HON. ROBERT BALDWIN SULLIVAN.

SURVEYOR GENERAL, 1838-40.

No. 14.

PROCEEDINGS

OF THE

ASSOCIATION

OF

Ontario Land Surveyors

ORGANIZED 1886. INCORPORATED 1892.

AT ITS

SEVENTH ANNUAL MEETING

SINCE INCORPORATION.

HELD AT

TORONTO

28th February and 1st and 2nd March,

1899

Being the Fourteenth Annual Meeting of Land Surveyors for Ontario.

The Eighth Annual Meeting of the Incorporated Association will be held in Toronto, commencing on Tuesday, 27th February, 1900.

PRINTED FOR THE ASSOCIATION BY
HENDERSON & CO., LOMBARD STREET,
TORONTO.

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NOTICES.

Members and others will be supplied with copies of the Annual Reports for 1886, 1887, 1888, 1889, 1891, 1892, 1893, 1894, 1895, 1896, 1897, or 1898 upon remitting to the Secretary fifty cents for each copy required.

In addition to exchanges from eight kindred Societies, members and associates not in arrears of dues will this year receive copies of the "Manual" issued by the Association, also the Report of the Clerk of Forestry and the Report of the Provincial Instructor in Road Making.

Each member of the Association is reminded of the fact that for the next Annual Meeting a good programme is most desirable, and to ensure its preparation it is not now too early to bear the matter in mind.

In addition to its use as a library, the Repository now serves as a drafting room for members when copying Crown Lands plans and notes.

Published annually by the Association of Ontario Land Surveyors. Edition, 1350 copies; price, 50 cents.

PATRONISE OUR ADVERTISERS.

PREFACE.

To the Members of the Association of Ontario Land Surveyors:

The Proceedings of the Association at its Seventh Annual Meeting are herewith presented.

Appended will be found the By-Laws of the Association and the papers used at the session of the Board of Examiners in February last.

Your consideration of the advertisements appearing in our columns is requested.

Respectfully submitted on behalf of the Council,

A. J. VAN NOSTRAND,

Secretary.

CONTENTS.

ASSOCIATION OF

ONTARIO LAND SURVEYORS

(INCORPORATED 1892)

Organized 23rd February, 1886.

OFFICERS FOR 1899-1900.

PRESIDENT.

HERBERT J. BOWMAN, O.L.S., - - - - - - Berlin.

VICE-PRESIDENT.

FRED L. FOSTER, O.L.S., - - - - - - - Toronto.

CHAIRMAN OF COUNCIL.

MAJOR VILLIERS SANKEY, O.L.S., - - - - - Toronto.

SECRETARY-TREASURER.

A. J. VAN NOSTRAND, O.L.S., - - - - - - Toronto.

MEMBERS OF COUNCIL.

HON. J. M. GIBSON, Commissioner of Crown Lands, - Toronto.

GEO. B. KIRKPATRICK, Toronto.
ALEX. NIVEN, Haliburton. } For Term ending April, 1902.

J. L. MORRIS, Pembroke.
JAS. DICKSON, Fenelon Falls. } For Term ending April, 1901.

VILLIERS SANKEY, Toronto.
J. W. TYRRELL, Hamilton. } For Term ending April, 1900.

AUDITORS.

A. W. CAMPBELL, - - - - - - - - - Toronto.
H. L. ESTEN, - - - - - - - - - - Toronto.

BANKERS.

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

COMMITTEES, 1899-1900.

STANDING.

LAND SURVEYING.—H. H. Gibson (Chairman), E. Bazett, Wm. Galbraith, M. Gaviller, C. J. Murphy, A. Niven, T. B. Speight, J. F. Whitson.

DRAINAGE.—W. F. Van Buskirk (Chairman), A. S. Code, John Davis W. B. Ford, E. Gardiner, J. L. Morris, Jno. Roger, Geo. Ross, Geo. Smith.

ENGINEERING.—H. K. Wicksteed (Chairman), M. J. Butler, A. W. Campbell, Willis Chipman, W. M. Davis, J. D. Evans, T. Harry Jones, J. L. Morris.

ENTERTAINMENT.—A. P. Walker (Chairman), H. J. Browne, H. L. Esten, P. S. Gibson, G. B. Kirkpatrick, V. Sankey. T. B. Speight.

PUBLICATION.—K. Gamble (Chairman), H. J. Browne, F. L. Foster, G. W. McFarlen, W. A. McLean, J. F. Whitson.

TOPOGRAPHICAL SURVEY.—Otto J. Klotz (Chairman), Geo. B. Abrey, C. A. Bigger, G. L. Brown, M. J. Butler, Willis Chipman, Jno. Galbraith, J. E. Schwitzer.

SPECIAL.

REPOSITORY AND BIOGRAPHY.—Willis Chipman (Chairman), H. J. Bowman, H. L. Esten, M. C. Schofield, C. Unwin, E. T. Wilkie, H. O. Wood,

EXPLORATION.—M. Gaviller (Chairman), Lewis Bolton, W. A. Browne, T. R. Deacon, Jas. Dickson, E. Stewart, J. W. Tyrrel, C. H. Wallace.

PROGRAMME OF THE

Association of Ontario Land Surveyors

(INCORPORATED.)

AT ITS SEVENTH ANNUAL MEETING HELD IN TORONTO,
28th FEBRUARY, 1st AND 2nd MARCH 1899.

PROGRAMME.

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

AT THE REPOSITORY, PARLIAMENT BUILDINGS.

Meeting of Council.

Meeting of Standing and Special 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.) Villiers Sankey, Chairman, Toronto.

President's Address.

Report of Committee on Publication. Killaly Gamble, Chairman, Toronto.

Report of Committee on Repository and Biography. H. L. Esten, Chairman, Toronto.

Report of Committee on Polar Research. J. W. Tyrrell, Chairman, Hamilton.

Paper—"Permanent Way." W. E. McMullen, St. John, N.B

Paper—"Progress of Gold Mining in the Central Belt of the Rainy River District.' —H. W. Selby, Dinorwic.

Paper—"Surveying in the Mining Lands of Ontario." F. L. Foster, Mine Centre.

Paper—"Dominion Lands Surveys." C. F. Aylsworth, Jr., Madoc.

Evening at 8 o'clock.

Paper—"More Reminiscences of an Old Land Surveyor." C. Unwin, Toronto.

Report of Committee on Exploration. James Dickson, Chairman, Fenelon Falls.

Paper—"Some Incidental Benefits from the Growth of Forests." Thomas Southworth, Toronto.

Paper—"Azimuths." L. B. Stewart, Toronto.

Paper—"Explorations." James Dickson, Fenelon Falls.

Wednesday, 1st March—Morning at 10 o'clock.

Report of Committee on Engineering, with Question Drawer. Willis Chipman, Chairman, Toronto.

Paper—"Highway Culverts and Bridges." A. W Campbell, Toronto.

Paper—"The Calculation of Strains in Bridge Trusses." James Warren, Walkerton.

Paper—"Railway Location Work." J. D. Evans, Trenton.

Afternoon at 2 o'clock.

Report of Committee on Land Surveying, with Question Drawer. A. Niven, Chairman, Haliburton.
Paper—"Our Professional Standing." B. J. Saunders, Fort William.
Paper—"Survey of the Boundary Line Between Nipissing and Algoma Districts." A. Niven, Haliburton.
Paper—"A Trip to the Yukon and Return." Lewis Bolton, Listowel.
Paper—"The Registry Act." P. S. Gibson, Willowdale.
Paper—"Open Questions." H. J. Bowman, Berlin.
Report of Committee on Topographical Survey." Otto J. Klotz, Chairman, Ottawa.

Evening at 8 o'clock.

ANNUAL DINNER

A. P Walker, Chairman of Committee on Entertainment.

Thursday, 2nd March—Morning at 10 o'clock.

Report of Committee on Drainage, with Question Drawer. George Ross, Chairman, Welland.
Paper—"Drains of Field Tile." W. F. Van Buskirk, Stratford.
A Suggested Amendment to the Ditches and Watercourses Act, George Smith, Woodville.
Paper—"The Lake Wawanosh Drainage Scheme." John H. Jones, Sarnia.
Paper—"The Payne River Drainage Scheme." T. H. Wiggins, Cornwall.
Report of Committee on Entertainment. A. P. Walker, Chairman, Toronto.
Report of Auditors A. W. Campbell and H. L. Easten, Toronto.
Unfinished Discussions.

Afternoon at 2 o'clock.

Ratification of New By-Laws.
Unfinished Business.
New Business.
Nomination of Officers (President, Vice-President, Two Members of Council Sec'y-Treasurer, and Auditors.)
Appointment of Scrutineers.
Adjournment.

Minutes of the Seventh Annual Meeting

OF THE

ASSOCIATION OF

ONTARIO LAND SURVEYORS

Held at the Repository, Parliament Buildings, Toronto, on

FEBRUARY 28th, MARCH 1st and 2nd, 1899.

MORNING SESSION.

Meeting of Council.
Meeting of Standing and Special Committees.

AFTERNOON SESSION.

The seventh Annual Meeting opened at 2 o'clock p.m., the President, Mr. Peter S. Gibson, Willowdale, in the chair.

The Minutes of the previous meeting, as printed in the "Proceedings" for 1898, were taken as read, and adopted on motion of the Secretary, seconded by Mr. Sewell.

No correspondence.

Mr. Sankey, Chairman of Council of Management, presented the Report of the Secretary-Treasurer and Financial Statement, and moved that the Financial Statement be referred to the Auditors for report, seconded by Mr. H. J. Bowman, and carried.

Captain Killaly Gamble read the Report of the Committee on Publication, and moved its adoption, seconded by Mr. J. W. Tyrrell. Carried.

The President then read his address, which was received with applause.

The report of Committee on Polar Research was read by the Chairman of the Committee, Mr. J. W. Tyrrell.

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

Paper: "Progress of Gold Mining in the Central Belt of the Rainy River District," by H. W. Selby, Dinorwic, was read by Mr. H. de Q. Sewell. After discussion the paper was, on motion, received and ordered to be published.

Paper: "Surveying in the Mining Lands of Ontario," by Mr. F. L. Foster, Mine Centre, was read by the writer.

It was moved by the Secretary, seconded by Mr. J. W. Tyrrell, "That the paper be received and printed in the Proceedings of the Association." Carried.

Mr. Dickson read the report of the Committee on Exploration, and moved its adoption, seconded by Mr. J. W. Tyrrell. Carried.

At 5 o'clock p.m. an adjournment was made till 8 o'clock p.m.

Evening Session.

At 8 o'clock p.m. the meeting was called to order by the Vice-President, Mr. H. J. Bowman.

A paper on "Explorations" was read by Mr. James Dickson, and was received with applause and adopted.

Paper on "Azimuths," by Prof. L. B. Stewart, of Toronto, was read by him. He illustrated his paper by a diagram on the board. In his opening remarks he said:

"A short time ago in looking over a back number of the Proceedings of the Association, I read Capt. Deville's paper on this subject, 'The Determination of Time by Observation of Stars in the vertical of Polaris,' and I set to work to see if a method could not be derived for determining the azimuth also from the data. The formulae given by Capt. Deville in his paper, and on which the tables in the Manual of the Dominion Land Surveys are founded, give, first of all, an expression for the perpendicular let fall from the pole on the vertical circle, the transits across which are observed. And then the hour angle is given in terms of that perpendicular distance. I set out from a different point and finally worked out an expression, and on comparing it with the formulae given in Capt. Deville's paper, I found it was nearly equivalent to his two formulae. The reason of the difference is quite obvious on an examination of his formulae.

"Then I continued the investigation and found also an expression for the azimuth in terms of the same data. Thus in my wanderings through mathematical symbols I ran across several expressions that I thought possibly might be useful, hence this paper." (Reads paper).

It was moved by Capt. Gamble, seconded by Mr. Van Nostrand, "That Prof. Stewart's paper be received and printed in the Proceedings of the Association." Carried.

The Report of the Committee on Repository and Biography was read by the Chairman of the Committee, Mr. H. L. Esten, Toronto, who moved its adoption, seconded by Mr. H. de Q. Sewell.

The motion to adopt was carried.

Mr. C. Unwin's paper, entitled "More Reminiscences of an old Land Surveyor," was read by Mr. H. L. Esten, and was received with applause.

At 10 o'clock p.m. the meeting adjourned.

Morning Session.

March 1st, 1899.

At 10 o'clock a.m. the meeting was opened by the President, Mr. Peter S. Gibson, in the chair.

A paper was read on "Culverts and Bridges," by Mr. A. W. Campbell, Toronto. He prefaced his paper with the following remarks:

"I find the question of the material which should be used in the construction of Culverts and Bridges is a matter which is giving Municipal Councils and Engineers considerable worry and trouble at the present time, and for that reason I thought I would take up this subject for discussion this morning.

"When timber was plentiful in the country of course it was the most econonmical material for use in these structures, but at the present time that material has been pretty well stripped from the face of the older townships, and we must look for some other material, something of a more durable character. For that reason I strongly recommend the use of iron and steel for superstructures and concrete and stone for foundations.

"Also in large culverts with a span of from five feet up to twelve or fifteen feet, I would recommend, where possible, concrete arches, and, in the smaller sluices, concrete pipes."

Mr. Campbell then read his paper, which was received with applause.

Mr. Tyrrell moved that the paper be received and adopted. He also said: "I consider this paper one of the most valuable we could have. We certainly, as engineers as well as surveyors, require education in this line and there is a vast amount of up-to-date information contained in this paper, which will be much appreciated in our Report."

Mr. Kirkpatrick, in seconding the motion said: "I think Mr. Campbell is deserving of the thanks of the Association, even if it is not the usual custom. If I were a working engineer I would hold up both hands for a vote of thanks to him."

A paper on "Railway Location Work," written by Mr. J. D. Evans, of Trenton, was presented by him to the meeting, and Mr Kirkpatrick moved the paper be received and adopted, seconded by Mr. Lewis Bolton, and carried.

Afternoon Session.

At 2 o'clock p.m. the meeting resumed, the President in the chair.

A paper on "The Calculation of the Strains in Bridge Trusses," by James Warren, of Walkerton, was read by Mr. J. L. Morris.

It was moved by Mr. James Dickson, seconded by Mr. Lewis Bolton, that the paper be received.

A paper, entitled "Some Incidental Benefits from the Growth of Forests," written by Mr. Thomas Southworth, of Toronto, was read by Mr. Whitson.

It was moved by Mr. James Dickson, seconded by Mr. John Davis, that the paper be received.

Mr. Lewis Bolton, of Listowel, read a paper on "A Trip to the Yukon and Return," which was received with applause.

