they have the method of constructing this tar sidewalk so perfected as they have in Galt. There is only one man in Ontario to-day, to my mind, that

knows how to make tar sidewalk, and that is Mr. Curliss, of Galt. If I were interested in making tar sidewalks any place where I could get tar cheaply, I would certainly pay that man a very high salary for his services. In Stratford they have adopted a certain amount of it, to what extent I don't know. I would not like to say off-hand what they cost, but they are very reasonable, much less than concrete.

I don't know that I can add anything further; I am not prepared to go into the question of cost here, but I am of the opinion that vitrified brick or a brick that will answer for paving purposes can be laid for a much less sum than you would gather from the paper.

Mr. Ellis—There is one thing I wanted to speak about in regard to the width of the streets, that is, I see you say sixty-six feet is ample width for a street. Well, it is all right enough as long as you have not any street car tracks on it, but if you take sixteen feet six inches off the middle of the roadway for car tracks, and twelve feet on each side for sidewalks, that makes forty feet, it only leaves you about thirteen feet on each side available, and the result is that it hardly leaves you room to pass between the car and the next vehicle. I think streets on which there is to be a double line of street car tracks should be at least eighty feet wide. Another thing too, when a street is confined in that way with street car tracks on it, it throws the whole of the travel on exactly one portion of the roadway, and the result is your pavement goes to pieces just on those spots where the wheels go and where the horses keep hammering in the same place, whereas, if it were a little wider the travel would be more evenly distributed and the pavement would wear longer. In Toronto, on Bloor street, where they have got street car tracks and macadam roadway on the sides, it is impossible to keep it in good repair.

I see Mr. Bowman speaks about the cross-section of the street. That is very nice where you haven't any buildings, but where there are houses on both sides of a street, one side of which is a foot and a half or two feet higher than the other, you cannot slope it off to the buildings; if you do you are in for damages.

Mr. Chipman—In some places in the Province you haven't a difference in inches, but a difference of seven or eight feet from side to side.

Mr. Ellis—Well, then, you must go in for damages or something of the kind; there is no other way of getting at it, but I am speaking of where there is two or three feet. We have some places two feet and a half, but we have only paid $480 damages in the whole change of eighty miles.

In regard to the question of kerbing, there is a patent artificial stone kerb made, kerb and gutter I ought to say. It is used very largely in Duluth and several other cities. We have not adopted it here because we can lay stone cheaper. Stone costs us about forty cents a lineal foot delivered on the ground, six-inch stone kerbing, twenty-four inches deep. But the kerbing has given satisfaction everywhere it has been put in. In some cases, it is made hollow and elec-

tric connections and wires are run through that, so as to avoid disturbing the streets.

In regard to cost, I don't see how Mr. Bowman can put in a gravel roadway for twenty-five cents a square yard. We have to pay ninety cents a cubic yard for our gravel, and say you put on six inches of gravel, that would be fifteen cents for gravel alone without any rolling, or excavation, or grading, or anything.

In regard to macadam roadway, I would like to know what he pays for his stone. We have to pay from $16 to $20 a toise (216 cubic feet) for broken stone, broken to go through a two-inch ring. If you want a man to make you a broken stone roadway, the best gauge is to say, you must not put a piece of stone in that road that you can't put in your mouth. If he can put it in his mouth it is the right size, but nothing larger. Supposing you put, say, six inches of broken stone on the roadway, that would be ½ of a cubic yard, and even at $2 that would be over thirty cents. But I would sooner have three inches of stone and an inch of gravel on top of that and thoroughly rolled.

In regard to the cost of vitrified brick, Mr. Chipman took some exception to that. Vitrified brick on concrete foundation costs us about $2.15 a square yard here, and we can lay asphalt pavement for $2.10. We have to pay $18 a thousand for vitrified brick. The cost of the brick is about $8 50 and the freight and duty is $10. I may say I was shown a sample of a new material of paving brick put in within the last few days that they propose to manufacture in Toronto. It has beaten anything I have seen yet in the way of vitrified brick that is imported from the States, and they say they can turn it out in Toronto for about $18 a thousand. They can not only turn it out in the shape of brick but in slabs six by four feet, and in the shape of columns, say, six feet long and eighteen inches through. I understand that they wish me to go down to New Jersey to examine and report on it for some of the people here, and I will know more about it then. They use the refuse clay from the brick kilns, the clay that is rejected and not fit for burning into brick. It will take a polish like granite. I saw some medallion work done here that looked more as if it had been engraved. They also use it for manufacturing mantelpieces and it polishes like marble. There is a piece of roadway of it in New York, down four years, and there is absolutely no wear on it at all, and it has some of the heaviest traffic in New York. It is called Pyro Granite. I put it in the "tumbler" with 300 pounds of shot and I gave it thirty revolutions to the minute, and kept it going for two hours, then I took it out and gave it another two hours after that, and I think there was one per cent. wear on it. So I came to the conclusion that it would stand fairly well.

In regard to the local improvement system, we are rather suffering from it here in Toronto, at least some say so. There is a difficulty about it in this way. Supposing, for instance, a person has a lot of property out in the suburbs and you go and lay a new pavement, who is going to carry on repairs? Why should the city pay that any more than anybody else? Why shouldn't they carry the local

improvement system into repairs as well? They do in some towns but it complicates matters tremendously.

In regard to the plans and profiles of new streets before they are laid out, I think it is a very good idea, indeed, that every new street before being accepted by a city or municipality of any kind, the person laying it out should be compelled to put in plans and profiles subject to the approval of the municipal engineer. In some cities they will not accept a street at all until it is not only graded, but sewered and paved; the proprietor must do that before the municipality will accept it.

In regard to the one foot reserve, I have had a good deal of trouble with that here too, but now it simply means that the council will not accept any plan with a one foot reserve on it at all. We found ourselves tied up in several places.

Mr. Bowman—Under the city's special Act they require all plans to be submitted to them?

Mr. Ellis—Yes, to the city engineer for approval.

Mr. Bowman—But country towns have not that Act.

Mr. Ellis—I am not sure about that. I don't think they are obliged to accept a street; they may simply say, We won't accept the street, and we won't put any public work on it.

In regard to Mr. Chipman speaking about pavement of residential streets being less than twenty-four feet wide, I must say that I think he is mistaken. Take any ordinary buggy and it takes about twenty-four feet to get around. We have one or two where the pavements are eighteen and twenty feet here, and I have seen cases where there was a good deal of trouble before they could turn around, but in twenty-four feet you can do it comfortably.

Mr. DeGursé—I think twenty-eight feet should be the minimum width.

Mr. Chipman—Any ordinary driver can turn around in twenty-four feet, or even in twenty feet; and a poor driver, if he can't turn in twenty feet, can go to a lane or a street crossing.

Mr. Ellis—Yes, but the difficulty is they don't; they drive up on to the boulevard and get up on to the concrete walks.

Mr. Chipman was speaking about the difficulty with these walks of making connections. Of course they are a little difficult in that way, but we tunnel in every case.

Mr. Chipman—So do we, but that does not apply to where the rock is near the surface.

Mr. Ellis—In regard to the lifetime, we have had them here for nine years and they are in just as good condition as when they went down, they are not more slippery. I tried a new mixture on the Queen street walk, that is, through Queen's Park, last year or the year before. We dusted sand over it evenly, and instead of trowelling it to a fine polish we left it, and it is standing well and

showing no signs of being slippery, whereas older walks have become very slippery indeed.

Mr. Gibson--What is the object of giving so much curvature to your asphalt roadways?

Mr. Ellis—Partly to get the water off.

Mr. Gibson—Well, but you get the horses down in every way, and we have a terrible time.

Mr. Ellis—Well, there is about six inches in forty-two feet. In regard to the price of sidewalks, I would like if Mr. Bowman could give me some information as to these tar sidewalks. Wooden sidewalks cost about five cents a square foot and you have to renew it every six years at the very least. If it doesn't rot out it wears out.

Mr. Gibson –I put down my sidewalks with cedar mud sills and they last ten or fifteen years.

Mr. Ellis—The average life of wooden sidewalks in Toronto, as given by the Street Commissioner, is five or six years. Of course we have some of them which last from ten to twelve years where they are not worn out by travel. I was trying to make a little calculation the other day as to what it cost at five cents a square foot, renewing every six years, and it cost about thirty cents at the end of thirty years. Now, take a concrete sidewalk, which costs about twenty cents, and it is certainly good for thirty years, so that would be a saving of ten cents a foot in that time, irrespective of interest.

Mr. Bowman—You notice this paper is not written as an authority or anything of that kind; it is more for the purpose of bringing out discussion than anything else, and it is not compiled from my own experience to any great extent; it is more from the reports of other engineers.

Mr. Chipman spoke in regard to the merits of concrete versus stone flagging for sidewalks, and I quite agree with him, that in a town having rock so near the surface as two feet, it would be very foolish for them to lay concrete sidewalks in advance of the construction of sewer connections, water works services and gas connections, but in places not having rock anywhere near the surface there is no great difficulty, as a concrete sidewalk properly made I think can be moved quite as readily as flagging. The blocks are probably not quite as strong, but if properly handled and put back again with a proper foundation they can be taken out as well as flagging. There is no comparison between the wearing of concrete and stone flagging of the kinds used in Ontario. If you go along King street, Toronto, you can soon see the quality of stone flagging. Yesterday, when it was wet, one had to be dodging in and out of pools of water, and that walk has been down I think not quite ten years; whereas, a little farther along the same block, at the Rossin House corner, you will find a walk put down at the same time, with granite surface, and you might say it is as good as the day it was put down

In regard to the remarks of Mr. Ellis about the width of streets, I may say that I was in my paper simply quoting the views advanced by Professor Haupt, in a paper that appeared in the January number

of *The Engineering Magazine*, on "The Planning of a City," in which he advanced the opinion that sixty-six feet was ample width for business streets. However, I am glad to have the experience of Mr. Ellis brought out that this is not sufficient for a business street such as they have in the city of Toronto, and it would be valuable for the engineers of the Province to know that business streets should be wider than that, probably eighty feet.

In regard to the sloping of the streets, the conditions that obtain in a country town are not the same as in a city, and although it would be inadmissible to have the sides of the streets sloping towards the lots in a crowded city, still in a country town where there is usually only one house to every sixty-six foot lot, there is no reason usually why the water that falls on this portion of the street may not be allowed to drain across the lots.