A paper on the "Survey of the Boundary Line Between Nipissing and Algoma Districts," by A. Niven, Haliburton, was read by him, and, on motion, adopted.

Mr. Sankey then presented the report of the Committee on the Ontario Bill of the Canadian Society of Civil Engineers.

In presenting the report Mr. Sankey said:

"You may remember that at the last meeting a Special Com-

mittee was appointed to meet a Special Committee of the Engineers' Association in view of their proposed legislation for incorporation in the Province of Ontario. I would be very glad if every member present would state his own personal conviction in the matter, so that the Committee and the Council may see what the real feeling of our Association is with regard to this matter.

" Prior to the meeting of last year a deputation from the Canadian Society of Civil Engineers waited on our Council and asked if we would be prepared to appoint a Committee to meet them and discuss the matter of incorporation with them. The Council were of opinion that the matter was of such importance that they did not feel it would be just for them to deal with it. But they assured the engineers that a Committee would be appointed when the Association met. On the meeting of the Association a Committee was appointed, of which I was the chairman, and this is the report we brought in last year. (Reads report of last year, printed in the Proceedings of 1898.)

" No special negotiations between the two Associations have taken place since. A bill has been introduced into the House this year. It was presented by Mr. Russell and got its first reading on the 22nd February, 1899.

" After the report of our Special Committee was presented last year, it was moved that Messrs. Kirkpatrick, Niven, and Sankey be appointed a committee to look after the interests of our Association in any legislation that may be proposed by the Canadian Society of Civil Engineers, and I now beg to present the report of that Special Committee."

Mr. Sankey then explained the provisions of the Engineers' Bill.

" In presenting this report I may add that it would appear to me advisable to take action as suggested by the Committee for this reason : they came to us last year and we neither broke off negotiations nor did we part with anything but good feeling. Our negotiations were carried on in a thoroughly businesslike and amicable manner, and I would be sorry if the Ontario Land Surveyors should in any way set up a barrier against the engineers.

In concluding his remarks, Mr. Sankey moved the adoption of the report of the Committee, seconded by Mr. Niven, and carried.

At 6.20 o'clock p.m. the meeting adjourned until the following morning, as the annual dinner took the place of an evening session.

Morning Session.

March 2nd, 1899.

At 10 o'clock a.m. the meeting was called to order by the President, Mr. Gibson in the chair.

The report of the Committee on Topographical Survey, Otto J. Klotz, Chairman, Ottawa, was read by Mr. John Roger, who moved that the report be adopted, seconded by Mr. Wicksteed, and carried.

The report of the Council of Management was read by Mr. Villiers Sankey. With the report he also presented the report of the Board of Examiners and that of the Secretary-Treasurer.

On motion of Mr. Sankey, seconded by Mr. John Davis, the report was adopted by the meeting.

Mr. Foster read a circular presented by the Canadian Historical Association requesting all who could to furnish that Association with specimens of old surveys, exhibits to show the laying out of the various parts of the Province for settlement, and instruments used, maps, charts, plans, field notes, models of early mechanical and domestic machinery. Miss FitzGibbon, Secretary of Association.

Report of Committee on Drainage, with Question Drawer. George Ross, Chairman, Welland, was read by the Chairman of the Committee, who moved its adoption, seconded by Mr. Bowman. Carried.

Report of Committee on Land Surveying, with Question Drawer. A. Niven, Chairman, Haliburton. Mr. Niven read the report and moved its adoption.

Mr. Niven then read last question in Question Drawer and moved the adoption of the report. Seconded by Mr. Lewis Bolton and carried.

It was moved by Mr. Bowman, "That the Council be instructed to take such action as may appear to them best to uphold the standing of our Association in matters connected with planting of monuments, and having particular reference to the case in Hamilton."

Before this motion was put, it was decided to leave the matter open until Mr. Sankey came and that the matter be referred to him, he being in close touch with the solicitor.

At 1 o'clock p.m. the meeting adjourned to 2 p.m.

Afternoon Session.

At 2 o'clock p.m. the meeting resumed, the President, Mr. Gibson, in the chair.

A paper on "The Payne River Drainage Scheme," by T. H. Wiggins, was read by him.

It was moved by Mr. Foster, seconded by Prof. Stewart, that it be received and adopted. Carried.

Paper, "Drains of Field Tile," by W. F. Van Buskirk, of Stratford, was then read by the writer, and received with applause.

The report of the auditors was presented by Mr. W. A. McLean, acting for Mr. Campbell.

It was moved by Mr. T. H. Jones, seconded by Mr. Foster, and carried, "That the report of the Auditors be received and adopted."

Paper, "Open Questions," by Mr. H. J. Bowman, of Berlin, was presented by him.

It was moved by Mr. Jones, seconded by Mr. Foster, and carried, "That it be received and adopted."

Discussion on the Bill to incorporate the Canadian Society of Civil Engineers in Ontario followed, and it was resolved that To the Committee for the consideration of the Canadian Society of Civil Engineers' Bill, composed of Messrs. Sankey, Kirkpatrick, and Niven, be added the names of Messrs. Wicksteed and J. S. Morris, and that the said Committee be continued in their duties.*

It was moved by Mr. G. B. Kirkpatrick, seconded by Mr. James Dickson, and resolved, "That the Secretary be instructed to address Joseph Kirk, C. Unwin, F. H. Lynch-Staunton, and M. C. Schofield, expressing regrets that they have been unable to be present at this meeting and conveying the good wishes of the members in attendance." Carried.

It was moved by Mr. W. F. Van Buskirk, seconded by Mr. James Dickson, and resolved, "That owing to the lateness of the hour, the paper by Mr. John H. Jones, entitled, "Perche Drain Dredging Work," be taken as read and printed in the Proceedings.

Photographs of machinery used in this work were presented for inspection.

A paper on "Our Professional Standing," by Mr. B. J. Saun-

*The above Committee met the Legislation Committee of the Can. Soc. of C. E. and the changes indicated in the previous discussion of the bill were conceded by the latter andop position of our Association was withdrawn. Owing to other causes the bill when discussed before a committee of the Legislature was held over for a future occasion. *Secretary.*

ders, Fort William, was taken as read, on motion of Mr. F. L. Foster, seconded by Capt. Killaly Gamble.

A paper by Mr. W. E. McMullen, on "Permanent Way," was taken as read on motion of Mr. V. Sankey, seconded by Capt. K. Gamble.

On motion of Mr. Sankey, seconded by Captain Gamble, it was resolved, "That the paper by Mr. George Smith, entitled, "A Suggested Amendment to the Ditches and Watercourses Act," be taken as read and printed in the Proceedings.

The report of the Committee on Entertainment was, on motion of Mr. A. P. Walker, seconded by Mr. F. L. Foster, taken as read, and ordered to be printed in the Proceedings.

Mr. Sankey—In the presenting of the report of the Council this morning and the amended By-laws I presume they are carried as amended and will be printed. Carried.

Moved by Mr. Kirkpatrick, seconded by Mr. Niven, and resolved, "That we have learned with regret of the removal by death since our last meeting of Messrs. Joseph DeGurse, Albert Fowlie, Thomas B. Gilliland, Thomas R. Hewson, Sherman M. Malcolm, John H. Ogilvie, and James A. McMillan, and that the Secretary be requested to convey to the relatives of the above this expression of sympathy for them in their bereavement and to insert in the forthcoming annual report an obituary notice of each." Carried.

Moved by Mr. Whitson, seconded by Mr. Jones, "That any omissions or clerical errors in the records of this meeting now in the hands of the Secretary and the stenographer, be corrected by the Committee on Publication before publishing the same." Carried.

NOMINATION OF OFFICERS:

PRESIDENT.

Mr. Dickson moved that the Vice-President, Mr. H. J. Bowman, be elected President for the ensuing year. Seconded by Mr. A. P. Walker. Carried unanimously.

VICE-PRESIDENT.

Mr. Morris moved Mr. F. L. Foster's nomination for Vice-President. Seconded by Mr. T. H. Wiggins, and carried unanimously.

SECRETARY-TREASURER.

Mr. T. H. Jones nominated Mr. A. J. Van Nostrand. Seconded by Mr. A. Niven, and carried unanimously.

MEMBERS OF COUNCIL.

Mr. Sankey nominated Mr. James Dickson.
Mr. T. H. Jones nominated Mr. H. K. Wicksteed.
Mr. J. L. Morris nominated Mr. W. F. Van Buskirk.
Mr. A. P. Walker nominated Mr. A Niven.
Mr. Wiggins nominated Mr. G. B. Kirkpatrick.
Mr. Walker nominated Mr. Hutcheon.
Mr. A. J. Van Nostrand nominated Mr. John Davis, Alton.
Mr. Foster nominated Mr. A. P. Walker.
Capt. K. Gamble nominated Mr. George Ross, of Welland.

AUDITORS.

Mr. Kirkpatrick moved, seconded by Mr. A. Niven, "That the present Auditors, Messrs. Campbell and H. L. Esten, be re-elected.

SCRUTINEERS.

The President appointed Messrs. Whitson and Gamble.

The President declared the persons nominated for the offices of President, Vice-President, Secretary-Treasurer and Auditors, as above, to be elected by acclamation.

It was moved by Mr. A. Niven, seconded by Mr. G. B. Kirkpatrick, and resolved, "That the sum of $200 be granted to the Secretary-Treasurer as a slight remuneration for his services during the year.

It was moved by Mr. Van Buskirk, seconded by Mr. A. Niven, "That the Auditors auditing the accounts for 1898 receive the sum of $5 each for their services." Carried.

Mr. T. Harry Jones moved "That the President leave the chair, and that the chair be taken by Capt. Van Buskirk, and that the thanks of the Association be tendered to our retiring President for the very able manner in which he has discharged the arduous duties of his office during the past year. No words will express our appreciation of his services. He is one of the oldest members of this Association, and one of the oldest practising surveyors in the Province, and he has at all times rendered us able aid. One good thing has taken place on our electing him to that position, and that is, we have him presiding at our annual dinner. Seconded by Mr. Niven and carried unanimously.

Mr. Gibson expressed his pleasure at receiving this vote of thanks and his desire to serve the Association in every way in his power.

Mr. A. J. Van Nostrand, in moving that a vote of thanks be tendered to Major Sankey, the Chairman of the Council, for the able and efficient manner in which he had performed his duties, said: "I can speak personally in this matter as no one else can, because he and I alone know how often the Secretary goes down to the City Hall to bother him when he is in the midst of some Esplanade agreement or other important duties, and all the work he does, the details of which it would take some time to enumerate, he does for love of the Association and the good of the profession at large. I think we are all indebted to him for more than the majority of us know.

Mr. Niven seconded this motion, stating that he knew Mr. Sankey had rendered great assistance to the Association at all times. Carried unanimously.

Mr. Sankey replied to the motion, stating that the performing of his duty to the Association gave him the greatest pleasure, and he desired to do his utmost to further the interests of the profession.

At 5.40 o'clock p.m. the meeting concluded by singing the National Anthem.

MEMBERS IN ATTENDANCE AT THE SEVENTH ANNUAL MEETING.

28TH FEBRUARY AND 1ST AND 2ND MARCH, 1899.

W. Beatty.
L. Bolton.
H. J. Bowman.
A. W. Campbell.
J. Davis.
J. Dickson.
H. L. Esten.
J. D. Evans.
R. P. Fairbairn.
W. B. Ford.
F. L. Foster.
J. Galbraith.
K. Gamble.
H. H. Gibson.
P. S. Gibson.
W. S. Gibson.
J. Hutcheon.
T. H. Jones.
G. B. Kirkpatrick.
H. McGrandle.
W. A. McLean.
A. J. McPherson.
J. L. Morris.
C. J. Murphy.
A. Niven.
J. A. Paterson.
J. Roger.
G. Ross.
V. Sankey.
H. DeQ. Sewell.
A. Smith.
H. Smith.
L. B. Stewart.
J. W. Tyrrell.
W.F. Van Buskirk.
A.J. Van Nostrand.
A. P. Walker.
A. T. Ward.
J. F. Whitson.
H. K. Wicksteed.
T. H. Wiggins.

RESULT OF ELECTIONS FOR 1899-1900.

President.....Herbert J. Bowman.....(by acclamation).
Vice-President.....Fred. L. Foster.....(by acclamation).
Secretary-Treasurer.....A. J. Van Nostrand.....(by acclamation).

Members of the Council of Management elected for the ensuing three years:

Geo. B. Kirkpatrick. Alex. Niven.

Auditors for the ensuing year: (by acclamation).

A. W. Campbell. H. L. Esten.

I hereby declare the above named officers elected.

A. J. VAN NOSTRAND,
Secretary-Treasurer.

Certified correct.

KILLALY GAMBLE, } *Scrutineers of Ballots.*
J. F. WHITSON, }

Under Sec. 16. Chap. 180, R.S.O., 1897 the Council appointed Mr. James Dickson to fill the vacancy caused by the resignation of Mr. F. L. Foster as member of the Council, Mr. Dickson being next to the members elected as above in the number of votes received.—*Secretary.*

PRESIDENT'S ADDRESS.

GENTLEMEN OF THE ASSOCIATION OF ONTARIO LAND SURVEYORS:

I need hardly tell you that it gives me much pleasure to address you as President. It is now about 42 years since I passed my final examination. The members of the Board of Examiners at that time were Russell, Assistant Commissioner of Crown Lands; Devine, Hawkins, Fleming, Roach, and D. Gibson. To meet the demands of the public the subjects for final examination have been so increased that at present an Ontario Land Surveyor must also be a Civil Engineer and Municipal Lawyer; he must have a theoretical and practical knowledge of Astronomy, Geology, Mineralogy, Botany, Laws relating to Mining, Registration, Drainage, Ditches and Watercourses, Municipal Law, and all Acts relating to Survey of Lands in Ontario, Levelling, Laying out Railways, and in Mathematics, Euclid, Algebra, Plane and Spherical Trigonometry, Mensuration, Laying Out and Dividing Land, etc., etc., must also be an Artistic Draughtsman, and versed in the principles of evidence, and capable of deciding at a glance the meaning of wills and other legal documents relating to the division of land. In addition to the above he must be proficient in a variety of other subjects too numerous to mention, but which will readily occur to you all, so we may say that his knowledge must extend over the surface of the earth about him, the heavens above him, and the earth beneath him, and from the certificates required of him before entering on his final examination he must be not only a scholar, but a cultured and refined gentleman.

When referring to a knowledge of statutory law, I do not mean that the surveyor has only to make himself familiar with the letter of the law, but he must also be up in the cases giving the decisions of the High Courts not only as to the meaning of statutes, but in cases where there is no statutory rule. In this way only can a surveyor be an expert in law cases, and by his reports actually block out the brief of the counsel. He must not only be well posted in his case, but be able to tell what he knows so as to command the confidence and convince the Court. To meet such circumstances and others which will readily occur to you, every O. L. S. should be a public speaker, an accomplishment which is easily acquired by our members in the regular course of their practice, if not during their course of study. I would like to impress upon the members of our Association the importance of becoming permanently established in localities where they may commence practice, since to be successful you must make yourself fully acquainted with the early, or, we may say, the original history of the locality, as to plans, field notes, instructions and reports of surveys of the townships, towns and villages and as to the original stakes and limits then

established, and whether the original surveys were single front, double fronts, or sectional surveys, and he must have full knowledge as to all special Acts as well as a critical knowledge of the Survey Act. He must be posted as to litigation of boundaries in the locality and law reports as to the same, and secure, if possible, all old field notes, plans, etc., etc., of other surveyors who may have practised in the locality. In order to be of use, such information, as well as your own notes, plans, etc., must be carefully indexed so that they may be referred to at short notice and be of use to your boys afterwards. While I do not wish to indulge in flattery, we know it is a common ambition of all good and great men to wish to be remembered by future generations. I claim that no profession presents so fair a field as ours in that respect. Only a few of our professional men and statesmen are remembered in after years, and often then only by reading some voluminous history, while the Ontario Land Surveyor in general practice has his name entered on plans, documents, etc., etc., as a guarantee of their value and correctness, which will be referred to daily during centuries to come.

I have sometimes wondered as to what becomes of so many Ontario Land Surveyors passed by the Board of Examiners, and I find on investigation that after years of experience there is a demand for them for important positions.

I might refer to the bill for incorporating the Canadian Society of Civil Engineers in Ontario. Of course an amalgamation with our Society would not do, as, while an Ontario Land Surveyor may readily prepare himself for a Civil Engineer, it would not be claimed that all members of the Canadian Society of Civil Engineers, made up, as it is, of such various classes, could qualify themselves for Ontario Land Surveyors. While I, personally, would benefit by the passage of the proposed bill and would be pleased to see it passed as a personal benefit, being myself a member of the Canadian Society of Civil Engineers, yet I am satisfied it would not be of advantage to a large number of the members of our Association, and I am of the opinion that the officials of the Association are responsible to such members in case of such legislation.

We have important legislation on hand as to the registration of plans, which we hope to see passed in order that the compiled plans so often spoken of in the Association may have a better standing, and at the same time put the paper titles of lands in such localities on a better footing. The matter will probably be discussed by the Association at this meeting.

I cannot but give expression to the pleasure to myself, as well as, I am sure, to other members of the Association, as to the harmony and pleasant intercourse that exists among the members of the Association, and we have every hope it may continue.

I am sure we are all pleased to look forward to the prospect of good times now looming up before us, and it is very gratifying to us to know that under such circumstances it is to Ontario Land Surveyors the country looks for assistance in opening up and developing the great interests of the country.

PETER S. GIBSON,
President.

REPORT OF THE COUNCIL OF MANAGEMENT.

The Council held two meetings, one on 19th April, 1898, and one on 29th December, 1898.

A number of non-residents on the list of practitioners were permitted to withdraw without payment of full arrears, each case being treated on its merits, and as was deemed in the best interests of the Association.

P. S. Gibson and A. Niven were re-appointed as members of the Board of Examiners for three-year term.

A copy of the Order in Council was received, notifying us that the Lieut.-Governor had re-appointed G. B. Kirkpatrick as member of the Board of Examiners for three years. The Standing and Special Committees, as appearing on page 6 of the printed Report of the Association for 1898, were struck by the Council.

The complaint of J. W. Tyrrell, re the removal of stone monuments planted by him, was considered. The particulars will come before the Association in "Question Drawer" of Land Surveying Committee.

The action of Foster v. Hall, re unlicensed practice in Rainy River District, was endorsed by the Council, and the cost of prosecution paid from Association funds. A conviction was secured and the practice of the defendent put a stop to.

The complaint of W. D. Heron against C. Potvin, in the County of Russell, for unlicensed practice, came before the Council, and a letter of warning was sent to Potvin. No repetition of the offence has since been reported.

The complaint of H. McGrandle, as to the running of timber berth lines by W. T. Jones, an employee of a lumber company, but not an authorized land surveyor, was investigated, but the facts disclosed did not warrant the Council in entering an action in this case. A letter of warning was sent to the parties complained against.

While the Council appreciate the delicate position in which a surveyor stands with regard to a prosecution within his own territory, we could point out the great difficulty the Council experience in securing sufficient evidence to establish a case without the open aid of some resident of the locality.

The compilation of Acts relating to land surveyors' practice in Ontario was printed, but, owing to the fact that important changes in Registry Act are expected to be made at the 1899 Session of the Legislature, it was thought wiser to issue last year only chapters 180 and 181 of R.S.O., 1897, and to delay the issue of the compilation until the result of the legislation of the present session of the Legislature is known.

A re-cast of the By-laws to suit the recent changes in the Statutes is presented herewith.

Respectfully submitted,

VILLIERS SANKEY,
Chairman of Council.

DISCUSSION.

Mr. Sankey—There is one item that we did not put into the report. During the last year I think the Association is to be congratulated on the very satisfactory settlements that we have reached with members of the Association who had got into what I may call serious arrears of dues. There were some that had allowed three or four years to climb up on them, and of course you all know it is often a very difficult thing to settle with such a man, especially if his practice has not been quite as flourishing as he would like, and others forget and do not pay their fees, but during the past year we took the list up, and except one or two instances which the Council think are really cases of hardship, we have settled almost all. I do not suppose there are more than two or three now that are over two or three years in arrears. It is about the only unpleasant work we have to do to make settlements and to try and do what we believe to be right and in the interests of the Association, without causing hardship for some of our members.

I have got here a "proof" of some of the proposed compilations of the Acts we propose to have printed and bound with the Acts that have already been issued. It will be a great benefit to Surveyors to have such a manual. We do not propose to include in this manual the Ditches and Watercourses Act; it would make the book too bulky. We are putting in references to the Fire Act, and the Line Fences Act, and a few extracts from the Railway Act

of Ontario, and it might be well to put in a few extracts from the Dominion Railway Act. I think also a specimen form of the certificate a surveyor is expected to sign on a notice of Arbitration would be useful.

REPORT OF BOARD OF EXAMINERS.

The annual examinations were held during the earlier part of February.

At this examination the marks, as fixed by the original By-laws, were adhered to on account of the short notice which would otherwise have been given to the candidates.

Copies of the papers used have been ordered to be published in the forthcoming Annual Report of the Association.

The following passed preliminary examination :

Edgar Augustus James, Thornhill.
William Alexander Beaton, London.
Stanley Herbert Fillmore, Fingal.
Frederick Conningham Denison, Toronto.

The following passed the final examination :

Charles Wilfrid McPherson, Toronto.
Carl Reinhardt, Montreal.
Finlay Donald McNaughton, Cornwall.
James John MacKay, Woodstock.
Henry Stanley Carpenter, Collingwood.

The following bonds were approved and filed :

Wilbert Silas Gibson.
John James Newman.
William Butterton Lord.
James Nevin Wallace.
James Samuel Dobie.
William Arthur McLean.
William Walter Meadows.
Franklin Joseph Robinson and
George Laing Brown.

Articles were filed by apprentices as follows:—

ARTICLES FILED.

Name of Pupil.	Name of Surveyor.	Residence.	Date of Articles.	Term.
Jackson, John Herbert	Newman, William.....	Windsor	Feb. 18, 1898.....	3 years.
Weeks, Melville Bell	Jones, T. Harry.....	Brantford.....	June 15, 1898	1 year.
Shaw, John Henry	Morris, J. L.....	Pembroke	June 8, 1898	1 year.

REPORT OF THE SECRETARY-TREASURER.

MR. CHAIRMAN,—I beg leave to submit the following report of the official business of the Association transacted in my department between 8th March, 1898, and 28th February, 1899.

The following circulars were issued:

No. 44 Ballot for 1898-99	225
" 45 Explanation of ballot with names of candidates	225
" 46 Announcement of annual meeting, 1899	300
" 47 Programme for annual meeting	400
Letters and accounts sent from Secretary's Office	1014
Post Cards	10
Letters and Post Cards received	442
Copies of 1898 Proceedings sent to Exchanges	815
Copies of 1898 Proceedings sent to members	220
Exchanges sent to members	1300

Our exchange list has been increased until we now include the following: Engineering Society of the Ontario School of Practical Science, Iowa Engineering Society, Illinois Society of Engineers and Surveyors, Michigan Engineering Society, Ohio Society of Surveyors and Civil Engineers, Indiana Engineering Society, Wisconsin Engineering Society, Purdue Society of Civil Engineers. In the cases of some of the above we have been unable to obtain a sufficient number of copies to afford one for each of our paid up members, but we hope to be in a better position in the future.

The report of the Ohio Society for 1898 has not yet been received, and that for the Wisconsin Society will be issued as part of a double number next year.

The Council is to be congratulated upon having at last come to satisfactory adjustments with the few members who were allowing annual dues to accumulate without their making any effort or expression therefor. It has been found that in nearly every case the delinquent member had not taken the trouble to inform himself on Association matters, and satisfactory arrangements have been made since these points were explained.

The list of practitioners has been slightly diminished during the past year by the withdrawal of a number of our members who are non-residents, and our membership has suffered more at the hands of the Grim Reaper since our last Association meeting than during any similar previous period. Particulars as to our loss in this direction will be found elsewhere.

Your Secretary-Treasurer takes this opportunity to remind members that all remittances to him are, or should be, acknowledged with a fair amount of promptness upon the authorized forms of the Association. Should any remitter fail to receive, within a reasonable time, an acknowledgment of the receipt of his enclosure, he would confer a favor by sending a post-card of inquiry, as

amongst such a large number of small transactions, it is found that an average of at least one annually is lost, overlooked, or otherwise unaccounted for.

All of which is respectfully submitted.

A. J. VAN NOSTRAND,
Secretary-Treasurer.

STATEMENT OF BALANCES, RECEIPTS AND EXPENDITURES BETWEEN 8TH MARCH, 1898, AND 28TH FEBRUARY, 1899.

DR.

To balance on hand, 8th March, 1898			$1,712 19
" Amount collected from advertisements in 1897 Report	$ 3 50		
" " " " " 1898 "	51 00		
" " from Proceedings sold	4 50		
			59 00
" " Registration Fees 5 at $1.00 each	5 00		
" " Annual Dues for 1895-6, 5 at $4.00 each	20 00		
" " " " " 1896-7, 8¾ " 4.00 "	35 00		
" " " " " 1897-8, 29¾ " 4.00 "	119 00		
" " " " " 1898-9, 144 " 4.00 "	576 00		
" " " " " 1899-0, 5¼ " 4.00 "	21 00		
" " Associate Fees " 1898-9, 2 " 2.00 "	4 00		
" " " " " 1899-0, 1 " 2.00 "	2 00		
			782 00
" Accrued Interest on deposit in Savings Bank			33 97
" Receipts in Board of Examiners account (including Government grant of $200.)			470 00
			3,057 16

CR.

By amount for publishing Proceedings of 1898 meeting	$378 10		
" Amount granted to Secretary-Treasurer for 1897-8	200 00		
" " Paid for postage	80 90		
" " " Printing and Stationery (including Manual proof)	74 95		
" " " Solicitor's fees and other Law expenses	59 89		
" " " Extra copies '98 exchange reports	39 10		
" " " Expenses of members of Council	38 25		
" " " Stenographer's fees, reporting annual meeting, 1898	35 00		
" " " Office sundries, repairs, etc.	11 70		
" " " Freight and Express charges	8 76		
" " " Customs, brokerage and entries	6 12		
" " " Caretaker for Repository	5 00		
" " " Additions to Library	3 00		
" " " Cartage	2 45		
" " " Bank collections	1 75		
" " " Binding and mounting	1 25		
			$946 22
" " " Disbursements in Board of Examiners account			446 49
" Balance on hand in Savings Bank, 28th February, 1899	$1,361 94		
" " " Current account, 28th February, 1899	302 51		
			1,664 45
			$3 057 16

A. J. VAN NOSTRAND,
Secretary-Treasurer.

We hereby certify that we have examined the accounts of the Secretary-Treasurer and vouchers therefor, also Financial Statement, and have found them correct.

Respectfully submitted,

A. W. CAMPBELL,
H. L. ESTEN,
Auditors.

REPORT OF PUBLICATION COMMITTEE.

MR. PRESIDENT,—The committee feel happy in again having issued a Report of our Proceedings containing much that is of value to our profession as well as matters of public interest; and we trust that the Report has met with general approval.

We desire anew earnestly to request members sending in "Papers" to be more careful as to the accuracy, size, and elegance of the accompanying diagrams.

The Association desires to return thanks to Sir George Kirkpatrick for his kindness in furnishing a portrait of the late Mr. John Macaulay, formerly acting Surveyor-General, a biographical sketch of whom we expect to insert in our next Report.

The printing of our Report was carefully executed by Messrs. Henderson & Co. One thousand three hundred and fifty copies were printed, at a cost of $378.

The members of the Association should consider the interests of those advertising with us.

We have exchanged Reports with the following Societies:

EXCHANGES SENT TO

School of Practical Science Engineering Society	200
Michigan Engineering Society	130
Ohio Society of Surveyors and Civil Engineers	100
Illinois Society of Engineers and Surveyors	130
Indiana Engineering Society	75
Iowa Civil Engineers' and Surveyors' Society	70
Wisconsin Engineering Society	20
Purdue Society of Civil Engineers	90
	815

Respectfully submitted

KILLALY GAMBLE,
Chairman.

REPORT OF COMMITTEE ON POLAR RESEARCH.

MR. PRESIDENT AND GENTLEMEN,—Your Committee on Polar Research are very sorry to have to report both poles of our globe still undiscovered; but you will be pleased to know that arrangements are now being made for the "final location" of our end of the axis during the present year, by a Canadian. Some of you are already familiar with the name of Captain J. E. Bernier of Quebec—to whose proposed Polar Expedition I refer.

I had hoped to receive a paper from Captain Bernier regarding his plans, or better still, to have had him here to address us in person, but having been unsuccessful in both these attempts, I have here a letter from Mr. Charles Baillairge, F.R.S.C., of Quebec, giving some of the details of the project, and I cannot do better than read what he says, for he seems to know whereof he writes.

The following is his letter in reply to my request for information:

QUEBEC, February 23, 1899.