In reference to the cost of gravel and macadam roadways, I may say that these figures were quoted direct from a paper read by City Engineer Campbell, of St. Thomas, in regard to his practice in that city. This paper was read at a meeting of the Good Roads Association a year ago.

I don't know that it is necessary to say anything about the local improvement system; it may have been abused here in Toronto, but throughout the country there is not so much danger of damage being done to the community by this as the "booms," one of which has lately exploded in this city.

Mr. Robertson—Don't you think that the streets of the future should provide for bicycle tracks as well?

Mr. Ellis—In regard to the wooden pavements, Mr. Bowman says they have practically gone out. Well, there is a good deal of truth in that, but at the same time they are the cheapest pavement and easiest laid you can possibly get. A young town can lay cedar blocks for about fifty-nine to sixty cents a square yard, and even if you renew it every four years it is a cheap pavement, and it keeps the roadway in fairly good travelling order until the community can afford to put down a first-class pavement.

A Member—It is all very well for places where real estate is very valuable, and they can afford it, to put down costly pavements; but taking growing towns, I think there is no pavement that will meet the requirements of the people so cheaply as wooden pavement.

Mr. Gibson—And have first-class drainage.

Mr. Gaviller—Yes, and a good fresh breeze blowing over it in the morning. The objections to the pavement are on sanitary grounds, I think, as well as the cost and quickness of its wearing out; and its absorbing qualities are rather too great.

MINING AND SMELTING OF THE COPPER NICKEL ORES OF THE SUDBURY DISTRICT, ONT.

By J. D. EVANS,

O.L.S., C.E., Trenton, Ont.

It was in the year 1883 that copper ore was first discovered in this district by rock cuttings made during the construction of the Canadian Pacific Railway; but it was not until late in the year 1886 that the discovery was made that nickel was associated with the copper, the latter occurring in copper pyrites (chalcopyrite) and the nickel in magnetic iron pyrites (pyrrotite), these two minerals being more or less intermixed and the one or the other prevailing.

These ore bodies occur usually in irregular large masses or isolated patches through the gangue rock (diorite). No well defined veins have been so far discovered. The deposits are extremely variable in their form and occurrence, sometimes cropping out on the slopes of hills, or on the top, while at other places indications are that the heaviest bodies of ore may be found in flats adjacent to elevated ground or ridges of rock.

When prospecting for and opening up a body of ore the work must be done with very primitive appliances, but so soon as the work done reveals a body of ore sufficient to warrant it, machinery should be employed, and in course of time that of the most approved description, for handling and treating the product, with a minimum outlay for manual labor, should be provided in order to be able to compete with those mines fully equipped with such machinery and appliances.

This equipment should consist of a suitable shaft-house and rock-house, which may be combined in one building, if surrounding circumstances admit of it, and provided with a suitable hoisting plant, rock crusher, revolving screens, assorting tables and a number of hopper bins for receiving the various classes of broken ore, etc., and also a ready means of reloading on to cars for transportation to the roasting yard.

The ore having been broken in the mine, with the use of dualin, in the usual way, and reduced to a size sufficiently small to be handled and loaded into tram cars by manual labor, it is hoisted to the surface in skips, or tram cars, or other equally suitable manner, and to an elevation in the rock house of a sufficient height to enable all the fol-

lowing methods of treatment to be done to the ore by gravity. The ore having been discharged from the skip or tram car and delivered near to the crusher, any rock or ore of too low a grade should be sorted out and sent to the waste dump, the remainder is then fed into the machine, which should be set to reduce it to a size that will pass through a $2\frac{1}{2}$-inch ring. From the crusher it passes into a revolving screen about 10 feet in length set in a slight incline (say 1 in 12), and having holes of two different dimensions; those occupying the first or upper 5 feet long of the screen should be $\frac{3}{8}$-inch in diameter, and throughout the remainder $1\frac{1}{2}$ inches in diameter. The product from the crushers, while passing through this screen, will be separated into three grades of fineness; that of the first is designated "fines," the second as "middlings" or "ragging," and that which passes along and discharges at the end of the screen is called "coarse" ore. The fines and ragging discharge into separate bins and are used as will be described hereafter; the coarse ore is, however, discharged on to a shaking table, set on a small incline, or any other device of a similar and suitable description. As the product passes along the length of this table all rock and low grade ore is picked off by boys or men (ranged along the sides of the table) and thrown into bins provided for the purpose. The good ore is discharged over the end into a bin or other receptacle.

From these various bins the product is drawn off by gravity and discharged into tram or railway cars, as circumstances necessitate, and is transported to the roasting yard.

In this condition the ore will assay about 5 or 6 per cent. nickel and a like percentage of copper. This, however, is subject to much variation, the copper and nickel contents vary very materially, usually from 2 to 10 per cent. for each of these metals and in rare instances up to 18 or 20 per cent. The iron and silica also vary, some ores having iron in excess and others silica.

The next process is for the purpose of getting rid of the excess of sulphur and consists of roasting or calcining the ore. The roasting yard should be at some considerable distance from the mine, from one half to a mile distant and usually in a south-easterly direction, in order that the sulphur fumes, arising during combustion, may cause as little annoyance as possible where the mining operations are carried on and the prevailing winds will carry these fumes away from the mining works.

If the nature of the ground admits of it, there should be two railway or tram tracks prepared with the roast heaps between, one elevated track to be used for placing the green or raw ore upon the heaps and the other a low track for removing the roasted ore from the piles or heaps. These heaps may be of any desired dimensions, but perhaps the most convenient and suitable would be about from 40 to 50 feet wide and from 100 to 120 feet long, with a passage way of, say, 4 or 6 feet between them. The space devoted to the roast yard should be of sufficient length to enable as many of these heaps to be built as will be necessary under the circumstances, which will depend entirely upon the output of the plant.

The floor of this yard should be prepared and made with a slight fall in cross-section and should be made impervious to surface water with a layer of clay or other suitable composition, and this should be covered with a layer of from 4 to 6 inches of fines (fine ore) before commencing to build the ore piles or heaps. The bottom for these piles is first laid with about 15 inches of wood; dry pine is very serviceable, or say two sticks of cordwood high regularly laid down in tiers, and provided with air spaces or canals about a foot wide at the ends of each tier, which is filled with fine kindling wood and will thus form flues for the fire to follow. Upon this wood is placed the coarse ore which is piled up to a height of about 6 feet, the sides and ends standing at a slope of about 45 degrees. This body of ore is then covered, top, sides and ends, with 6 or 8 inches of ragging or middlings and finally with a light layer of fines. To fire this heap a small quantity of kindling and cordwood of dry pine is placed along the ground all round and against the outer margin and fired, the fire making its way gradually into the interior. At this stage great precautions are necessary and a constant watch must be kept to prevent the fire from burning too rapidly. Cracks and openings will form in the outer crust, due to the wood being consumed and the ore settling, thereby creating too great a draft and too much heat and thus causing the ore to melt and run together in large masses and give endless trouble and expense in breaking it up again. This can be largely avoided by throwing on fresh fine ore and thus check over-burning. After the fire is well started, say from 4 to 6 days, combustion will proceed without much further attention for from 60 to 90 days, the fuel being furnished by the sulphur contained in the ore. After the fire has expended itself and the pile cooled off, the ore is ready for the next process, that of smelting.

During the process of roasting a large percentage of the sulphur is thrown off and oxygen is taken up. Sufficient sulphur should, however, remain in the ore to carry on the process of smelting successfully.

The next process is smelting. The ore is taken from the roast yard and transported to the smelting furnace where it is deposited in suitable bins adjacent and convenient to the charging door of the furnace. Smelting is for the purpose of eliminating all rocky constituents and a large per cent. of the iron and thus reduce the weight of the resultant to from about one-seventh to one-twelfth of that of the ore charge, the product being known as matte, containing copper, nickel, sulphur and iron. A charge may consist of any quantity of ore from 2,000 to 5,000 lbs. at a time, with the requisite quantity of coke about one-seventh in weight. The best furnace for modern work is that known as the Herreshoff Water Jacketed Blast furnace, consisting of a shell, oval in shape, in plan 4ft. x 7ft. at the tuyeres and 8 feet deep from the charging door, set up upon cast-iron legs about 2 feet from the floor, built of sheet steel, the inside lining being five-sixteenth inches thick and the outer one-fourth inch and having a two inch water space between; the bottom consisting of a cast-iron

plate covered with one tier of fire brick. The tuyeres are 13 in number, 5 on each side and 3 at the back. In front of the furnace is placed a circular fore hearth or well made of cast iron, with a water space similar to the furnace around the circumference, which is lined throughout with fire brick; it has also a cast-iron lid or cover. This well is about 3 feet in diameter and 2 feet deep and is placed on four wheels for easy transportation. It has an opening in the back near the bottom, opposite to a similar opening in the furnace, through which the molten material flows and fills up the well to the top. A lip is formed in front at the upper edge, over which the slag, which separates from the heavier matte and floats to the surface, flows in a steady stream and discharges into a cast-iron pot provided for the purpose. This pot is removed at intervals and another substituted. In the meantime the matte continues settling and accumulating at the bottom of the well until a sufficient quantity is stored up when it is withdrawn through an opening called the tapping hole, placed at the side and at the height of about the centre line of the well. When a sufficient quantity has been taken the hole is closed with a clay plug. This process is repeated as often as is necessary, great care being taken to prevent any of the matte passing off with the slag and also the slag following the matte when tapping. The difference in appearance between these two products can be readily detected by a practised eye and easily recognized by the workman.

A furnace of the dimensions mentioned is capable of smelting from 100 to 125 tons of ore in 24 hours. Under very favorable circumstances as much as 150 tons have been smelted. The resultant matte will assay from 15 to 25% nickel and 20 to 25% copper, the slag about $\frac{3}{10}$ to $\frac{5}{10}$% of 1% of each (nickel and copper), this last showing a loss of less than 1% of the two metals, which is considered very good work. In the process of separation of the matte from the slag in the well, the sulphur performs a very important part. It first takes up or absorbs the nickel and then the copper, after which it takes up iron. If there should not be sufficient quantity of sulphur to take up all the copper and nickel and some iron, a loss would be entailed, as copper and nickel would go off with the slag. Had the roasting process been carried too far, thus leaving an insufficient quantity of sulphur, the shortage could easily be made up by introducing a certain quantity of green or raw ore in the charge.