MY DEAR MR. TYRRELL:

I don't know that I can enlighten you as to Bernier's proposed trip to the North Pole more than you have already been by the newspapers. In the Montreal La Presse of December, 31, 1898, issued a colored sheet containing Bernier's lecture on the subject at Montreal and a letter of mine read at the Conference, and reproduced with it.

I consider the time has arrived when it behoves us to reach the pole, and that now that so many other nations have tried their best at it and failed, it is for Canada to solve the problem. Former trips, though unsuccessful, have been very instructive as to wind and currents and drift of ice. De Long's voyage especially, and then Nansen's, have supplied the necessary data to make a final attempt a triumph. As Bernier says, all former explorers have worked against nature or natural forces, and he intends to avail himself of such aids.

He will, I believe, go by Behring's Straits as De Long did, leaving, say, in June. Getting by September to opposite the mouth of the Lena, a river from Siberian Russia, emptying into the Polar basin, he will then with his party take to the ice and foot it to the pole, the drift ice helping him on to some extent. After leaving the pole, he will walk and steer for Spitzbergen, getting there the following spring and there re-embarking with his party for Norway on his way back; or, if he only gets there in the fall of 1900, wait there till the following spring for the tourists' vessel from Norway to return him.

He will have say 100 Eskimo dogs and 100 deer, with moss for the latter, then as the loaded traineaus and kayaks at the start lighten, and as one dog after another gets fagged out, kill it to feed the others, and as the deer become less required, also due to consumption of provisions, kill one and then another, feeding on the best of their flesh and giving the remainder to the dogs, securing, of course, the pelt or furs for his return journey. He will have among other paraphernalia a boat in two sections, hinged together, so that the one half folding over the other will form a camp for the men at night or during rough weather; will use oil for light and fuel and replenish his supplies on his return from what he can get of the walrus and other blubber-bearing amphibian mammalia, a bear occasionally revivifying the larder.

If Bernier gets the money he will reach the pole, but the work has to be done on foot and not rely on a vessel taking him there. There are no storms worth mentioning in those regions, no cold severer than that of the Klondyke, and with pluck and courage they are bound to get there at last. In fact I feel just like going there myself. If Bernier cannot raise the money in Canada, he will get it in the States and plant the Stars and Stripes there instead of the flag of England, and then we will say with a voice, "What fools we were not to have made the final attempt for science and glory.

Bernier thinks it may cost him less to buy a second-hand vessel to get to the Lena and there abandon it than to pay $10,000 for a new vessel to take him there.

Very truly yours,

CHAS. BAILLAIRGE,
F. R. S. C., etc., etc.

Captain Bernier is at the present time in St. John's, Newfoundland, endeavoring to secure a suitable vessel for his voyage, and he is evidently very much in earnest.

Your Committee ventures the opinion that Bernier's plans appear to be well laid, and that his project is not unlikely to be crowned with success.

Let us hope that sufficient partiotic Canadian capital may not be lacking to enable him to plant the Canadian flag at the pole. The only serious defect we observe in the Bernier expedition is that there is not to be a land surveyor in the party.

J. W. TYRRELL,
Chairman Committee Polar Research.

DISCUSSION.

Mr. Tyrrell—I had considerable correspondence with Capt. Bernier, and had hoped to have had him present with us, but he was compelled to return immediately to St. John's, Newfoundland, on pressing business.

Most of the expeditions to the north have gone in direct opposition to what Nansen has proved to be the drift of the polar ice, and therefore have made little progress, having often found themselves further back at the end of a hard day's labor than the day before. It seems to me we might do something towards assisting the expedition now proposed.

Mr. Gibson—What do you think we might do in the way of bonusing an expedition of this kind ?

Mr. Bowman—I think the proper course would be to send an Ontario Land Surveyor along with it to ensure the success of the expedition. I do not know any Ontario Land Surveyor who would do better than our friend Mr. J. W. Tyrrell. I would vote for a grant towards it if Mr. Tyrrell would go with it. It would be an honor to have a representative with that expedition, if it is to be a Canadian expedition.

Mr. Tyrrell—It is receiving some assistance from the Dominion Government. I was not able to obtain such information regarding the expedition as I had hoped. Most of the information I got was from the Secretary of the Royal Society.

The President requested the Vice-President, Mr. Bowman, to take the chair.

Mr. Dickson—It is said it would be an honor to the profession to have one of the Ontario Land Surveyors there, but I think the honor would be to the expedition. I do not think this Association should be called upon to furnish any of the funds; we could furnish a man equal to any they could get in the Dominion. Mr. Tyrrell has had more experience in this line than any other Ontario Land Surveyor to-day, and I would be very much pleased to see him engaged by the Dominion Government to go with the expedition.

Mr. Niven—I would be very much pleased if a member of the Association of Ontario Land Surveyors would join that expedition, and I do not know of anyone more efficient than Mr. Tyrrell.

REPORT OF COMMITTEE ON EXPLORATION, 1899.

MR. PRESIDENT AND GENTLEMEN,—Your Committee on Explorations have not succeeded in securing anything new which would would be of interest to the Association at its present session.

Early in the month of December last I wrote to each member of the Committee asking for any information any of them might have on any subject likely to interest the Association, or to name any matter he wished to bring before this meeting. I have only had replies from three, none of whom had any suggestions to make or any information to impart.

We are glad of the fact that two exploratory surveys were undertaken last season by the Provincial Government. One, the continuation of the western boundary of the District of Nipissing north to the Arctic Ocean, by Mr. Niven, the other by Mr. Speight, commencing at the north-east angle of the Township of Hodgins, and ending on the main line of the Canadian Pacific Railway, about four miles from Dalton Station. In both of these surveys, especially that of Mr. Niven, no small amount of hardship was endured. But, as usual, the pluck, energy, and endurance of the party was equal to every difficulty and overcame every obstacle, and their cost a mere bagatelle for the amount of useful information thus obtained of a hitherto practically unknown section of country. And also as the lines have been well opened out, blazed, and durable mile-posts planted, they can be taken up at any given point, and used as a base from which future surveys can be made.

Your Committee hold fast to the motto that if a thing is worth doing at all it is worth doing well, and therefore submit that an exploratory survey is of as much importance and should be performed with as great a degree of care as any other.

We know that there are members of other professions who look upon surveyors as a very much overpaid class, and that the cash outlay on more than half the surveys ordered by our Government is simply cash wasted, and unfortunately many of our legislators are imbued with the same spirit. Your Committee take a strong and unanimous stand in opposition to any such teaching, and would urge that both surveyors and assistants be remunerated on a much more liberal scale for the dangers they encounter and the duties they perform.

In order to obtain his diploma a surveyor has to spend as many of the best years of his life, study as hard, be at as great an outlay, and pass as severe an examination as members of either the legal or medical profession; also quite as large an amount of brain power is necessary, and we think we are quite within the mark when we venture the assertion that the brain power in our profession is equal to that of either of the others.

We have all frequently been assured by some office gentlemen of what a happy time we must have—must is the word, there can be no doubt about its being the right one—away from all worldly cares. How they envied us our annual picnic, and how much they should like to share it. It has been our good fortune sometimes to take one or more of those gentlemen with us on our "outing." But, generally speaking, if they are within a reasonable distance of any well-defined route of travel, by some strange and unfortunate combination of circumstances they are seldom able to remain out to the close of the "pic-nic," and, what is still more remarkable, the party as a rule survives their departure.

In all the different paths of life we have always been assured that there is room at the top of the ladder. But there does not seem to be any top to the ladder in our profession. In the others we find gentlemen attaining both eminence and wealth in the course of a few years, while we surveyors have nothing more to look forward to than a paltry six or seven dollars per diem for about one-third of the year if we are so fortunate as to secure work from the Government each season. If not so engaged, the prospects are still more gloomy.

We would most earnestly and respectfully urge upon both the Government of our own Province of Ontario and also that of the Dominion the advantages that would accrue from the prosecution of a more thorough and extensive system of exploratory surveys in future than has ever been done in the past.

All of which is respectfully submitted,

JAMES DICKSON,
Chairman.

REPORT OF COMMITTEE ON REPOSITORY AND BIOGRAPHY, 1898 AND 1899.

MR. PRESIDENT,—Your Commitee have to report as follows: A large number of books, pamphlets, and maps have been added to our collection, and have been catalogued and arranged, which catalogue, together with a list of our reports and exchanges to date is attached to this report and will be printed in the Proceedings.

A welcome addition has been made to the furniture of the Repository in the shape of a step ladder, which was very necessary on account of the height of the windows from the ground; the table also has been newly covered.

A suggestion has been made that we exchange our present rooms for the three rooms, two of which are at present unoccupied, on the opposite side of the passage; the third, which is occupied by Mr. Southworth, would, the Secretary informs us, be readily

exchanged by him for our corresponding room.

Your Committee also made enquiries about a room in the top flat of the east wing, some years ago Mr. Tully having suggested that we should obain possession of it for draughting, etc. We found it not particularly suitable for that purpose, besides which the Survey Department object to the plans, etc., being taken so far from their offices; as a place for depositing our books, charts, etc., our present rooms in the basement are certainly preferable.

Little has been done during the past year towards collecting biographical sketches, photos, etc. We regret to say that the members of the profession seem too modest to respond to our appeals.

Mr. Unwin, a member of the Committee, has kindly consented to write some more reminiscenses. Your Committee would suggest that some other of the older members of the profession do likewise.

We have to acknowledge the presentation to our library by Mr. Tyrrell of his book, "Across the Sub-Arctics of Canada."

All of which is respectfully submitted.

H. L. ESTEN,
Chairman.

SUPPLEMENT TO CATALOGUE PUBLISHED IN REPORT OF 1897.

A.

Archives, Canadian, 1895, 1896, 1897.
Across the Sub-Arctics of Canada. Tyrrell.

B.

Bell, Dr., Nine pamphlets by.
British Columbia Board of Trade, 18th and 19th Reports.
British Columbia, Pamphlet on.
Boundary Survey, New York and Pennsylvania, 1886.
Bureau of Industries, Ontario, Report of, 1896.
Bureau of Mines, 5th, 6th (2 copies). and 7th Reports, 1895-6-7.
Bureau of Mines, Maps, 1896.
Baillairge, Charles, Biography of.
Bureau of Mines, Report of 1898, 2 vols. (except 3rd part of one).
Baillairge on Technical Education of the People.

C.

Cumberland Yard and Shops, Blue Print.
Canadian Almanac, 29 vols., ranging from 1859 to 1895.

Census of Canada, vols. 1, 2, 3, 4, and 5.
Coast and Geodetic Survey, United States, Reports 1891-2-3.
Compass, The, vol. 3, August, 1898, No. 1.
Colorado State Agricultural College, No. 45 and 48.
Costa Rica, Republic of.
Canada, Map of Dominion.
Civil Service Examiners, Reports of, 1883-85-86-87-88-89.
Canadian Engineer, 46 numbers.

D.

Don Improvement, Viaduct and Esplanade Question. Letter from President of C. P. Ry. to Mayor of Toronto.
Dawson Route between Lake Superior and Red River.

E.

Engineer, City of Toronto, Reports for 1892, 1894, 1895 (three copies), 1896, and 1897.
Estimates of Province of Ontario for 1897.
Engineer, City of Hamilton, Report, 1897.
Engineers, Canadian Society of, Charter, By-Laws, etc.
Engineering Directory.

F.

Forestry, Papers and Reports Upon. Kirkwood.
Farthest North. Nansen. 2 vols.
Forest Reservation and National Park, Report of Royal Commission on.

G.

Geographical Society of Quebec, Transactions of (book).
Geographical Society of Quebec, Transactions of (5 pamphlets).
Geological Survey of New Jersey, vol. 1, 1888.
Geologist, State of New Jersey, Report of.
Geological Survey of Canada, vols. 8 and 9, 1895 and 1896.
Geological Survey of Canada, Maps, 1895.
Geographical Society of Quebec, By-Laws of.
Geodetic and Coast Survey, Reports, 1891, 1892, and 1893.

H.

Hamilton, Report of City Engineer, 1897.

I.

Industries, Bureau of, Report of, 1896.

L.

Lehigh University, Founders Day Addresses.
Land and Engineering Surveying. Baker.
Lake St. John and James' Bay, Report of Exploration (ten copies). O'Sullivan.
Labrador, Map of.
Lehigh University, Register.
Lehigh University, Courses of Mining Engineering.

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DISCUSSION.

Mr. Van Nostrand—In connection with that step-ladder question, which has been revived, I think, for the third year, I beg to state that we have at last secured a step-ladder, at the expense of 45 cents. It was a very difficult matter to get one. We sent to Hamilton at last and got it, and had it sent here by special express. When it arrived it was appropriated by the Surveys Branch, and they had the audacity to put their mark on it. That has been erased, and I have since put the Association mark on it, and it is now in our possession.

Mr. Kirkpatrick—I would like to ask, has one surveyor the right to remove the marks of another surveyor ?

REPORT OF COMMITTEE ON TOPOGRAPHICAL SURVEYING.

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

Although since the last report the inauguration of active work cannot be reported, yet matters of importance have taken place, and undoubtedly a beginning for triangulation or geodetic operations has been brought forward in a specific manner. The Committee refers to the paper by H. S. Pritchett, Superintendent of the U. S. Coast and Geodetic Survey, on "A Plan for International Measurement of an Arc of the 98th Meridian," read before the Royal Society of Canada, May 27th, 1898, a copy of which, with his accompanying charts, is herewith submitted, to be incorporated with this report.

Your Chairman was present at the reading of the paper, and took part in the discussion; he also presented a copy of the Memorandum prepared by the Committee of the Dominion Land Surveyors' Association in 1888, on the general scheme of a "Trigonometrical Survey of the Dominion," and read extracts of letters to him from Dr. Gill, Astronomer Royal at the Cape, earnestly advocating the latter.

The reading and discussion of Dr. Pritchett's paper was followed by a memorial from the Royal Society to the Federal Government supporting the scheme, to which the Mexican Government has already given its support.

You will notice that the 98th meridian has been chosen on account of its great length on land, and, therefore, available for measurement.

In our country it passes a little west of Winnipeg, through Lake Winnipeg and on towards King William's Land, in the Arctic, together about 750 miles.

From the geographical position of this meridian, it will be seen that its utilization for our practical purposes is rather circumscribed, and a prolongation of the oblique arc along the Atlantic, extending to our borders, through New Brunswick, Nova Scotia, and Cape Breton, would serve more useful purposes for land surveys and accurate delineation of topographical features there than that offered by the 98th meridian. However, the latter as an international work, and one of the highest importance from a scientific point of view, deserves our hearty support, and we should take pride in taking part for the first time in an undertaking of such import, toward which every civilized and progressive nation of the world has bent her energies in some way.

It must be impressed that the inauguration of this work is a serious undertaking, for the work, in order to be valuable, must be done as well as can be done anywhere, otherwise its value will be comparatively useless for the object in view. Experienced men for such work we have not many, and we would necessarily have "to feel our way."

However, if the measurement along the 98th meridian is inaugurated, the scheme for a general triangulation of the Dominion would necessarily and undoubtedly follow.

For this reason, too, we think that the support of the Association should be extended for the international measurement of this meridian, and formally presented to the Dominion Government.

All of which is respectfully submitted.

OTTO J. KLOTZ, Chairman.

February 27, 1899.

The necessity for a careful and accurate triangulation of any country, as the basis of a systematic survey, is so well established, and the expense involved in such work so well justified on utilitarian grounds, that no defence for such expenditure on the part of any civilized country is now needed.

The large systems of triangulation, which have been constructed by different countries, have usually been designed as the bases of systematic surveys. Their employment in the determination of an arc, either of a meridian or of a parallel of latitude, has been ordinarily a secondary consideration, but the value of the data furnished by such triangulation schemes, for the final solution of the problem of the earth's spheroid, are of such high interest, that most nations have been glad to shape their plans for triangulation in such a way as to accomplish the latter end as well as the former. The necessity for an accurate triangulation across Canada, as the basis of a systematic map of the country, needs no argument from me, but I gladly avail myself of this opportunity to call to the attention of the Royal Society a plan by which, not only the utilitarian object of a primary triangulation may be secured, but also, a plan by which, through the co-operation of the three Governments in North America, an international geodetic work, of the highest value to this continent and to the world, may be carried out.

The size and shape of the earth may be found, either from two meridional arcs or two longitudinal arcs, or from a single oblique arc. The first method was exclusively employed during the last century, because it was possible to determine latitudes with far greater precision than longitudes; but, in recent times, the electric telegraph has so simplified the determination of longitudes, that the last two methods may now be applied with entire success.

All three are comparatively simple in their theory, although the problem, considered in detail, becomes an intricate and difficult one.

The process in each case is as follows:—For the first case, we have only to measure the length of two lines running north and south, and observe the latitudes of the extremities. From this data, the flattening is first found, and afterwards the absolute length of the axis. This method was that used up to the present time, and our knowledge of the figure of the earth, and of the constants of the spheroid, depends wholly on measurements of such arcs of the meridian.

The second case, that of determining the earth's figure by means of longitudinal arcs, is rapidly coming into use, on account of the application of electricity to the determination of longitudes. The fundamental idea, like the preceding one, is simple. We measure the distance between two points lying nearly, or exactly, east and west, determine their longitudes, and, also, their reciprocal directions. The latitudes need not be accurate when the observations are near the equator, and when the line is nearly east and west the azimuths do not need to be accurately known. A second arc gives similar relations, and by means of both we can determine the earth's compression and its absolute size.

A third way of getting at the constants of the spheroid is by an oblique arc, such as has just been completed in the United States, between the northern part of Maine and the southern part of Alabama. Here we have a case, where the directions between the extreme points are of much greater importance than in the last method. As usual, the latitude of the extreme points must be found, and with this data, and the reciprocal azimuths, the flattening of the earth may be deduced. The simple addition of the length of the line joining the two points, enables us also to find the size of the earth, and thus completely determine the figure. It is evident that the method is not applicable, when the line is nearly north and south, or east and west, or when the work lies near the equator. The most favorable conditions are when the arc is quite oblique to the meridian, and above middle latitudes.

Two discussions of the form and size of the earth are in use in geodesy, and both depend entirely on the results obtained of measures and arcs of the meridian. The first of these is that obtained by Bessel, in 1841, from ten small arcs, whose aggregate length amounted to 50.6 degrees. This discussion gave an equatorial value of the radius of 6,377,397 meters, and a polar semi-axis of 6,356,079 meters, and a value of the compression of 1-299.15. The arcs employed in the discussion are all short, and are now considered of little importance. The result, however, was by far the most correct up to this time, and was accepted universally among scientific men until the discussion of Colonel Clarke in 1866. From

PRINCIPAL ARCS OF THE MERIDIAN, THE PARALLEL AND OBLIQUE ARCS

FOR THE MEASUREMENT OF THE EARTH'S FIGURE AND SIZE

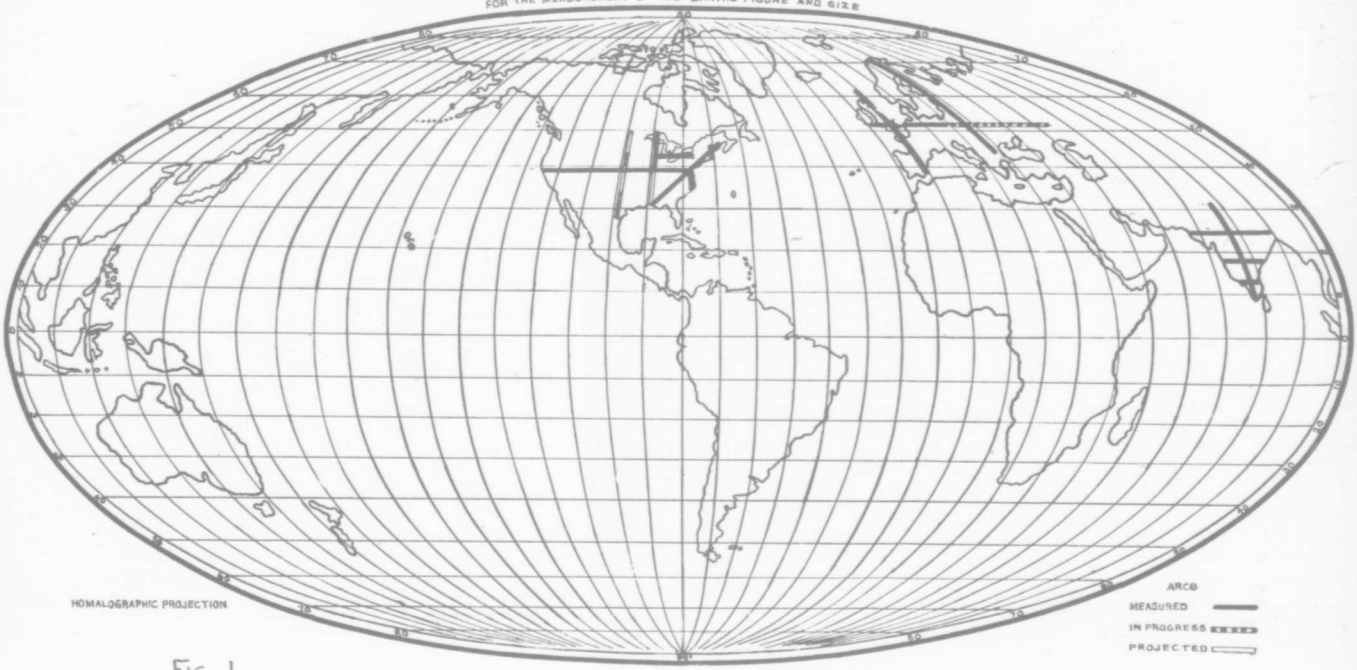


FIG. 1.

a combination of five arcs, having an aggregate length of 76.5 degrees, he deduced an equatorial radius of 6,378,206 meters, and a polar semi-axis of 6,356,584 meters, giving a compression of 1-294.98. The arcs included in this result were the English, the Indian, the Russian, the Cape, and the Peruvian arcs. In 1880, Colonel Clarke published another discussion of the problem of the earth's figure from a discussion of six arcs, whose aggregate length was 81.7 degrees, from which he deduced values slightly different from those just given. From the homolographic projection which accompanies this paper, the meagreness of the data is at once evident. See fig. 1.

I beg now to call your attention to two arcs which have been completed in the United States by the Coast and Geodetic Survey, and which, with the exception of the Peruvian arc, and a few small arcs measured years ago in the United States and of but little value, constitute the first important contributions to the determination of the figure of the earth made in the western hemisphere. The first of these is an oblique arc, extending from Calais, Me., to Mobile, Ala., a distance of 22.1 degrees, or 1,525 statute miles. The number of principal triangulation stations is 172, and the number of base lines 6; 61 latitudes, 48 azimuths and 14 longitudes, all telegraphic, constitute the astronomical data for the discussion. The ease with which this arc could be extended from the Canadian border to Cape Breton is evident at once, from an inspection of the map of the region. This extension would increase the length of the arc about 5 deg., and would, at the same time, form an admirable foundation for a trigonometric survey of the Maritime Provinces.

The second arc is that which is just nearing completion, an arc of the parallel in latitude 39 deg. The character of the triangulation throughout the extent of this arc varies greatly, on account of the difference in the character of the country. The terminal points of the arc are Cape May, N.J., and Point Arena, Cal. The length of the arc measured on the parallel is 48 deg. 46 min., equal to 2620 statute miles. The number of base lines is 10, the length of the shortest being 2.4 statute miles, and of the longest 7.9 statute miles, or an average of 5.3 miles. The average number of conditional equations, subsisting in the triangles of the base net, is between 20 and 21. A number of different kinds of apparatus were employed in the base measures. They all depend on the committee meter as the unit of length. This iron meter is one of the original standards introduced by the French committee in 1879, compared at different times and by different means.

The distance between adjacent base lines varies from 108 miles to 531 miles. This long chain of triangles is characteristic, as compared with similar undertakings, by its strength of composition.

The chain consists of quadrilaterals, central figures, or other strong combinations of triangles. The size of the triangles, where they cross the central valley is of necessity of ordinary character; but in crossing the Rocky Mountains their utmost development has been reached. The longest side of a triangle, from Mount Ellen to Uncompaghre, was 182.1 statute miles. The highest trigonometric station was 14,396 feet, and the spherical excess of the adjusted triangle was 73.8 seconds, the triangle having an area of 5,600 square miles. The observation of this gigantic arc was begun 27 years ago, and the last observations which remain to complete the work are now in progress. They will be finished during the present summer, and as the discussion of this vast amount of material is already well advanced, it seems possible that we shall have the results of the completed work ready for publication within the next eighteen months. A preliminary discussion of these results points to certain interesting conclusions relative to the form of the ellipsoid which will best represent this portion of the globe.

The results of the discussion point in the same direction with the preliminary discussion of the arc of the 52nd parallel in Europe, namely, that the curvature is greater than would be required in an oblate spheroid of the dimensions of our earth.

Without, however, attempting to give in detail these preliminary results, I beg to call your attention to the inauguration of the measurement of an arc of the 98th meridian, which has already been begun in the United States, and which, if it could be extended along its whole length throughout Canada and Mexico, would make by far the longest arc of the meridian which has ever been measured, and would, taken in connection with the arc of the parallel, and the arc which I have just mentioned, give data for a most excellent definitive discussion of the spheroid which would best fit the continent of North America. This arc, as is seen from the attached sketch, extends throughout the United States, north and south, and from the southern limit of Canada to the Frozen ocean, and from the southern limit of the United States to the Pacific at Acapulco. The southern end of the arc is in latitude 17 deg., and the northern limit of the arc may very well be extended to 67 deg., making a total length of 50 deg. The longest arcs of the meridian heretofore measured are the following:

The Anglo-French arc.....	22	deg.	10	min.
The Russian arc.....	25	"	20	"
The Indian arc.....	23	"	49	"

It will thus be seen that the arc here proposed is double the longest arc of the meridian which has up to this time been measured. The value of this arc, as compared to the part lying in the United States, alone would be enormous. Dr. Gill has called atten-

PRINCIPAL ARCS MEASURED AND CONTINENT OF NORTH AMERICA

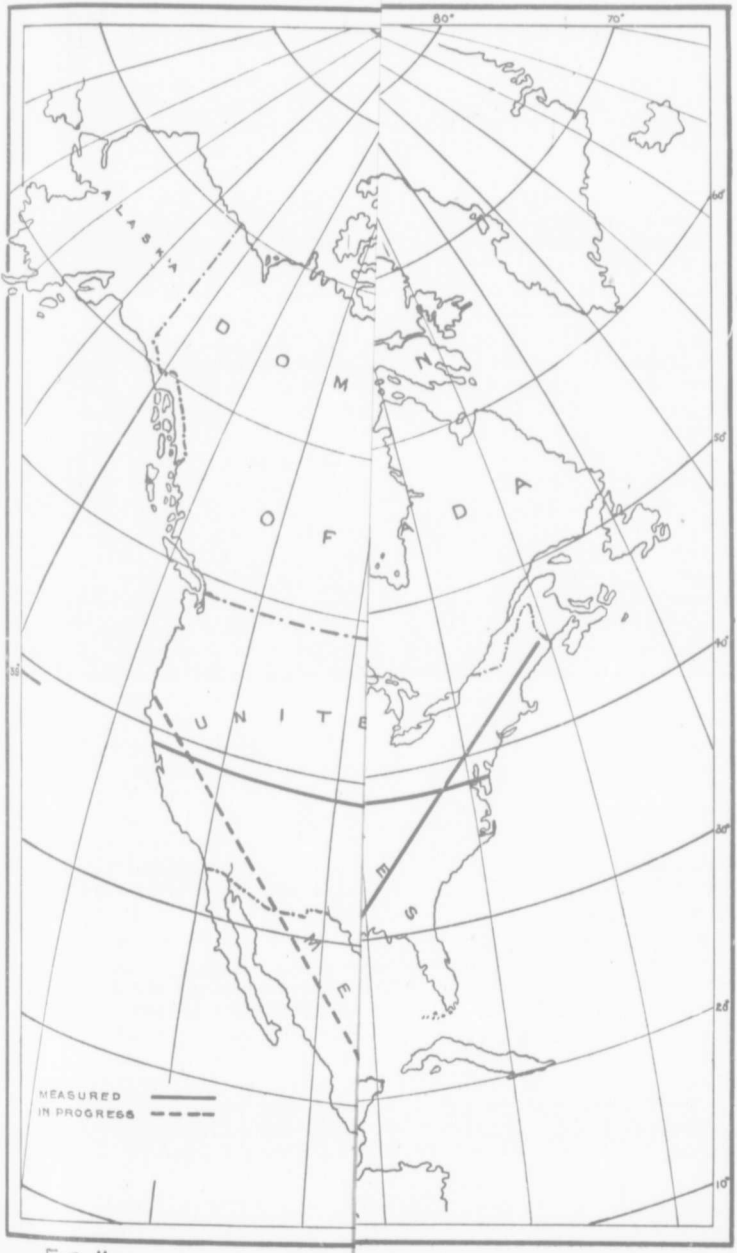


FIG. II.