The furnace charge is made up of ore and about $\frac{1}{7}$ its weight of the best coke, there being no necessity for any flux of any description, providing that the ores are assorted so as to give the requisite quantities of silica and iron.

The matte can be raised to a higher grade by a process called bessemerizing or blowing in a converter. This can be done by passing the molten matte at once to the converter, or it can be resmelted in a cupola and then transferred to the converter. During the process of blowing, the iron is oxidized and is removed in the form of slag, as is also a portion of the sulphur, resulting in a product carrying from 8 or 10 to 15% sulphur, the balance being copper and nickel.

The further process of refining the copper and nickel as an alloy, or separating the two metals and producing them in the pure metallic form, or as an oxide, cannot be done in Canada, there being no works for that purpose. But the matte is shipped to the United States or Europe to undergo further treatment.

In order to ascertain the value of the product of the mines and furnaces and the loss, if any, during the process of roasting and smelting, repeated assays are made.

Samples should be taken from each and every ton of ore shipped from the mine and assays made thereof, say once a month, also of samples taken from the charges at least every six hours and assayed every week, also of samples taken from each pot of matte when in its liquid condition and the same of the slag taken as often. These should be assayed for every day's run.

It is essentially necessary that the furnace charges should be very carefully weighed for each and every charge, and in order to have correct returns of all the products, the ore should be carefully weighed on track scales in transit from the mines to he roast yard, as also each and every pot or other unit of matte should be weighed and preferably while in its liquid state.

DISCUSSION.

The President—It just occurred to me while you were talking about sulphur going to waste, why they could not utilize it for the manufacture of sulphide pulp.

Mr. Evans—That question has often been taken up, but the ore is of a magnetic quality and is a mono-sulphide, and it requires bi-sulphide to make it valuable.

APPENDIX.

BIOGRAPHICAL SKETCH OF LIEUTENANT-COLONEL JOSEPH BOUCHETTE, SURVEYOR-GENERAL FOR THE ESTABLISHMENT OF THE INTERNATIONAL BOUNDARY, UNDER THE TERMS OF THE TREATY OF GHENT, IN 1817-18; ALSO SURVEYOR-GENERAL FOR LOWER CANADA.*

ONE of the ablest topographers of the age, he was born in Canada in 1774, and was the son of Commodore Bouchette, who distinguished himself by an exploit which history has recorded and which is well known to have prevented the threatened surrender of the Canadas to the arms of America—"the taking of General Carlton (Lord Dorchester), which appeared almost certain, would have rendered their fate inevitable."

Commodore Bouchette, however, landed the commander-in-chief in safety at Quebec, after escaping the most imminent danger that menaced them in their descent of the St. Lawrence from Montreal to Quebec, the banks of the river being occupied by the enemy who were bivouacked on the shores of its narrow passes.

As early as the year 1790, Lieutenant-Colonel Bouchette was employed as a draftsman in the office of his late uncle, the Hon. Major Holland, then Surveyor-General of British North America, and subsequently of Lower Canada, after the division of the Province of Quebec.

In 1791 he was tempted to follow the profession of his father, and in consequence entered the provincial navy, and sailed on the great lakes in Upper Canada till 1796. In the year 1794, at a very early period of his life, he succeeded, through the most vigorous exertions in raising and saving His Majesty's war vessel *Onondaga* (the Commodore's ship), carrying 14 guns, which had been cast away in York (now Toronto) harbour, and totally abandoned as lost; and taking the command, he sailed with her to Niagara, where he was received amidst the cheers of the garrison and others assembled on the shores to greet the arrival of the rescued vessel.

This service elicited the unqualified approbation of Lord Dorchester, and "young Bouchette" was promoted, on the 12th May, 1794, to the rank of Second-Lieutenant in the provincial navy.

He continued in the command of an armed vessel until 1796 during which period he made surveys of the most important harbours on

*From "Sketches of Celebrated Canadians," by Henry J. Morgan, and "Portraits of British Americans" by W. Notman, with Biographical Sketches edited by Fennings Taylor.

Lake Ontario, including the harbour of York, previous to that place being established as a military post and town in 1793.

The provincial navy was partially reduced in 1796 and it was Lieutenant's Bouchette's lot as junior officer (then commanding an armed vessel) to be included in the reduction. Owing, however, to the illness of officers who remained in command, he continued on duty for several months afterwards, successively commanding the vessels of those officers who were victims to the fever and ague, so generally prevalent. His activity meanwhile had not been altogether unnoticed, for he immediately obtained an unsolicited lieutenancy in the Battalion of of Royal Canadian Volunteers; and having raised his quota of men continued in that provincial corps until its reduction in 1802.

Being known to possess some nautical knowledge, he was selected in 1797 to command an armed row-galley, with a detachment of 30 men of his regiment, and four artillery-men, to cruise between Quebec and Montreal, in order to detect certain treasonable practices, which led to the execution of Colonel McLean, an American, at the former place. This service afforded Colonel Bouchette an opportunity of conveying much valuable information to the Government, relative to the soundings, etc., of the harbour of Montreal and several other sections of the St. Lawrence.

In 1800 he was the officer chosen by the order of His Royal Highness the late Duke of Kent, then commander of His Majesty's forces in North America, to repair to Halifax with a detachment of his regiment to acquire a more uniform system of military tactics, and subsequently conveying the same to his own regiment, which he effected to the entire satisfaction of the commander in-chief in Canada, by whom he was appointed Adjutant of the regiment.

By this time Major Holland, the companion-in-arms of the immortal Wolfe, had become, through age and infirmity, in some measure inadequate to the duties of his laborious office of Surveyor General, and Lieutenant Bouchette was in consequence attached to his department. After Major Holland's death in 1803, he was appointed deputy Surveyor-General, and in the following year received His Majesty's commission of Surveyor-General of Lower Canada and thus became the successor of his venerable uncle.

During the American war of 1812, he was actively employed in the campaign in conveying important despatches from headquarters to Major-General Sir Roger Sheaffe, commanding in Upper Canada, with confidential instructions to report on the general defensive state of the frontier, whether possessing any interesting posts and at the same time to reconnoitre and ascertain the position and strength of the enemy as he proceeded. For this service he received high commendation and his views of the defenceless state of York, now Toronto, and of the manner in which it would be taken by the enemy proved but too prophetic.

In November 1813, at a very critical juncture, he was ordered to repair to Lachine whither it had been found expedient to assemble a considerable force, and, on the 9th, that place became the headquar-

iers. He accompanied the commander of the forces to Coteau-du-Lac, where he received important reconnoitering instructions. The American generals, Hampton and Wilkinson, were at this period concerting a junction of their respective armies; the one marching into the Province by the Chateauquay country, whilst the other descended the St. Lawrence. Their project was frustrated and ended in a repulse and precipitate retreat within the limits of their own territory.

Colonel Bouchette had, however, previously followed up closely his instructions, and did not return to Lachine until he had ascertained the strength and position of the enemy at the cross-roads, some miles above McMartin's mills on the Riviere aux Raisins, and, under cover of the night, proceeding in a canoe with two Indians to the mouth of that river, crossed over to the south side of Lake St. Francis, near the Salmon river, to watch the movements of the enemy, then in full retreat; being uncertain, however, whether they meant to proceed further down the St. Lawrence (although about entering Salmon River), he immediately went down the Beauharnois channel, ascertained the condition and situation of the gun-boats, and, having put the forces on that line of military communication on their guard, he repaired to headquarters to submit his report.

In the month of August 1814, the project he had long conceived of publishing a topographical and geographical exhibit and description of Canada, being matured, notwithstanding the various other objects, of a military character, he had been called upon to attend to, he sailed from Canada to England, on board the man of war *Ajax*, for the purpose of personally superintending the publication of his work.

The colonial patronage this work received from the governor-in-chief and provincial legislature paved the way to the distinguished countenance and auspices under which it was afterwards produced to the world.

Colonel Bouchette, whilst in England, was nominated Surveyor-General, under the several articles of the Treaty of Ghent, for establishing the boundary between His Majesty's possessions in America and the United States. After his appointment, he prepared, at the instance of the Commissioners and the agent under that treaty, a project of operations for the year 1817, which he submitted to the Board at Boston.

In the spring of that year he commenced his field operations; and, after erecting a monument, in conjunction with the American surveyor, at the source of the River St. Croix, from whence the land boundary departs, he proceeded in the establishment of the due north line from that point, dividing New Brunswick from the State of Maine, to the highlands, continuing, however, the exploration line to the extent of one hundred miles in the wilderness, making numerous exploratory surveys of the various rivers intersected in his progress, and sketching the face of the country, frequently from the summit of the loftiest trees, to the imminent peril of his life.

By these arduous means he ascertained the position of the several ridges of highlands, stretching westward from the exploring line, and was enabled to judge, from their continuity and elevation, which ridge was most likely to become the boundary between both territories, in virtue of the fifth article of the Treaty of Ghent.

The result of his labors during the summer of 1817 was conveyed to the Board of Commissioners in extensive and explanatory plans, sections and reports, for which he received the commendation of the Board, and upon which the strongest arguments of His Majesty's agent were chiefly grounded, in claiming the whole extent of country north of Mars Hill ridge of highlands, which is that pointed out by Colonel Bouchette as the legitimate boundary between that part of the British possessions and the territory of the United States. And, although the Ashburton Treaty of 1842 afterwards yielded to the pretensions of the United States to a boundary much further north, and coming within a few miles of the St. Lawrence, it is now generally admitted that the line of boundary pointed out by Colonel Bouchette was that upon which the British negotiator should have insisted.

The ensuing season he was proceeding to the establishment of the geographical boundary on the 45th parallel of north latitude when he was taken dangerously ill at Montreal, on his return from Burlington, where he had met the Board, and received its encomiums for his field services of 1817; and, from the continuance of his illness during part of the summer, the service was performed by Mr. Tierks, as His Britannic Majesty's astronomer.

In 1827, with a view of ascertaining the statistics of Lower Canada, he visited all parts of the Province, and, devoting himself to long and laborious researches, he deduced explanatory reports and tabular statistical statements, that met with the marked approbation of His Majesty's representative in the colony.