PRINCIPAL ARCS MEASURED AND IN PROGRESS ON THE CONTINENT OF NORTH AMERICA

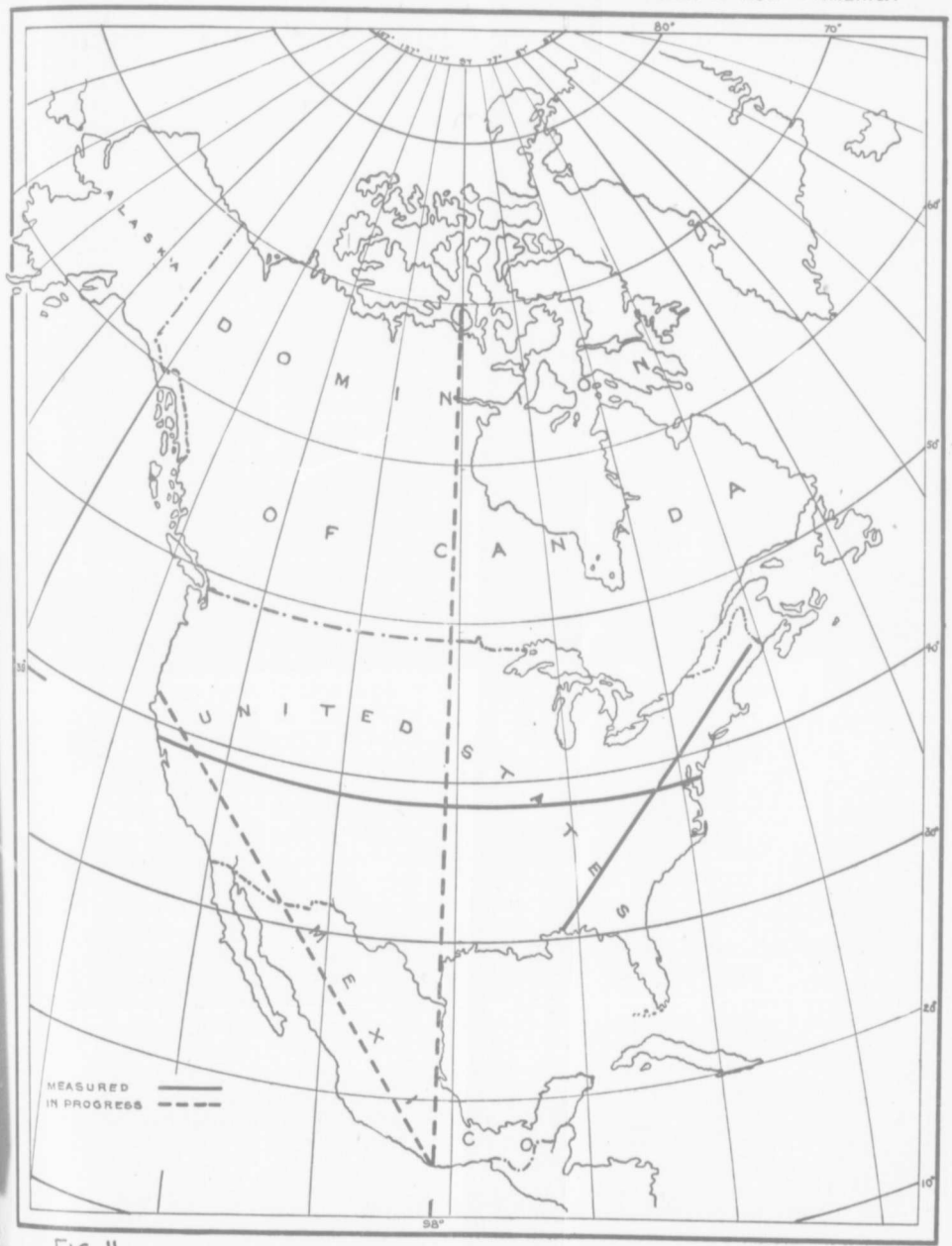


FIG. II.

tion, in the report on the Geodetic Survey of South Africa, 1883-1892, pp. 157-159, to the great advantages to geodesy, which accrue from the measurement of long arcs.

The length of the arc in the three countries is as follows: In Canada, to latitude 67 deg., 760 miles; in the United States, 1,590 miles; and in Mexico, 690 miles; in all, 3,040 miles. The character of the country through which the triangulation would need to be carried is such that it would be comparatively inexpensive, unless in Canada the forests should add to the expense. A very close estimate of the cost of this work can be gained from the cost of similar work in the measurement of the 39th parallel, since more than a thousand miles of this arc passed through a region which was entirely similar to that contained in the arc of the 98th meridian. I find, after a careful investigation, that the entire cost of this work, including salaries, expenses of travel, instruments, and erection of signals, subsistence of parties, and all expenses connected with the work, was at the rate of $120 a mile. At the present time it could doubtless be done for less; probably at the rate of $100 a mile. The sides of the triangles would be from ten to thirty miles, and the work would be in every way analogus to that which has already been carried on along the 39th parallel, through the States of Indiana, Illinois, Missouri, Kansas, and portions of Colorado. Part of this line, at the time when the observations were made, was heavily wooded; and required the cutting out of long and expensive lines, the removal of obstructions, and the building of signals, which made that work quite as expensive, if not more so, than the work of the 98th meridian would be. At this estimate, the cost to the three countries would be as follows: To Canada, $76,000; to the United States, $159,000; and to Mexico, $69,000. The rapidity with which this work could be carried out, would depend on the number of parties that can be put in the field. It is expected that the part of the triangulation lying in the United States will be finished in from six to eight years.

Without going into any longer discussion of this matter, one may say, briefly, that the completion of this measurement of the 98th meridian would, combined with the measurement of the 39th parallel already completed, make an epoch in our knowledge of the earth's figure and size, and would furnish data which could probably never be improved upon, so far as the North American continent is concerned. See fig. 2.

In suggesting this co-operation in a great international work, it seems fitting to call attention to the history of the International Geodetic Association for the measurement of the earth. The first plan for co-operation in geodetic measurements on a large scale seems to have come from General Bayer. In 1861 he wrote to the Prussian Minister of War recommending that the nations of

middle Europe should combine forces, and devote themselves to the solution of this problem; and calling attention to the fact that France had undertaken the work on a large scale in the eighteenth century, England and Russia in the nineteenth, and that the eastern and western parts of the continent were much farther advanced in this work than his own country. At this time only three arcs of the meridian had been measured in Europe, and the anomalies in the deflection of the plumb line had not been explained. The first and most natural proposition was that these anomalies were due to the attraction of the mountains, but when deflections of the plumb line were found on extended plains, and when, as they then supposed, the great Himilayas exercised no appreciable effect, they were led to suppose great changes of density in the earth's surface. Perhaps this phase of the question stimulated, as much as anything else, the co-operation of the different Governments; and in October, 1864, there was effected an organization for the measurement of arcs in middle Europe. Nineteen States gave support to the project. This general plan remained unchanged until 1887, when the middle European association was merged into an international one, and nations from all parts of the world became parties to the convention. The organization was continued for a period of ten years. In 1896 new powers were assumed by the organization, and a new convention to last for ten years, or until 1906, was drawn up. The following countries have joined this convention:

Germany,	Spain,	Japan,	Roumania,
Austria-Hungary,	United States,	Mexico,	Russia,
Belgium,	France,	Norway,	Servia,
Chile,	Greece,	Holland,	Sweden,
Denmark,	Italy,	Portugal,	Switzerland,

It is with very great pleasure that I am able to add that, within the last month, Great Britain has also given her adherence to this convention, and has named as delegate and representative on the permanent committee Professor George Darwin.

This is, in brief, the origin and growth of the present international organization. An outline of the methods of the work, and the results attained, will show what is being done by concerted national action to determine the size and the figure of the earth. From the beginning of the work up to 1887, the results were largely of local importance. Each State Government reported on the operations within its borders, and which were intended primarily to serve as bases of maps for the various countries. The triangulation, measure of base lines, astronomical observations, precise levels, and tidal observations, found their greatest use locally, but in the last ten years questions have been taken up which are of the greatest interest to each individual country, and to the world as a whole.

As illustrating the methods which are now being pursued, I may mention that the last undertaking on the part of the International Geodetic Association contemplates a final and definite solution of the variation of latitude. The association proposes to establish four stations, as nearly as possible at equal distances around the earth, and all within half a mile of the same parallel of latitude. The character of latitude variation from season to season is now comparatively well known, and the fact that we are sixty feet nearer the equator at one season of the year than at another no longer appears startling, but the results so far have been to a certain extent vitiated by the fact that the star places are uncertain; and although by an ingenious method of combining the observations this defect to a large extent disappeared, nevertheless the observations do not yield the desired precision. The method proposed by the International Association, and now in progress of being put into practice, will be free of any errors in the accepted position or proper motions of the stars. This can be accomplished by locating the points on the same parallel of latitude, and as nearly as possible equally distant. Four stations have been chosen, all on the parallel of 39 deg. 8 min. Two stations are taken in the United States, one on the Atlantic coast, and one on the Pacific coast; one station in Japan, and one in Italy. At the present time, a most careful examination of the topography of the various regions in which stations are to be established is being made, in order that all the conditions may be comparable and well determined. It is proposed to carry on latitude observations with precision at these four stations, for a period of seven, possibly ten, years; at the end of which time sufficient data will be at hand to predict the position of the pole with all the precision necessary for the most refined astronomical calculations for at least a century to come.

The result of this international effort at co-operation seems so striking, and the ends to be accomplished are so well worthy the efforts of the best thought and the best energy of any nation, that it seems a fitting example to encourage an effort of similar co-operation among the nations of the North American continent.

NOTE.—Since this paper was read, the Government of Mexico has announced, through the Secretary of the Interior, its readiness to undertake its part of the work here proposed.

[COPY.]

To His Excellency the Governor in Council, etc.:

The Royal Society of Canada has the honor to bring to the notice of Your Excellency a proposal by Dr. Pritchett, Superintendent of the United States Coast and Geodetic Survey, to measure an arc along the 98th meridian from Acapulco, Mexico, to the

shore of the Arctic Sea in Canada. Dr. Pritchett's views are explained in a paper read by him at the last meeting of the Society. A copy of this paper, with explanatory maps, is appended.

The measurement of the 98th meridian has been in progress for some time as part of the general survey of the United States. The object of Dr. Pritchett in urging its extension through Canada and Mexico is to provide data for the determination of the figure and dimensions of the earth and while from this point of view the work would be purely scientific, the Canadian portion of it would also be of great practical utility in forming the basis of a thorough geographical survey for this Dominion.

While it is true that the promotion of science is mainly due to a few of the most advanced and wealthy nations and that these nations have frequently sent expeditions, or established stations abroad when information had to be obtained in semi-civilized or wild and uninhabited countries, it is also a fact that the least favored of the civilized nations have not unfrequently assumed the task of assisting science to the extent of collecting data obtainable within their own borders.

In the present instance the survey is in progress within the limits of the United States and quite recently the Government of Mexico has announced its readiness to undertake its part of the work. The successful execution of the project as a whole, therefore, now entirely depends on the co-operation of Canada. It is respectfully suggested, therefore, that a limited grant for this purpose would be regarded as a contribution to aid in the general researches of the nations of the world, while at the same time it would serve to inaugurate a very much needed work and one of great practical importance to the future of the Dominion.

Extensive triangulations have seldom been undertaken upon scientific grounds alone; their primary object has been utilitarian and to provide a basis for systematic surveys. Without such a basis there is no finality in results; the same ground is being surveyed over and over again, as is the case in the Dominion, by the land surveyor, the geologist, the railway and canal engineer, the hydrographer. For every new project a new survey has to be made. The labour and expenditure on these surveys would be considerably reduced and often entirely unnecessary if we had a systematic triangulation carried out as in other countries. This fact has long been recognized in Europe, where every country has been accurately mapped. Outside of Europe may be cited the United States, whose triangulation is well advanced; India, which offers a striking instance of extensive and well conducted surveys; the Cape of Good Hope and Natal, which have executed a joint triangulation of South Africa; New Zealand, where triangulation has preceded all other surveys. It must not be supposed that there were

no objections raised in these countries to the inception of the work; on the contrary, it was frequently opposed by those who did not understand its practical value, but their opinions changed after they had been in a position to appreciate its usefulness. Of the survey of South Africa, Mr. David Gill, Her Majesty's Astronomer at the Cape, says:

"The influence of the geodetic survey has made itself felt by raising the whole tone of survey operations in South Africa. Strongly as it was at first opposed and grudgingly as it was maintained, its advantages are now fully acknowledged, and by none more warmly than the Surveyor-Generals of the Cape Colony and Bechuanaland."

The triangulation of the 98th meridian would be for Canada the first step in the right direction, to be followed by others, as the resources of the country would allow. It is believed that an appropriation of say $10,000 for a few years would be sufficient to carry to completion the measurement of the 98th meridian. The Royal Society of Canada strongly recommends such a grant, and believes that the work will be of great benefit to Canada, not only by its immediate practical results, but also in placing the country in a more favorable light before the scientific world.

And your memorialists humbly pray that Your Excellency will take the foregoing facts into your favorable consideration.

REPORT OF COMMITTEE ON DRAINAGE.

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

Some members of this committee do not appear to take any interest in its report, and neither attend the annual meeting of the Association nor even take time to write a letter on what they know or don't know about drainage; others write to say that they have been engaged on work other than drainage, and refer the chairman to members further west for information. From this one might reasonably suppose that very little work was now being done under "The Municipal Drainage Act," or "The Ditches and Watercourses Act," or that these Acts were now so well perfected that no further changes in them were required, and that they were expressed in language so clear and precise that all would interpret and apply them in a uniform manner. At the last session of the Ontario Legislature no amendments were made to these two Acts, but a slight amendment was made to the Municipal Act referring to drainage debentures. Though this is a little out of the usual

course of events, the fact appears to be that the work of drainage construction and repair is going on about as usual, and the lawyers and judges are called in as heretofore to see that justice is done. Judging from the reported cases the amount of litigation keeps well up to the average of former years. The great questions of "benefit," "injuring liability," and "outlet" are still to the fore, as well as innumerable other details, which have been gone over and decided by the Courts in more ways than one. Still, your committee does not think it can make a better use of the time at its disposal than to call attention to a few of the points on which decisions have been given:

1. With regard to the "petition" required by sub-section 1 of section 3 of the Municipal Drainage Act. The decision of Drainage Referee Britton, in the case of Malahide vs. Dereham, brings out clearly the fact that the petition must define the area to be drained and be signed by the majority of owners of lands in the initiating township to be benefited. The following is quoted from his report dated February 14th, 1895:

"Again the petition is not for the draining of any area described in the petition. It is simply a petition for the survey of a proposed drain which the petitioners want, and to have plans and specifications, with estimates of the proposed work to be done under the provisions of the Municipal Drainage Act, the drain to commence at the south half of lot 28, in the 11th concession of Dereham, to cross certain lots in Dereham, to enter Malahide and cross certain lots in that township, and to terminate in the Catfish Marsh drain in the township of Malahide. This is not for the drainage of any particular area in Dereham. It is something persons in Dereham and Malahide wish to have done, but it does not give authority to Dereham to have it done and assess lands in other townships for its cost.

"When the township of Dereham undertakes to assess lands in Malahide, the onus is upon Dereham of showing very clearly the legal right to do so.

"The petition to that township in this case does not purport to be signed by the majority in number (exclusive of farmers' sons not actual owners), as shown by the last revised assessment roll to be the owners of the lands to be benefited in any described area within the township of Dereham. It was not shown that the petition was in fact so signed by such majority. The assessment roll was not produced.

"Looking at what was in evidence before me, this petition was not so signed."

In the report of Referee Britton on the case of Gosfield South vs. Mersea, which came before him in February, 1895, we find that the Council of Mersea acted on a petition which asked that lots

11 and 12, concession A, be drained by means of a drain through said lots sufficient to relieve said lots from injury caused by waters brought down upon them from the higher lands to the north and east. The engineer reported a work that would cost $1,026, and assessed the said lots 11 and 12 the sum of $42 in all, as follows: For benefit, $20; for outlet liability, $10; and for injuring liability, $12. In the two lots mentioned there was an area of about 35 acres liable to be flooded.

The Referee discusses the petition as follows:

"Again what was asked for in this petition was not what was really contemplated by section 3, sub-section 1. That provides for lands useless, or comparatively useless, by reason of surface water naturally upon it. Such lands may be benefited, first, by the construction of a drain; second, by the improving of a stream, creek, or watercourse as therein stated; or, third, by the lowering of the water of a lake or pond, or by all of these together.

"This petition, although the first part of it is in the form prescribed by section 4 asks for a drain to relieve lots 11 and 12 from injury, caused by water brought down upon them from the higher lands to the north and east by the drains constructed in what is known as Sturgeon Creek and Coulson drain and other drains. The Council cannot do such a work merely because it is petitioned for."

2. With regard to "benefit," the following extracts from the Referee's report on the above case of Gosfield South vs. Mersea will aid us in considering it:

"Whenever a case occurs where the work to benefit petitioners cannot be done except at a cost far in excess of the benefit directly upon, and by furnishing an improved outlet for any and all lands assessed, such work ought not to be proceeded with merely for the sake of benefit.

It may be answered, that is a matter of judgment and discretion to be exercised by the Council, and, if such is within the statute, the referee has no jurisdiction to prevent it. I am of opinion that the referee has jurisdiction and should deal with it on an appeal by another municipality.

"There was no attempt to ascertain the amount for which lots 11 and 12 should be assessed for benefit, and that was necessary whatever meaning may be attached to the word "benefit." Mr. McGeorge, an engineer of large experience, says he would first ascertain what the assessment should be for benefit, and that, in his opinion, would be the amount required to take away the water that runs upon these lots 11 and 12 in a state of nature. He does not think that benefit means all the advantage that is to accrue to land by reason of taking the surface water away."

3. With regard to "injuring liability," the Referee discusses it as follows in the above case of Gosfield South vs. Mersea:

"The Council may, as authorized by sub-section 3 of section 3, under certain circumstances and in a proper case, without any petition proceed with the construction of a drainage work required for relieving lands and roads injured by water caused to flow upon them. An engineer's report would be necessary, but that report would be different from the present. The engineer would require to determine under what circumstances such water was caused to flow upon and injure. It is not merely a question of water being brought down from higher lands to lower, waters that might come without any drainage work, but it is to be determined what water by any means by man employed, is caused from lands and roads to flow upon and injure other lands and roads where no compensation has been paid, and no corresponding benefit conferred, and having ascertained that to assess and charge the lands from which water was caused to flow and injure, for the construction and maintenance of the drainage work necessary for the relief of the injured lands and to the extent of the cost of such work."

In Referee Britton's report in re Tilbury North vs. Romney, we find the following paragraph:

"The counsel for respondent township contends that under sub-section 3 of section 3 the engineer's report can be upheld. I do not think so. I do not think sub-section 3 of section 3 applies to such a case as this at all. That sub-section applies, as it seems to me, where in doing a work under sub-section 1, or where a work has been done under that sub-section, water is caused to flow from the lands or roads of such municipality, company or individual, upon and injure lands or roads of any other municipality, company or individual, then the lands and roads from which water is so caused to flow may be assessed and charged for the construction of the drainage works, for relieving the injured lands or roads from such water, and to the extent of the cost of the work necessary for such relief."

In the appeal of the townships of Caradoc and Metcalfe from the judgment of the Drainage Referee, given in favor of Ekfrid, the judgment of the Referee was reversed and Osler, J.A., in stating his conclusions (November 9th, 1897), refers to "injuring liability" as follows:

"Assessment for relief from injuring liability seems to be the same thing as assessment for what is defined, or rather described, as 'injuring liability' in sub-section 3 of section 3, viz.: the assessment of lands from which water is 'by any means caused to flow upon and injure' other lands; the assessment being for the cost of the drainage work necessary for relieving the injured lands from such water."

4. We will now consider some references relating to "outlet liability." In the above case of Caradoc and Ekfrid, Osler, J.A., discusses it in part as follows:

"Now, the lands in Caradoc which have been assessed by the engineer already had an outlet by means of Government Drain Number One, so far as they were directly or intermediately drained through it. The great bulk of these lands needed no other outlet than that which they already had. Their lands lay high and the drainage they already had was sufficient for them. For that work they had already paid, and what they are now charged for is a new work not giving them any new outlet. It is plain from the evidence of the engineer that, so far as they are concerned, the work does not give them an improved outlet. I speak now of the great bulk of the property assessed, for there may be cases of a few lots along the course of the drain, the outlet of which is improved, or which are distinctly benefited by the new work. What I regard as objectionable in the principle which the engineer seems to have adopted is this, that to use his own language, he has taxed the lands because they contribute water to the area drained, charging lands within that area with outlet expenses, no matter how remote they are, and although the new work, or perhaps the drain itself, is not necessary for the cultivation or drainage of the land.

Unless the work when constructed would provide an improved outlet for the lands in Caradoc directly, or as under the new Act may perhaps now be the case, indirectly, I cannot see what power the engineer had to assess them for such work, and this affects so large a proportion of the sum charged against that township that it appears to me the Referee should have given effect to Caradoc's appeal, and overruled the report of the engineer."

Drainage Referee Thomas Hodgins, in an oral decision given on the 8th of October, 1898, in re Wainfleet and Moulton, is reported in part as follows:

"The two grounds on which this assessment must be set aside were decided by the Court of Appeal some years ago in re Orford and Howard, 18 A. R., 496. First, as to the meaning of the term "outlet," and how an assessment for it should be borne, the observations of Osler, J. A., may be referred to: "The object was to prevent one municipality from taking advantage of a drain then already, i.e., at the time the Act was passed, or thereafter constructed by another municipality, without contributing to the cost. Every drain into which another drain is made to flow is an outlet or is used as an outlet for it; and unless the application of the section is limited to a case of that kind, which comes within its express words, the whole of a multitude of drainage areas may be taxed for outlet purposes for as many as exist between the watershed and the point where the waters of all are ultimately discharged.

The language of the section in the two cases it provides for, points to a direct and intentional user of a particular drain, or of causing water to flow upon and injure defined or definable lands. In the one case the municipality which uses the constructed drain of another merely as an outlet may be assessed for a proportionate share of the cost of the construction of the drain so used."

Referee Hodgins then continues:

"It may be laid down as a general proposition that when a drain has to be made larger than is required for the drainage of the adjoining lands because of its having to carry off the waters coming from the drains of higher lands, such higher lands should bear a proportion of the cost of such larger drain.

"The other point on which I referred the report back to the engineer was because he had assessed the entire scheme substantially for outlet; that under the statute was not correct, for in the same case of Orford and Howard Osler, J. A., says: 'The assessment being single (for outlet), in respect of one entire scheme, but made up partly for benefit, partly for outlet, and partly for relieving lands injured by water cast upon them by Orford, and no distinction being made as to lots assessed for benefit, injury, or outlet, I think the whole must fail."

The explanations of various points in the Drainage Act given by the judges throw considerable light on the principles governing the assessment of lands, but a study of the decisions given serves to show that work under its provisions must be undertaken with the greatest care, and even after a careful study of the sections of the Act the most experienced may have his report "set aside."

Some proposed amendments to the Municipal Drainage Act, of considerable importance, serving to elucidate its meaning or facilitate its working have been sent in and are appended hereto for your consideration.

All of which is respectfully submitted.

GEORGE ROSS,
Chairman.

QUESTION DRAWER.

Question 1.—Can lands of railway companies be assessed and charged for the construction and maintenance of drainage work done under "The Municipal Drainage Act"?

Answer.—This seems to be a disputed question, and railway companies having a Dominion charter sometimes refuse to pay their assessment, but there is little doubt that they are liable under

the Act. Referee Britton, in re Caradoc and Ekfrid, refers to it as follows: "The omission of the lands of the railway companies, if objectionable, is for the Court of Revision. In so stating I am not expressing an opinion as to whether railways under Dominion charter are subject to the drainage laws of Ontario or not.

Question 2.—Can a municipality be compelled to undertake the construction of a drain or the deepening and widening of a drain or creek for the relief of certain lands, under sub-section 3 of section 3, of the said Act, when the petition required by sub-section 1 of said section has not been presented to the Council of said municipality ?

Answer.—Such work as is authorized by section 75 can be done without a petition. The Council might be "compelled" to proceed with the necessary drainage work by an action for damages.

Question 3.—Can a Municipal Council take steps under said Act without a petition for the construction of any drainage work, and if so can the lands benefited by said work be assessed and charged for the same as provided in the Act for work done under petition ?

Answer.—Only as provided for under section 75.

PROPOSED AMENDMENTS TO DRAINAGE ACT.

With regard to the report of the Drainage Committee, I might suggest a few changes in the Drainage Act to facilitate the working of the Act.

First, with regard to bridges between the travelled portion of the highway and the lands of private owners.

Under the provisions of the Act as per advice from solicitors experienced in drainage matters, the Municipal Council initiating or undertaking the work must build those bridges, and funds must be provided for construction as well as a fund for maintenance of such. This would, perhaps, lead to difficulty and perhaps litigation between the owner and the Municipal Council, and it is difficult to state just what is a proper bridge, and in case of accident owing to non-repair the Municipal Council would perhaps be held liable for damages. Unless the owners agreed to accept the sum set apart in the estimates or a sum sufficient for the purpose, the Councils of flat and level townships would have enormous difficulty in maintaining the bridges. Again, there is considerable dispute as to whether an engineer must provide for maintenance of bridges on drains constructed before 1894, as before one can have maintenance the drain must be constructed, and "construction" under the Act means the original opening of work, and it is held by a member of

the Drainage Commission that it was not the intention to frame the section so as to provide for maintenance of drains already constructed, but only of drains to be constructed after 1894.

This would give two sets of drains—one constructed before 1894, on which the engineer should not allow for maintenance of bridges; and the other, drains constructed after 1894, on which he must provide for maintenance. A very complicated state in drainage. I would suggest that this section be amended so that a sum be paid to the owner instead of the Municipal Council constructing and maintaining same, and that the amount be subject to the same rights of appeal as an assessment on lands. Also, that the section be so worded as to render clear what bridges the maintenance of which is to be provided for.

Second. With regard to section 84 of the Drainage Act, whereby Award Drains are made Municipal.

When an award drain lies in two townships and the parties of the upper township wishes to municipalize the award, the petitioners in any described area in the initiating municipality must possess as well the majority of persons interested in the award in both townships.

This would render the municipalizing of the award more difficult than the initiation of a new drain which in all justice should not be the case. I would suggest that the change be made to "the majority of the persons interested in such award in the initiating township.

A. S. Code,
Member of Commitee on Drainage.

DISCUSSION.

Mr. Bowman—Those decisions regarding the different kinds of assessments will be invaluable. I would like to ask if any of the members have had any experience in applying the Municipal Drainage Act in towns for the construction of storm water sewers. In Berlin there is a petition for a large storm water sewer under the Municipal Drainage Act, requiring these troublesome assessments to be made on a fifth of an acre lot, and it seems to me a pretty big undertaking, as there is about 300 acres in the drainage area. Has any gentleman present had experience in preparing these assessments ?

Mr. Morris—I had a case of a small area to be drained. The application was under the Ditches and Watercourses Act. It was

found the only possible way to get rid of the water was to go through a village. On reading the Ditches and Watercourses Act, my own opinion was that it was never intended to cover expensive storm water drainage; that it was impossible to act under that; so we got legal advice on the question, and the opinion was that we could not use the Drainage Act to get rid of the water; it was never intended that storm water drainage should be by means of assessment—that is, under the Municipal Act, no assessment could be put in in that way except by means of petition, local improvement. I thought I would go for better advice, and I got the advice of a gentleman retired from the profession of the law, who had a good deal to do with that class of work, and his opinion was he did not think there was any legal way whatever to get rid of the water—that is, to build an expensive sewer. He recommended me to refer back the report for a new award. I understand there are a number of applications endeavoring to make the Drainage Act and the Municipal Act do what it was intended that the Ditches and Watercourses Act should do—that is, the drainage of surrounding lands in the outskirts of small municipalities. And I think it possible there might be some amendment probably to the Drainage Act that might include cases of that kind, not under the Municipal Act at all, but under the Drainage Act.

Mr. Van Buskirk—I took a case to a solicitor. We wanted to put in a storm sewer. The trouble is that the sanitary sewer is already in and assessments have been made for that. The solicitor's opinion was that it could not be put in under the local improvement clauses of the Municipal Act, without petition, and it could not be put in under the drainage clauses of the Municipal Act without petition, and it is impossible to get a petition for either one of them, so I concluded to advise the Council to pay for it out of the general fund. To submit a by-law to the people raising money to do so under the present state of the law is the only way I see of doing it. There ought to be some amendment to the local improvement clauses of the Municipal Act empowering us to put in storm sewers.

Mr. Bowman—On what grounds did the solicitor rule that you could not put in a storm water sewer under the Drainage Act? We know previous to 1894 the Drainage Act and the Municipal Act were all mixed up together.

Mr. Van Buskirk—He did not say we could not. It could not be done without petition. He said it might be done.