Availing himself of these several tours as a means of perfecting his topographical work on Lower Canada, he solicited from the seigneurs copies of the plans of their respective *fiefs* and *seigneurs*, and was enabled to compile maps of the Province still more voluminous and correct than the former; and, desirous of rendering the information thus acquired as generally useful as possible, not only to the Government, but to the public in the mother country and the colony, he repaired to England in 1830, under the formal sanction and support of the Provincial Legislature and the approbation of the Executive Government, to superintend the publication of a new work on the topography, geography and statistics of Lower Canada, which grew out of the materials studiously collected during the previous fifteen years, with a view to the accomplishment of that object.

The works published by Colonel Bouchette are as follows:

1815.—Topographical maps of Lower Canada in two sections. First, District of Quebec, Three Rivers and Gaspé. Second, the District of Montreal. Geographical map of British America and of the United States. These maps, which were published on a very

large scale, were accompanied by a topographical description of Lower Canada. They were, moreover, published simultaneously in English and French.

1831.—British Dominions in North America, 2 vols. 4to.; elegantly printed and illustrated with vignettes, views and plans. Topographical Dictionary of Lower Canada, 1 vol. 4to. Topographical map of the District of Quebec and Three Rivers. Topographical map of the District of Montreal. Geographical map of British America and of the Northern, Western, and Central States of America. This map, though published by the subject of this sketch, was, it is said, compiled by his eldest son.

Colonel Bouchette died at Montreal on the 9th April, 1841, and was buried in the Church of Notre Dame in that city. We cannot, in concluding this memoir, do better than to quote the following passage, taken from one of the many obituary notices of his death, which appeared in the public journals of the time:

"For sentiments of loyalty to his sovereign, and he honestly and faithfully served not less than four of them; for his veneration and attachment to constitutional government, and for the perpetuation of the connection of his native Canada with Great Britain, the late Surveyor-General was also conspicuously distinguished. With such qualities both of head and heart—and we regret that we cannot, on the present occasion, do them greater justice—the memory of Colonel Bouchette will be long cherished by his surviving friends, and his public labours reflect honour and credit upon his native country."

PAPERS USED AT THE APRIL, 1895, SESSION OF THE BOARD OF EXAMINERS.

BOARD OF EXAMINERS' RECORDS

BETWEEN JULY, 1892, AND FEBRUARY, 1895.

PRELIMINARY CANDIDATES.

NAME.	ADDRESS.	DATE OF CERTIFICATE.
Abrey, George Spencer	Toronto Junction	12th November, 1892.
Code, Abram Silas	Glencoe	" " "
Hopkins, Marshall Willard	Stony Creek	" " "
Bolton, Ellsworth Doan	Listowel	8th April, 1893.
Richardson, Jocelyn Johnston	St. Catharines	" " "
Heaman, John Andrew	London	9th November, 1893.
Bow, James Alexander	Orillia	4th April, 1894.
Ford, William Butterton	London	" " "
Gibson, Wilbert Silas	Willowdale	" " "
Maclean, William Arthur	St. Thomas	" " "
McNaughton, Finlay Donald	Cornwall	" " "
Newman, John James	Windsor	" " "
Ward, Archeson Thomas	Toronto	" " "

(No candidates for Preliminary Examination at November, 1894, session.)

FINAL CANDIDATES.

NAME.	ADDRESS.	DATE WHEN SWORN IN.
McMullen, William Ernest	Toronto	11th November, 1892.
Deacon, Thomas Russ	North Bay	12th " "
Moore, Thomas Alexander	London South	" " "
Newman, William	Leamington	" " "
Silvester, George Ernest	Ringwood	" " "
Beatty, Herbert John	Pembroke	8th " 1893.
Harvey, Thomas Alexander	London	13th " "
Hopkins, Marshall Willard	Hamilton	" " "
McLennan, Murdoch John	Williamstown	" " "
Fairchild, Charles Court	Brantford	9th April, 1894.
Allan, John Richard	Renfrew	6th November, 1894.

PRELIMINARY.

(No candidates).

FINAL.

SUBJECT NO. 1—GEOMETRY.

Max. Marks 100, Min. Marks 50.

1. All the exterior angles of any rectilineal figure are together equal to four right angles. Prop. 32, bk. i.

2. In any right-angled triangle the square which is described upon the side subtending the right angle is equal to the sum of the squares described upon the sides which contain the right angle. Prop. 47, bk. i.

3. Trisect a right angle.

4. If a straight line be divided into two equal and also into two unequal parts, the squares of the two unequal parts are together double of the square of half the line and of the square of the line between the points of section. Prop. 9, bk. ii.

5. If from the vertex A of a right-angled triangle, BAC, AD be dropped perpendicular on the base, show that the rectangles of BC and BD, BC and CD, BD and CD are respectively equal to the squares upon AB, AC, AD.

6. If from any point without a circle two straight lines be drawn, one of which cuts the circle, and the other touches it, the rectangle contained by the whole line which cuts the circle, and the part of it without the circle shall be equal to the square of the line which touches it. Prop. 36, bk. iii.

7. The angle at the centre of a circle is double of the angle at the circumference upon the same base, that is, upon the same part of the circumference. Prop. 20, bk. iii.

8. To inscribe an equilateral and equiangular pentagon in a given circle. Prop. 11, bk. iv.

9. In a right-angled triangle if a perpendicular be drawn from the right angle to the base, the triangles on each side of it are similar to the whole triangle, and to one another. Prop. 8, bk. vi.

10. To cut a given straight line in extreme and mean ratio. Prop. 30, bk. vi.

11. To find the centre of a given circle. Prop. 1, bk. iii.

SUBJECT NO. 2—ALGEBRA.

Max. Marks 100, Min. Marks 40.

1. Find the arithmetical, geometrical, and harmonical means between 2 and $4\frac{1}{2}$.

2. Solve $\frac{7x+1}{x-1} = \frac{35}{9}$; $\frac{x+4}{x+2} = 3\frac{1}{9}$

3. (*a*). To what power is x raised by being multiplied n times by x? (*b*). Express x^a in another form.

4. Define "pure" and "affected" quadratics and give an example of each.

5. Solve $\frac{10x^2+17}{18} - \frac{12x^2+2}{11x^2-8} = \frac{5x^2-4}{9}$

6. The stones which pave a square court would just cover a rectangular area whose length is six yards longer and breadth four yards shorter than the side of the square. Find the area of the court.

7. There are two bars of metal, the first containing 14 oz. of silver and 6 oz. of tin, the second containing 8 oz. of silver and 12 oz. of tin. How much must be taken from each to form a bar of 20 oz., containing equal weights of silver and tin.

8. A train, an hour after starting, meets with an accident which detains it an hour, after which it proceeds at three-fifths of its former rate and arrives 3 hours behind time, but, had an accident happened 50 miles further on, it would have arrived $1\frac{1}{3}$ hours sooner. Find the length of the line

GROUP NO. 3—TRIGONOMETRY, PLANE AND SPHERICAL

Max. Marks 100, Min. Marks 50.

1. What is the value of the unit of circular measurement expressed in minutes? Show how this value is arrived at.

2. Write down the trigonometrical ratios of an angle and show which are reciprocals.

3. Given three sides of any plane triangle, show formulæ for angle A in terms of $\sin \frac{1}{2}A$, $\cos \frac{1}{2}A$. Prove the truth of the formulæ.

4. From an eminence of 268 feet in perpendicular height, the angle of depression of the top of a steeple which stood on the same horizontal plane, was found to be 40° 3′, and of the bottom, 56° 18′. What was the height of the steeple? Illustrate your solution by a diagram.

5. Find area of a triangle, two of whose sides are 80 and 90 feet and the contained angle = 28° 57′ 18″.

6. State and prove Napier's Rules of Circular Parts.

7. In any spherical triangle the sines of the angle are proportionate to the sine of the opposite side. State as a formulæ and prove the truth of the expression.

8. State and prove Napier's Analogies.

9. Given $a = 68° 20' 25''$, $b = 52° 18' 15''$, $C = 117° 12' 20''$. Find c, A, B.

GROUP NO. 4—MENSURATION OF SUPERFICIES AND LAYING OUT AND DIVIDING LAND.

Max. Marks 150, Min. Marks 75.

1. Explain the method and give the formulæ for finding the areas of a triangle, a circle, and a regular polygon.

Find the areas of the following:

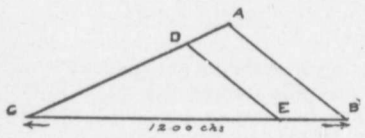
Triangle, 2 sides being 24 yds, 17.6 yds., included angle 30°.

Triangle, equilateral, perimiter = 125 ft. Give area in sq. yds.

Find the length of the minute hand of a clock, the point of which moves over an arc of 5 in. in $3\frac{1}{4}$ minutes.

2 Define the terms—Latitude, Departure, Course, Distance.

How are areas calculated by Latitude and Departure.



3. Describe and explain the uses of a traverse table.

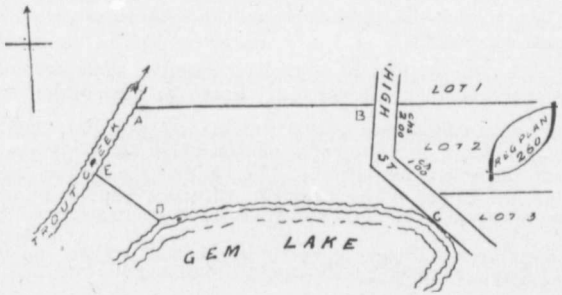
4. Area of A B C = 12.96^{ac} Cut off 3.24^{ac} from E by a line // with A B. Find CE.

SUBJECT NO. 5—DESCRIPTIONS.

Max. Marks 100, Min. Marks 75.

1. If, in a description, a distance is given "more or less to a post," and the position of the post cannot be found, what would govern for such distance?

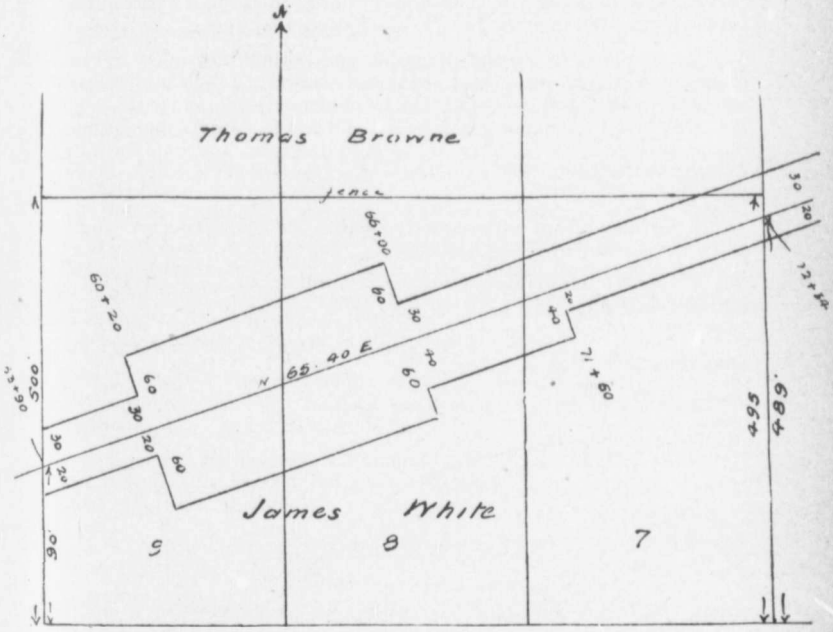
2. Define a boundary to the shore of a lake, and to the shore of a mill-pond.



3. Write a description of property A B C D in the above diagram, giving imaginary bearings and distances.

4. Describe, by metes and bounds, the north-east two acres of a 200 acre lot, in a double-front concession in a township in which the concession lines run due north and south and the side lines due east and west.

5. Define the terms (*a*) "Party wall," (*b*) "Centre line," with reference to right of way of a railway.



6. Calculate area in acres and describe lands required from James White.

GROUP No. 6—USE AND ADJUSTMENT OF INSTRUMENTS FOR SURVEYING AND LEVELLING.

Max. Marks 100, Min. Marks 70.

(Vivâ voce.)

Subject No. 7—The Laying Out of Curves.

Max. Marks 50, Min. Marks 20.

1. Show, by lettered diagram, and explain the meaning of the following terms: angle of intersection, degree of curve, length of curve, radius of curve, deflection angle, simple, reversed, and compound curves.

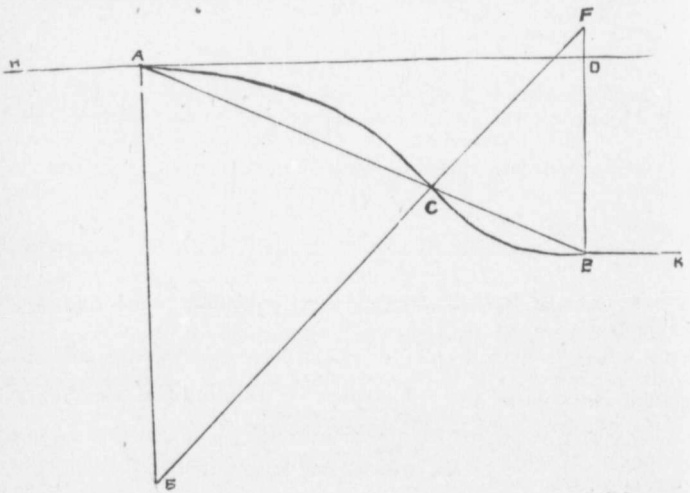
2. Show, by lettered diagram, and prove, (*a*) That the angle of intersection is equal to the central angle subtended by the chord joining the tangent points; (*b*) That the deflection angle is equal to half of the degree of curve; (*c*) That the reversing point of a reverse curve between parallel tangents is in the line joining the tangent points.

3. (*a*) Show, by lettered diagram, and explain how to lay out on the ground, simple, compound and reverse curves. (*b*) If a 2° curve has been located and it is desirable to change the curve so that the E C may be on a tangent parallel to, and a few feet from, the former, but preserving the B C; shew by lettered diagram, and explain how to find the degree of the new curve—the angle of intersection being known.

4. Given angle of intersection, $I = 16° .. 52'$ and deflection angle $D = 1° .. 20'$; find the length of curve.

5. Given angle of intersection, $I = 28°$, and deflection angle, $D = 1°$; find the tangent.

6. Show, by lettered diagram, how to lay out a curve by tangent and chord deflections.



7. Given the perpendicular distance between two parallel tangents BD$=b=8$ feet, the distance between the two tangent points A B$=a=160$ feet and the first radius, EC$=$R$=900$ feet; of a reversed curve uniting the tangents H A and B K; find the chord A C$=a'$ and radius C F$=$R$'$.

Subject No. 8—Practical Astronomy.

Max. Marks 150, Min. Marks 75.

1. Show, by lettered diagram. and explain the meaning of the following terms: azimuth, hour angle, prime vertical, celestial longitude, true horizon, sensible horizon, dip, parallax, ecliptic, right ascension, declination, equation of time.

2. Show, by diagram, the relative positions of Ursa Major and Ursa Minor with Polaris on its upper transit; also show, by lettered diagram, and explain how to obtain the azimuth of Polaris on its eastern elongation and draw a meridian line.

3. In latitude 24°..30′..00″ N., in the forenoon, the true altitude of the sun's center was 33°..20′..00″ when its declination was 6°..47′..50″ S. What was the apparent time of observation?

4. When in latitude 48°..51′ N, the sun's declination is 18°..30′ N., and its altitude 52°..35′; what is its azimuth from the north?

5. At a given place in south latitude, when the sun's declination is 15°..8′..10″ S., and its true altitude 39°..5′..28″, at 2h..56m..42.7 sec. p.m.; find the latitude of the place.

6. Show, by lettered diagram, and explain the three systems for finding the position of a body on the celestial sphere by spherical coordinates.

7. Show, by lettered diagram, and explain the method of finding the latitude of a place when given two altitudes of the sun and the interval of time between the observations.

Subject No. 9—Survey Act.

Max. Marks 150, Min. Marks 90.

1. Give definition of a "proof-line;" and when would you use it?

2. State what steps should be taken to have monuments planted on governing lines of townships.

3. In cases where concession lines and side road lines or parts of same were not run in original survey, or have been obliterated, what steps are necessary to have such lines surveyed and permanently marked on the ground?

4. In cases where concession lines were not run in the original survey, or have been obliterated, how would you establish the depths of adjacent concessions?

5 Describe the different methods of running a line between lots in a single front concession.

6. What is a double-front concession? and how are posts to be replaced where lost, and lines between lots therein to be run?

7. Describe the sectional system of survey and the different methods of running lot lines in that system.

8. How would you establish a side-line between lots in townships where the side-lines only were run in original survey?

9. In a single-front concession, lots 37 to 40, adjoining west boundary, are broken in front by a lake and no posts were planted in the original survey to regulate the widths of these lots. How would you run the side-lines of these lots?

10. In what case would you run a side-line between lots on the astronomical course given on the original plan and field-notes?

GROUP NO. 10—MINING AND OTHER ACTS.

Max. Marks 100, Min. Marks 35.

RE MINING ACT.

1. Define Mining Location.

(*a*) When a mining location in the unsurveyed territory within the districts of Algoma, Thunder Bay and Rainy River, and that part of the district of Nipissing which lies North of the French River, Lake Nipissing, and the River Mattawa, borders upon a lake or river, what reservation is made by the Crown?

(*b*) Which is the front of the location?

(*c*) What direction and length shall its other outlines be?

(*d*) What shall be its area?

(*e*) In what cases may the Commissoner of Crown Lands direct that the reservation referred to in (*a*) shall not be made?

RE REGISTRY ACT.

2. When any land is surveyed and subdivided for the purpose of being sold or conveyed in lots, by reference to a plan which has not been already registered—

(*a*) Who shall file with the registrar the plan?

(*b*) In what time?

(*c*) On what scale shall the plan be?

(*d*) How shall the plan be mounted?

(*e*) Who shall sign the plan, and how shall it be certified? Give certificate.

RE DITCHES AND WATERCOURSES ACT.

3. Give limit of work that may be carried out under this Act and what lands are liable for the construction of a ditch under this Act.

4. Under this Act how do you proceed to enforce maintenance? Who may ask for such maintenance?

5. After the Clerk receives the requisition, up to the time of his notifying the interested parties of the filing of the Award, state the duties of both Engineer and Clerk.

RE DRAINAGE ACT.

6 Under what heads shall the Engineer, in his report, make his assessment? Distinguish between the heads, and give form of schedule for assessment.

7. Define Construction, Maintenance, Sufficient Outlet, Initiating Municipality, Owner.

8. Write out short report for drainage work, having due regard to the arrangement of the various heads of which the report is made up.

9. What shall the Engineer's estimate of the work include?

SUBJECT NO. 11—LEVELLING.

Max. Marks 50, Min. Marks 35.

1. Define, Level line, Horizontal line, Levelling. Is it usual in ordinary levelling to make corrections for curvature and refraction? Give reasons,

2. Name some of the different methods of levelling with the instruments used in each case. For what purpose is each particularly adapted?

3. Describe the "Dumpy level" and show how to adjust it.

4. How would you determine whether the rod is being held vertical or not by the rodman?

5. Why is it best to take foresights and backsights of equal length?

6. Give the method of procedure in levelling a certain distance for sections, with form of Field Book and method of keeping notes.

GROUP NO. 12—PRINCIPLES OF EVIDENCE AND DRAWING UP OF AFFIDAVITS.

Max. Marks 80, Min. Marks 35.

1. What is evidence?

2. State what you consider would be good evidence.

3. Distinguish between hearsay, traditional, circumstantial and direct evidence.

4. Under what circumstances would you attach value to a person's evidence for or against his own interest?

5. Prepare a good affidavit to establish an original corner over 80 years old, giving the several steps of proof?

6. Prepare an improper affidavit, pointing out the defects therein.

Group No. 13.

(Vivá voce, and specimens)

Group No. 14—Geology and Mineralogy.

Max. Marks 75, Min. Marks 25.

1. Explain, by diagram or otherwise, the following terms. conformable, unconformable, fault, fold, strike, dip, vein, anticlinal, synclinal, outcrop, country rock and gangue.

2. Name three of the principal geological agencies engaged in the shaping of the earth's surface and describe the principal points of each.

3. In which rocks are the most valuable ores found in Ontario?

4. Into what three great classes are rocks divided? Give a short description of each class.

5. Describe the formation of coal-beds. Where are the principal coal-fields in the Dominion of Canada situate? Name the classes of coal found in these fields. What are the names of the different varieties of coal?

6. Name and describe two of the great limestone formations of Ontario. Give the relative position of each as to other formations.

7. How are the various mountain ranges supposed to have been formed on the earth?

8. Describe two causes in the formation of valleys.

9. Explain the economic values of the rocks in the following formations: Hudson river, Salina and Carboniferous.

10. Name, and fully describe, six characters by which minerals are distinguished from one another, with example of each.

11. How may carbonates and silicates be distinguished by the use of the blow-pipe?

12. Make a diagram showing the structure of oxidizing and reducing flames and state which they are.

13. Name the minerals composing the scale of hardness, and explain how the scale is used.

14. Explain the commercial uses of the following minerals and give the general composition of 6 of them: graphite, hematite, halite, calcite, malachite, gypsum, barite, apatite, limonite, asbestos, anthracite, muscovite, dolomite, galena, cerussite.

15. Give an account of petroleum; how it originated: under what condition it now exists and with what it is associated. How is petroleum obtained?

16. To which classes of minerals do the most abundant ores of iron belong, or name the minerals.

17. Distinguish the following: (*a*) granite from gneiss, (*b*) galena from graphite, (*c*) native gold from copper pyrites, (*d*) granite from pegmatite, (*e*) common limestone from marble

18. Give a method of determining each of the following metals in the ore: iron, copper, lead, sulphur, mercury, aluminium.

19. Explain the differences between quick-lime, hydraulic lime, and Portland cement.

FORMS OF CERTIFICATE.

[FORM A] CERTIFICATE OF SERVICE (Ordinary Term).

I, ..., a Land Surveyor
(Name of Surveyor.)
for Ontario, duly admitted and practising therein as such, hereby certify that
..... has served regularly and faithfully as an
(Name of pupil.)
apprentice with me, under written articles, duly executed before two witnesses, and filed with the Secretary of the Board of Examiners, for the term of three successive years, being from the ..... day of .....
189.., to the ..... day of ....., 189..

Dated at ..... Ontario,
this ..... day of ....., 189.. .....
Ontario Land Surveyor.

[FORM B] CERTIFICATE OF SERVICE (Shortened Term).

I, ..., a practising Land Surveyor for
(Name of Surveyor.)
Ontario, hereby certify that ....., a graduate
(Name of pupil.)
of ....., has served as an apprentice with me, under articles duly filed, as required by section 17 of chapter 152, Revised Statutes of Ontario (1887), during twelve successive months of actual practice, being from the ..... day of ....., 189.., to the ..... day of ....., 189..

Dated at ....., Ontario,
this ..... day of ....., 189.. .....
Ontario Land Surveyor.

NEW BY-LAWS.

By-law No. 40. "The following Surveyors, having duly registered, and having proved to the satisfaction of the Council that they had been respectively in actual practice as duly authorized and qualified Land Surveyors for Ontario for a period of not less than 35 years prior to July 1st, 1892, are hereby placed on the list of Registered Surveyors for Ontario, and are exempt from the payment of further dues under the authority of sub-section 4 of section 10, chapter 34, Ontario Statutes, 1892, viz.: Tom S. Rubidge and James A. Gibson." Passed by the Council of Management 6th November, 1894. Ratified by the Association at annual meeting, 27th February, 1895.

By-law No. 41. "To provide for the exemption of certain surveyors from the operations of the 'Act to Incorporate the Association of Ontario Land Surveyors.'

"Whereas, under section 10, sub-section 4, the Association may exempt from the operations of the Act any Surveyor who has been in the actual practice of his profession for a period of thirty-five years or more as a duly qualified Surveyor; and whereas Charles J. Wheelock, Thomas Weatherald, Michael Deane, John Smith Brown, and William Edward Yarnold have represented to the Council that they had been in practice as aforesaid for a period of not less than thirty-five years previous to the date of the assenting to of the said Act, viz., 14th April, 1892; be it resolved that the said Surveyors be and are hereby exempted under the said Act." Passed by the Council of Management, 4th April, 1895.

By-law No. 42. "To provide for the exemption of Alexander Davidson from the operations of the 'Act to Incorporate the Association of Ontario Land Surveyors.'

"Whereas, under section 10, sub-section 4, of the said Act, the Association may exempt from the operations of the Act any Surveyor who has been in the actual practice of his profession for a period of thirty-five years or more as a duly qualified Surveyor; and whereas Alexander Davidson has requested that he be exempted as aforesaid in consequence of physical disability; be it resolved that the said Alexander Davidson be and is hereby exempted under said Act." Passed by the Council of Management, 4th April, 1895.

OBITUARY.

William Robinson.

We have this year to record the decease of one of the oldest of our members. Mr. William Robinson, O.L.S., died at his residence in London, on October 11th, 1894, after a long life of usefulness He was born at New Ross, County Wexford, Ireland, on March 27th, 1812. From his brother he got his first idea of land surveying. In 1836 Mr. Robinson came to Canada with his father, mother, three brothers and one sister and located at Burford, but in the following spring he went to Hamilton, where he found employment as a carpenter, of which calling he had previously acquired theoretical and some practical knowledge. From Hamilton he went to Brantford, and, after eighteen months' further experience, he proceeded, in the spring of 1839, to London, where he spent two years, and located in Toronto at the end of that period. Here, while in the service of the late Thomas Young, architect of King's College, also City Engineer and Drawing Master for the College, Mr. Robinson took a course of private study in land surveying and architecture. After leaving Mr. Young he purposed going to New York, but, having received a good offer of employment from Mr. Ritchie, one of the most prominent builders of the time in Toronto, he availed himself of it and remained for two years in Mr. Ritchie's employ, adding to his other duties that of instructing the workmen in geometrical drawing and the various practical problems connected with their work.

At the end of this time he again resumed the study of land surveying, receiving his commission at Montreal in May, 1846, with the Hon. William Henry Boulton and Hon. W. Robinson as his sureties. Returning to Toronto, the following winter was spent by him in teaching geometrical drawing to the workmen, and in the spring of that year he accepted the position of Superintendent of Buildings.

In April, 1849, he commenced a survey of the Toronto and Owen Sound Road diagonally through the Townships of Melancthon, Artemesia, Hill, etc., and completed the work (embracing about 200,000 acres) by the middle of December.

After his return he, in company with Mr. C. Rankin, conducted a business in Toronto for two years, when Mr. Rankin removed to Owen Sound, and the business was carried on by Mr. Robinson until 1852. Owing to ill health, he then returned to his father's at Burford, but shortly afterwards entered a partnership with Mr. W. B. Leather, an English engineer, and together they conducted a prac-

tice in London (Canada) for four years, at the end of which time Mr. Robinson again opened an office for himself.

In May, 1857, he was appointed City Engineer for London and held the office for more than 21 years, until the completion of the water-works, in 1878, when he resigned, with the request that his then partner, Mr. T. H. Tracey, be appointed to the position. He then paid visits to Europe and New York and returned to London, where he resided up to the time of his death. From his estate of $30,000, he bequeathed liberal legacies to all the benevolent societies in the city in which so many years of his life had been spent. He was a gentleman of rare skill and attainments, and was universally respected.

The famous water-works of the Forest City, constructed from plans prepared by himself, will be a standing monument to his memory.

THOMAS WILLIAM WALSH.

Since the date of our annual meeting the grim reaper has claimed another member of the Association in the person of Thomas William Walsh, who died at his residence, John street, Simcoe, on 14th March, 1895, in the 76th year of his age. His father was Francis Leigh Walsh, who held the position of Registrar of Deeds for Norfolk County from the beginning of the century up to a period little more than ten years ago. Thomas Walsh, the grandfather of Mr. T. W. Walsh, was a U. E. Loyalist, and one of the first two settlers in what is now Norfolk County. He also was a Land Surveyor, and the name has thus been prominent in the profession ever since that portion of Canada took its place in history.

Born in the Township of Charlotteville, in Norfolk, in May, 1819, the subject of this notice was a life-long resident of that county. He received his commission as a Land Surveyor on 25th April, 1842, and continued to exercise the duties of that calling for more than 52 years.

In 1858 Mr. Walsh was a candidate for political honors, but was unsuccessful, being defeated by Walker Powell, now Adjutant-General of Canada.

Since that date Mr. Walsh filled honorable municipal positions in Simcoe, and was for two years Warden of the county. In 1855 he received his appointment as County Treasurer, and up to the time of his death continued to occupy that office with efficiency. Upon the establishment of the Association of Ontario Land Surveyors Mr. Walsh became enrolled as a member, and was placed on the honorary list of exempted members on 4th April, 1894.

His widow, a son, daughter and three orphaned grandchildren survive him.

LIST OF MEMBERS.

The names of those members granted exemption by By-laws ratified by the Association are marked*.
The names of those granted exemption by By-laws passed by Council since the annual meeting are marked†

NAME. RESIDENCE, P.O. ADDRESS.

Abrey, George Brockitt.....Toronto Junction.
D.L.S., Town Engineer.

Allan, John Richard.....Renfrew.
Grad. S.P.S.

Aylsworth, Charles Fraser, Sr. ...Madoc.
D.L.S.

Aylsworth, Charles Fraser, Jr.....Madoc.

Aylsworth, John Sidney .....Selby, P. O. Box 23.
D.L.S.

Aylsworth, William Robert .....Belleville, P.O. Box 2.
D.L.S.

Baird, Alexander .....Leamington.
D.L.S.

Barrow, Ernest George.....Hamilton.
D.L.S., M.C.S.C.E.

Bazett, Edward .....Burk's Falls.
D.L.S.

Beatty, David .....Parry Sound.
D.L.S.

Beatty, Herbert John.....Pembroke.
Grad. S.P.S.

Beatty, Walter .....Delta.
D.L.S.

Bell, Andrew .....Almonte.
D.L.S.

Bell, James Anthony .....St. Thomas.
D.L.S., Co. Engineer, Elgin.

Bigger, Charles Albert .....Ottawa, 68 Daly Ave.

Bolger, Francis.....Lindsay.
D.L.S.

Bolger, Thomas Oliver.....Kingston.
D.L.S., City Engineer.

Bolton, Jesse Nunn.....Toronto, 264 Major st.
D.L.S.

Bolton, Lewis .....Listowel.
D.L.S.

NAME. RESIDENCE, P.O. ADDRESS.

Booth, Charles Edward Stuart....Kingston, 196 Colborne st.

Bowman, Clemens Dersteine.....West Montrose.

Bowman, Herbert Joseph .....Berlin.
Grad. S.P.S., Town Engineer.

Bray, Edgar..... .....Oakville.
D.L.S.

Bray, Harry Freeman .....Oakville.

Bray Samuel .....Ottawa, Dept of Ind'n Affairs.
D.L.S.

Brown, David Rose .....Cornwall.
D.L.S.

†Brown, John Smith .....Kemptville.
D.L.S.

Browne, Harry John.....Toronto, 17 Toronto st.
D.L.S., C.E.

Browne, William Albert.....Toronto, 17 Toronto st.

Burke, William Robert.....Ingersoll.
D.L.S.

Burt, Frederick Percy .....New York, N. Y.
Manager and Treasurer Eng. News Pub. Co., Tribune Building.

Butler, Matthew Joseph .....Napanee, P O Box 359
M.I.C.E., M.A.S.C.E., M.C.S.C.E., C.E.

Caddy, Cyprian Francis.....Campbellford.
D.L.S.

*Caddy, Edward C.....Cobourg.
D.L.S.

Caddy, John St. Vincent.....Ottawa, 559 King st.
D.L.S.

Cameron, Alfred John .....Peterborough.

Campbell, Archibald William.....St. Thomas.
City Engineer.

Carre, Henry.....Belleville, P.O. Box 203.
City Engineer, B.A. and C.E. (Trin. Coll., Dublin), D.L.S.

Carroll, Cyrus .....Hamilton, 6½ James st. s.
M.C.S.C.E., D.L.S.

Casgrain, Joseph Philippe Bâby...Morrisburg.
D.L.S., P.L.S. (Que.), C.E.

Cavana, Allan George.....Orillia.
D.L.S.

*Cheesman, Thomas.....Mitchell.
D.L.S.

Chipman, Willis ....Toronto, 103 Bay st.
B.A., Sc. (McGill), M.A.S.C.E., M.C.S.C.E.

Coad, Richard.....Glencoe.
D.L.S.

NAME. RESIDENCE, P.O. ADDRESS.

Cozens, Joseph ..... Sault Ste. Marie.
D.L.S.

Creswicke, Henry ..... Barrie.
D.L.S.

*Cromwell, Joseph M. O ..... Perth.
D.L.S.

†Davidson, Alexander ..... Arkona.
D.L.S.

Davidson, Walter Stanley ..... Arkona.

Davis, Allan Ross ..... Napanee.
B.A., Sc. (McGill).

Davis, John ..... Alton.

Davis, William Mahlon ..... Woodstock.
Grad. R. M. Coll.

Deacon, Thomas Russ ..... Rat Portage.
Grad. S.P.S., Town Engineer.

†Deane, Michael ..... Lindsay.
D.L.S.

Deans, William James ..... Oshawa.

DeGurse, Joseph ..... Windsor, P.O. Box 167.
Chief Eng., L.E. & D.E. R.

DeMorest, Richard Watson ..... Sudbury.

Dickson, James ..... Fenelon Falls.
D.L.S., Ins. of Crown Land Surveys.

Dobbie, Thomas William ..... Tilsonburg.
D.L.S.

Doupe, Joseph ..... Winnipeg, Man., 190 Smith st.
D.L.S., P.L.S. (Man.), C.E. (McGill).

Ellis, Henry Disney ..... Toronto, City Hall.
D.L.S., Eng. in charge of Roadways.

Esten, Henry Lionel ..... Toronto, 157 Bay st.

Evans, John Dunlop ..... Trenton.
D.L.S., Chief Eng., Cent. Ont. Ry.

Fair, John ..... Brantford.

Fairbairn, Richard Purdom ..... Toronto, 127 Major st.
Surveyor for Dept. of Pub. Works.

Fairchild, Charles Court ..... Simcoe.
Grad. S.P.S.

Farncomb, Alfred Ernest ..... London, 213 Dundas st.

Farncomb, Frederick William .... London, 213 Dundas st.

Fawcett, Thomas ..... Ottawa, Dept. of Interior.
Dom. Topographical Surveyor.

NAME. RESIDENCE, P.O. ADDRESS.

Fitton, Charles Edward.....Orillia.
D.L.S.

Fitzgerald, James William.....Peterborough, Box 333.
D.L.S.

Flater, Frederick William.....Chatham.

Foster, Frederick Lucas.....Toronto, 157 Bay st.
D.L.S.

Francis, John James.....Sarnia, P.O. Box 304.
D.L.S.

*Fraser, Charles.....Wallaceburg.
D.L.S.

Galbraith William.....Bracebridge.
D.L.S.

Gamble, Killaly.....Toronto, 193 Bloor st. e.
D.L.S., P.L.S. (Man.)

Gardiner, Edward.....St. Catharines.
D.L.S.

Gaviller, Maurice.....Collingwood, Box 773.
C.E. (McGill), D.L.S.

Gibbons, James.....Renfrew.

Gibson, Harold Holmes.....Willowdale.

*Gibson, James Alexander.....Oshawa.
D.L.S.

Gibson, Peter Silas.....Willowdale.
C.E., M.S. (Mich. Univ.), D.L.S., Engineer Tp. of York.

Graydon, Aquila Ormsby.....London.
City Engineer.

Griffin, Albert Dyke.....Woodstock, P.O. Box 612.

Hanning, Clement George.....Preston.
D.L.S., C.E., (Trin. Coll., Dublin).

Hart, Milner.....Toronto, 103 Bay st.
D.L.S.

Harvey, Thomas Alexander.....London, 1 Oxford st.

Henderson, Eder Eli.....Henderson P.O., Maine.

Henry Frederick.....London, Albion Building.

*Hermon, Royal Wilkinson.....Rednersville.
D.L.S.

Hewson, Thomas Ringwood.....Hamilton, 42 James st. n.
D.L.S.

Hobson, Joseph.....Hamilton, G. T. Ry. Office.
D.L.S., Chief Eng. G.T.R.

Hopkins, Marshall Willard.....Hamilton, 28 James st. s.
B.A., Sc. (McGill), A.M.C.S.C.E.

NAME. RESIDENCE, P.O. ADDRESS.

Howitt, Alfred.....Gourock.
D.L.S.

Hutcheon, James.....Guelph.
Grad. S.P.S.

Innes, William Livingstone.....Peterborough, 372½ Water st.
C.E. (Toronto Univ.)

James, Darrell Denman.....Toronto, 72 Victoria st.
B.A., Grad. S.P.S.

James, Silas.....Toronto, 72 Victoria st.
D.L.S.

Johnson, Robert Thornton .....Orangeville.

Jones, Charles Albert.....Petrolea.
D.L.S.

Jones, John Henry .....Sarnia.
D.L.S.

Jones, Thomas Henry.....Brantford.
City Engineer, B.A.Sc. (McGill).

*Keefer, Thomas Coltrin.....Ottawa.
D.L.S., C.E.

Kennedy, James Henry.....St. Thomas, P.O. Box 434.
C.E., (Tor. Univ.), M.C.S.C.E.

Kippax, Hargreaves .....Huron, South Dakota.
Assistant Surveyor General.

*Kirk, Joseph.....Stratford, P.O. Box 373.
D.L.S.

Kirkpatrick, George Brownly ....Toronto, Dept. of Crown Lands.
Director of Surveys, D.L.S.

Klotz, Otto Julius.....Ottawa, 437 Albert st.
C.E. (Mich. Univ.), Dom. Topographical Surveyor.

Laird, James Steward .....Essex.
D.L.S.

Laird, Robert .....Toronto, City Engineer's office.
Grad. S.P.S.

Lane, Andrew.....Sparrow's Point, Md.
Grad. S.P.S., Draughtsman Maryland Steel Co.

Lewis, John Bower.....Ottawa, Brunswick House.
D.L.S.

NAME. RESIDENCE, P.O. ADDRESS.

Lougheed, Aaron ..... Port Arthur.
D.L.S.

*Low, Nathaniel E..... Wiarton.
D.L.S.

Lumsden, Hugh David..... Toronto, 63 Homewood ave.
D.L.S., M.I.C.E., M.C.S.C.E.

*Lynch-Staunton, Francis H..... Hamilton.
D.L.S.

Macdougall, Allan Hay..... Port Arthur.
D.L.S.

MacKenzie, William Lyon ..... Galt.

MacNabb, John Chisholm..... Chatham.
C.E.

MacPherson, Duncan..... Montreal.
Eng. Dept. C.P.Ry.

McAree, John ..... Toronto.
Dom. Topographical Surveyor, B.A.Sc., Toronto.

*McCallum, James ..... Fort Frances.
D.L.S.

McCulloch, Andrew Lake..... Galt.
Grad. S.P.S., A.M.C.S.C.E.

McDonell, Augustine..... Chatham, 4 & 5 Ebert's Block.
D.L.S.

McDowall, Robert ..... Owen Sound.
Town Engineer, Grad. S.P.S.

McEvoy, Henry Robinson..... St. Mary's.
D.L.S.

McFarlen, George Walter..... Toronto, Court House.
Grad. S.P.S.

McGeorge, William Graham..... Chatham, 5 Sandwich st. w.
D.L.S.

McGrandle, Hugh ..... Huntsville.

McKay, Owen..... Windsor, P.O. Box 167.
Grad. S.P.S.

McKenna, John Joseph..... Dublin.

McLatchie, John..... Ottawa, 28 Stanley ave.
D.L.S., P.L.S. (Que. & Man.)

McLean, James Keachie..... Elora.
D.L.S.

NAME. RESIDENCE, P.O. ADDRESS.

McLennan, Murdoch John ..... Williamstown.
B.A., Sc. (McGill).

McLennan, Roderick ..... Toronto, 115 Avenue rd
D.L.S.

McMullen, William Ernest ..... Toronto, 7 Murray st.

McNab, John Duncan ..... Owen Sound.

McPhillips, George ..... Windsor, P.O. Box 556.
D.L.S.

Malcolm, Sherman .... Blenheim.
D.L.S.

Manigault, William Mazyck ..... Strathroy, P.O. Box 300.
D.L.S.

Marshall, James ..... Holyrood.
D.L.S.

Miles, Charles Falconer ..... Toronto, 343 Huron st.
D.L.S.

Moore, John Mackenzie ..... London, Albion Building.

Moore, John Harrison ..... Smith's Falls.

Moore, Thomas Alexander .... London South.

Morris, James Lewis ..... Pembroke.
D.L.S., C.E., (Toronto Univ.)

Mountain, George Alphonse ..... Ottawa.
M.C.S.C.E., D.L.S., P.L.S., (Que.)

Munro, John Vicar ..... London, Albion Building.

Murdoch, William ..... Rat Portage.
D.L.S.

Murphy, Charles Joseph ..... Toronto, 157 Bay st.

Newman, William ..... Windsor, 57 Sandwich st.
Grad. S.P.S.

Niven, Alexander ..... Haliburton.
D.L.S.

Ogilvie, John Henry ..... West Superior, Wis., [Tower av. 1810½
D.L.S.

Ogilvie, William ..... Juneau, Alaska, U.S.
D.L.S.

NAME. RESIDENCE, P.O. ADDRESS.

O'Hara, Walter Francis .....Chatham.
D.L.S.

Paterson, James Allison ....Toronto, 23 Adelaide st. e.
C.E.

Patten, Thaddeus James .....Little Current.

Pedder, James Robert .....Doon.
Grad. S.P.S.

Pinhey, Charles Herbert .....Coteau Landing, P.Q.
Grad. S.P.S., A.M.C.S.C.E.

Proudfoot, Hume Blake.....Toronto, 33 Tranby ave.
D.L.S., C.E. (Toronto Univ.)

Purvis, Frank .....Eganville.
D.L.S.

Rainboth, Edward J.....Ottawa.
D.L.S.

Rainboth, George Charles.....Aylmer, Que.
D.L.S., P.L.S. Que.

Reilly, William Robinson..... Regina, Assa.
D.L.S., P.L.S. Man.

Ritchie, Nelson Thomas ....Kincardine.

Roberts, Vaughan Maurice .....New York, N.Y., 137 Broadway.

Robertson, James .....Glencoe.
Grad. S.P.S.

Roger, John.....Mitchell.

Rombough, W. R .....Durham.
D.L.S.

Rorke, Louis Valentine.....Sudbury.

Ross, George .....Welland.
B.A., Sc. (McGill).

*Rubidge, Tom S.....Cornwall.
D.L.S., Asst. Eng. Dept. Rys. and Canals.

Russell, Alexander Lord .....Port Arthur.
D.L.S.

Sankey, Villiers .....Toronto, City Hall.
D.L.S., City Surveyor.

Saunders, Bryce Johnston.....Brockville, P.O. Box 114.
Town Engineer, B.A., Sc. (McGill), D.L.S.

NAME. RESIDENCE, P.O. ADDRESS.

Scane, Thomas ..... Ridgetown.
D.L.S.

*Schofield, Milton C. ..... Guelph.
D.L.S.

Seager, Edmund ..... Fort Frances.
D.L.S.

Selby, Henry Walter ..... Toronto Junction.
D.L.S.

Sewell, Henry DeQuincey ..... Port Arthur.
D.L.S., A.M.I.C.E.

Sing, Josiah Gershom ..... Meaford.
D.L.S.

Smith, George ..... Woodville.

Smith, Henry ..... Toronto, Crown Lands Dept.
Supt. Colonization Roads, D.L.S., M.C.S.C.E.

Speight, Thomas Bailey ..... Toronto, Yonge St. Arcade.
D.L.S.

Steele, Edward Charles ..... Goderich.

Stewart, Elihu ..... Collingwood.
D.L.S.

Stewart, John ..... Montreal.
D.L.S.

Stewart, Walter Edgar ..... Aylmer.

*Strange, Henry ..... Rockwood.
D.L.S., C.E.

Tiernan, Joseph Martin ..... Tilbury Centre.

Traynor, Isaac ..... Dundalk.
D.L.S.

Turnbull, Thomas ..... Winnipeg, Man., C.P.R. Office.
D.L.S., C.E., (Toronto Univ.

Tyrrell, James Williams ..... Hamilton, 42 James st. n.
Co. Eng. for Wentworth, C.E., D.L.S.

Unwin, Charles ..... Toronto, 157 Bay st.
D.L.S.

Ure, Frederick John ..... Woodstock.
C.E.

NAME. RESIDENCE, P.O. ADDRESS.

VanBuskirk, William Fraser ....Stratford.
Grad. R.M. Coll.

VanNostrand, Arthur J.....Toronto, Yonge St Arcade.
D.L.S.

Wadsworth, Vernon Bayley.....Toronto, 103 Bay st.
D.L.S.

Walker, Alfred Paverley .....Toronto, C.P.Ry, Eng. Office.
A.M.C.S.C.E.

Wallace, Charles Hugh.....Hamilton.

Warren, James .....Walkerton.
Depy. Registrar County of Bruce, A.M.C.S.C.E.

Watson, John McCormack .....Orillia, P.O. Box 224.

†Weatherald, Thomas .....Goderich, P.O. Box 273.
D.L.S., C.E.

†Wheelock, Charles J.....Orangeville.
D.L.S.

Wheelock, Charles Richard.....Orangeville.
Treasurer County of Dufferin.

Whitson, James Francis .....Toronto, Crown Lands Dept.

Wicksteed, Henry King .....Cobourg.
D.L.S., C.E.

Wiggins, Thomas Henry .....Brockville.
Grad. S.P.S.

Wilde, John Absalom.....Sault Ste. Marie.

Wilkie, Edward Thomson.....Carleton Place.
D.L.S.

Wilkins, Frederick William.....Ottawa, Dept. of Interior.
Dom. Topographical Surveyor.

Williams, David ....Kingston.
D.L.S.

Winter, Henry.....Thornyhurst.
D.L.S., C.E.

*Wood, Henry O.....Billing's Bridge.
D.L.S.

Yarnold, William Edward.....Port Perry, P.O. Box 44.
D.L.S.

REGISTERED AND WITHDRAWN.

The names of those who have become "Associates" under By-law No. 39 are marked *

NAME.	RESIDENCE, P.O. ADDRESS.
Apsey, John Fletcher	Baltimore, Md., 2125 N. Chas. st.
	Grad. S.P.S.
Blake, Frank Lever	Toronto, Meteorological Office.
	D.L.S.
Bowman, Franklin Meyer	Berlin.
	Grad. S.P.S.
Burnet, Hugh	Victoria, B.C.
	P.L.S. (B.C.).
Cambie, Henry John	Vancouver, B.C.
	P.L.S. (B.C.).
Coleman, Richard Herbert	Toronto, 204 King st. e.
Drewry, William Stewart	Ottawa, Dept. of Interior.
Ducker, William A	Winnipeg, M., 314 McWilliam st.
	D.L.S.
Edwards, George	Thurso, Que.
Fowlie, Albert	Orillia.
	D.L.S.
Green, Thomas Daniel	Ottawa, Dept. of Indian Affairs.
Galbraith, John	Toronto, Sch. of Prac. Science.
	Prof. Engineering.
Gibson, George	St. Catharines.
	D.L.S.
Haskins, William	Hamilton, 45 Wellington st. s.
	M.I.C.E., D.L.S.
*Harris, John Walter	Winnipeg, Assm't. Com. Dept.
	P.L.S. (Man)., D.L.S.
Hermon, Ernest Bolton	Vancouver, B.C.
	P.L.S. (B.C. , D.L.S.

NAME. RESIDENCE, P.O. ADDRESS.

Irwin, James M.....Peterborough.
D.L.S.

Jephson, Richard Jermy .....Calgary, Alta.
P.L.S. (B.C.) D.L.S.

Kains, Tom..... .....Victoria, B.C.
Surveyor-General, B.C.

Lendrum, Robt. Watt.....South Edmonton, Alta.
D.L.S.

Livingstone, Thomas Chisholm ....Winnipeg, Man.
D.L.S.

MacLeod, Henry Augustus F ....Ottawa, 340 Cooper st.
C.E., D.L.S.

MacMillan, James A.....Calgary, Alta.
P.L.S. (B.C.).

*McFadden, Moses .....Neepawa, Man.
D.L.S.

Magrath, Charles Alexander.....Lethbridge, Alta.
B.A. Sc. (McGill), D.L.S.

Morris, Alfred Edmund.....Perth.

Pearce, William.....Calgary, Alta.
Dom. Insp. of Mines.

Ponton, Archibald William.... ..Regina, Assa.
D.L.S.

Pope, Robert Tyndall.....Ireland.
C.E., D.L.S.

Reid, James Hales.....Bowmanville, Box 35.
C.E., F.G.S.

Reiffenstein James H.....Ottawa, Dept. of Interior.
D.L.S.

Rogers, Richard Birdsall.... .....Peterborough.
B. A. Sc. (McGill), D.L.S.

Ross, Joseph Edmund .....New Westminster, B.C.
P.L.S. (B.C.).

NAME.	RESIDENCE, P.O. ADDRESS.
Sanderson, Daniel Leavens	Coral, Mich.
Strathern, John P.L.S. (B.C.), D.L.S.	Vancouver, B.C.
Sherman, Ruyter Stinson P.L.S. (B.C.).	Vancouver, B.C.
*Silvester, George Ernest Grad. S.P.S.	Pittsburgh, Pa., Shiffler Bridge Co.
Simpson, George Albert C.E., D.L.S.	Winnipeg, Man., N. P. & M. R'y.
Spry, William C.E., D.L.S.	Toronto.
Stewart, Louis Beaufort Lect. in Surveying.	Toronto, Sch. of Prac. Science.
Thomson, Augustus Clifford C.E., D.L.S.	Kansas City, Mo.
Tracey, Thomas H P.L.S. (B.C.), C.E., D.L.S.	Vancouver, B.C.
Vicars, John Richard Odlum P.L.S. (B.C.), D.L.S.	Kamloops, B.C.
Weekes, Abel Seneca D.L.S.	Wetaskiwin, Alta.
Wheeler, Arthur Oliver P.L.S. (B.C.), D.L.S.	New Westminster, B.C.
Willson, Alfred D.L.S., Comm. Can. Co.	Toronto, 204 King st. e.

SUMMARY.

Active members subject to dues	195
Active members exempted from dues	21
Withdrawn from practice (including Associates)	45
Dead	4
Total number enrolled since incorporation	265