Mr. Bowman—To make it under the Municipal Drainage Act you have to have a petition of the majority of the owners benefited in any described area. But it seems to me it is perfectly applicable

to one municipality at least, and if you can go from one township to another why cannot you go from a town or a village to include lands outside of the corporation in the township.

Mr. Morris—The difficulty was we were unable to get a petition. Parties not interested did not want the storm water sewer and yet if it was constructed at the expense of those who were anxious to have it the others would get the benefit. They were draining into it and were not paying for it.

Mr. Ross—I think if you get the majority of the certain section that was to be benefitted, they could put in the drain, and could assess other parties directly benefitted for improved outlet only. With regard to the Local Improvement Act you can only assess parties that are directly benefitted. You cannot assess for outlet at all. That is the trouble with the Municipal Act under which local improvements generally come.

REPORT OF COMMITTEE ON LAND SURVEYING.

Mr. President,—Your Committee beg to report that so far as they have been able to ascertain Land Surveyors in the Province have had a fairly successful year.

Several members have reported that the amendments of 1897 to the Survey Act have given general satisfaction, especially the running of lines on the astronomic course in the Huron and Ottawa territory.

The Committee are pleased to note that the Council have been successful in putting a stop to illegal practice in different parts of the country, and this must prove of great service to surveyors in the newer parts of the country and throughout the mining districts.

The Committee are also pleased to note that the Engineers' Bill for incorporation, now before the Legislature, is receiving the attention of the Association.

A number of questions in surveying have been sent in. These, with replies, are appended hereto.

All of which is respectfully submitted.

A. Niven, Chairman.

March 1st, 1899.

QUESTION DRAWER.

Question 1.—On what bearing should the line between lots 20 and 21 be run? The lines between lots are not shown in notes of original survey (which was a traverse of Longwood's Road), except the line between lots 13 and 14, which was run as shown on plan. The original plan gives the bearing N. 16 deg. W. mag. to the line between lots 17 and 18, which was evidently intended for governing line. Mag. var. 0° 45'. Longwood's Road is not on our course.

Answer.—Run at angle 27 deg. 45 min. with line between lots 13 and 14. (Sec. 25, cap. 181).

Question 2.—In this case the front line of the last 6 lots of con. 3 is entirely obliterated, and no points in front of said lots can be obtained by evidence as to the original line eastward from the south-west angle of lot 19. The Council require the line correctly located in front of said lots. How is it to be done? Con. 3 is 5 chains longer than con. 2. To divide equally on east boundary would cause much confusion.

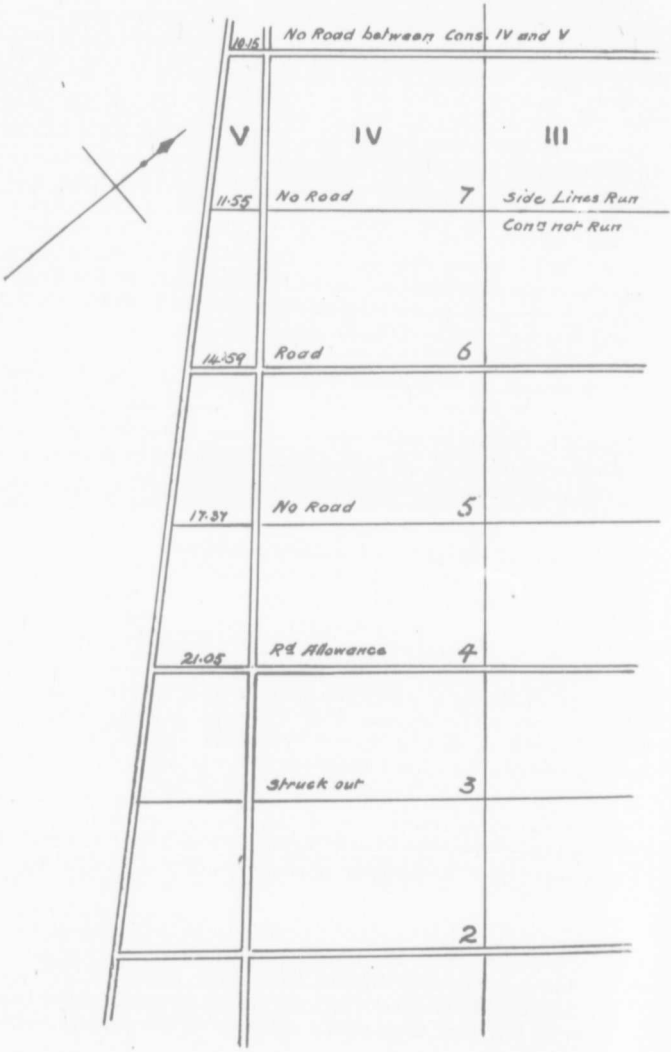
Answer.—Divide proportionately on east boundary and connect south-east angle of lot 24 thus established with post at south-west angle of lot 19 by a straight line.

Question 3 A.—How would you re-establish line between concessions ten and eleven, in this case, across lots one and two? There is an old post corner of lot 1, con. 10, south boundary. All old blazes and posts on concession line have been obliterated by fire. Centre line of concession was originally run from south boundary across lots 1 and 2, and as shown by dotted line to the west boundary. Afterwards lots 51, 52, 53, and 54 were surveyed off by another surveyor under instructions from Department, who mentions in notes that distance from south side of river along west boundary south 14 deg. 50 min. E. "to limitation of 11th con. is 40 chains 60 links, as shown on sketch." No mention made in field notes of rear of lot 53 intersecting concession line.

Answer.—Follow original survey of con. 11, establish intersection of front of same with west boundary, according to original notes, and connect with point opposite south-west angle lot 1, con. 10.

Question 3 B.—How would you run lines between lots 2 and 3 and between 3 and 4, in the township of Brudenell. How would you run line between lots 285 and 286, Range B north? Supposing none of side lines between lots 280 to 290, inclusive, have been run prior to July 1st, 1897, would you run on astronomic course

GUELPH


10.15
No Road between Cons. IV and V
V
IV
III
11.55
No Road
7
Side Lines Run
Con'n not Run
14.59
Road
6
17.37
No Road
5
21.05
Rg Allowance
4
Struck out
3
2

of line between 280 and 281, as shown in field notes, or on course of line as posted on ground ?

Answer.—Run on astronomical course. Divide proportionately along concession line between 10 and 11, and if no lines run in block prior to 1st July, 1897, run on astronomic course.

Question 4.—A private survey was made by me for "A" of parts of lots 27, 28, and 29, in the B. F. and 1st Concessions of Saltfleet, and the boundaries thereby ascertained were marked by cut stone monuments, planted with centres upon the lines. After the completion of the work, an unfriendly neighbor, "B," owning adjoining land, though not deprived of any acreage by the line surveyed, removed two of my monuments, throwing them to one side, and inscribing thereon, "The man who planted these had a h— of a cheek." I wish to know, 1st, if "B" was justified in removing the said monuments ? and, 2nd, if not, can our Association properly proceed against "B"? and, third, if our Association has the right to proceed against him, are we not morally bound to do so, in order that the acts of our profession may be respected ?

Answer.—1. Was not justified. 2. Do not think the Council would be warranted in incurring expense for protection of members' clients.

Question 5.—In running line between lots 2 and 3, con. 2, the original post on north side of road being lost, which post would you start from, that at A or B ? Which constitutes the "best evidence" of the location of the lost corner at C ? The posts at A and B have neither of them been moved since original survey, but were carelessly planted in that survey, and are not in line. To start from B would make the lot 4 links narrower than if the line was run from A. Sub-sec. 2, sec. 37, chap. 181.

Answer.—From the post at B.

Question 6.—In part of Division B, in Guelph Township (Canada Company survey), the side lines were run in the original survey, but not the concession lines. According to the field notes a road allowance was left between cons. 4 and 5, at the lines between lots 2, 3, and 3-4, but no road is shown in the notes of the lines between lots 4-5, 5-6, 6-7, nor 7-8. The plan shows a road right through, as on the annexed tracing. The patents of the south-west halves of lots 5 and 6, con. 4, give metes and bounds, and refer to a road allowance between concessions 4 and 5. The patent of the south-west half of lot 7, con. 4, gives metes and bounds, but does not mention a road allowance. Lots 6 and 7, con. 5, are described in patent by number only. A road has always been open across lots 4 and 5, but none across lots 6 and 7. The Town-

ship Council now wish to have the road allowance located with a view to selling to the adjoining owners. Is there a road allowance there, and if so, how should it be located? Should the whole of such allowance be taken off the fifth concession, as appears to have been done across lot 5? In calculating the areas for patent of 6 and 7, con. 5, there had apparently been fifty links deducted from the chainage given in the notes.

Answer.—Would recommend a municipal survey, which should be executed under the advice of the township solicitor. When confirmed by the Commissioner the dispute would be settled (sub-sec. 45 of s. 14, chap. 181).

Question 7.—In the opinion of your Committee, what is the custom of land surveyors in fixing the shore line of a lake or river?

Answer.—To take the high water mark, which is the line of vegetation.

DISCUSSION.

Mr. Niven replied to certain questions with illustrations on the blackboard. He then referred to question number 4, which had been presented to him coming from Hamilton, and said:

I sympathize very much with the surveyor in this case. I think when surveyors plant posts or monuments, in this case stone monuments, it is very wrong for any person to come and interfere with them. I have always thought that a monument planted by a surveyor should be held to be sacred, as it were, until removed by some proper authority, and although I do not see exactly how the Association could interfere in this case, I think that the surveyor is entitled to the moral support of the Association, and if anything can be done to help him in this case it should be done.

Mr. Tyrrell—Being the surveyor in this case referred to, I naturally feel strongly on the subject. B., who is referred to in the question, is making quite a boast round Hamilton of his action in the matter—of the way in which he has disregarded the survey, and considers our work of no consequence whatever. We ought in some way to try and insist on our acts being respected. I would not like the Association to go into expensive costs in litigation, but we might do something in the way of warning this individual of the consequences which he is laying himself open to.

Mr. Niven—If I understand the Criminal Code, the man who threw those monuments out left himself liable to be proceeded against.

Mr. Dickson—I think the client should proceed.

Mr. Kirkpatrick—Was it because they encroached on his land ?

Mr. Tyrrell—He does not express any theory in regard to them at all. He was not consulted in regard to making this survey. It is true the monuments were on his side of the fence. Being a worm fence one of them was directly on the centre of the old fence at one end and at the other there was nothing but an old brush fence, and it was not supposed to be the true line, which came some few feet in on his place.

Mr. Kirkpatrick—Supposing the stone monuments had not been planted there and a post had been, and he pulled that post up, that post was there to define the boundary line between his land and this widow's. Surely if he pulled up that post and threw it away, he would lay himself open under the Survey Act. No man shall disturb any man's landmark. He may say it is not mine, but it was hers, and certainly you cannot plant a post between two people's land unless you encroach. If you plant a six-inch square post, the universal practice is to plant three inches of that on one man's land and three inches on the other, so that the centre of the post shall be the dividing line. And then, on a similar argument, if you plant a monument six inches square, of course it might be possible to plant it wholly on her land and let the edge be his, but that would not be the ordinary custom with the surveyor, because a stone monument is marked generally with a cross or pointed at the top, and the extreme top is the centre. Of course he may dispute your survey, but that is not the question. I think the client ought to bring the action.

Mr. Niven—I think his act would make him amenable to the law, and it would be a simple matter to punish him.

Mr. Dickson—I had a case in the Township of Cavan, where I ran a line and the man deliberately went and pulled up all my pegs. He was summoned by my client before the Police Magistrate at Port Hope, and he threw it out altogether. The Police Magistrate said there was no law for it. He had no jurisdiction.

Mr. Bowman—The Council might obtain the opinion of a solicitor in the matter, and if the action of this Hamilton party was against the solicitor's advice, then have him warned to have the monuments put back and pay for the cost of putting them back. There seems to be a difference of opinion as to our rights in the matter, and the Association has funds and could get this thing looked into, and a report made, and an opinion given by some lawyer of good standing.

Mr. Wicksteed—It would give us strength. It does away with the value of the Association as a society if we do not assist each other in these matters.

The President—Section 42 of the Survey Act says, (Reads.)

Mr. Jones—It seems to me we have taken action in other cases perhaps somewhat differing from this. We have obtained solicitors' opinions, and I think in some cases prosecution has been made. This seems to be a straight case of law, and where the local surveyor could probably take action. I think the Council of the Association should write to this man requiring him to replace the posts and threatening a law suit if he does not do so.

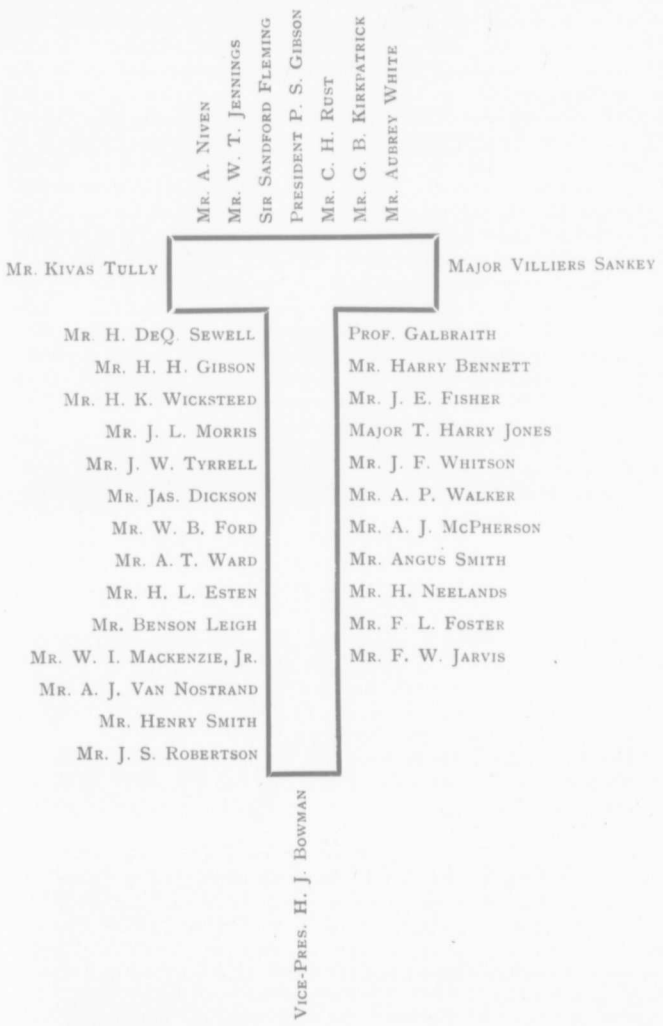
Mr. Wicksteed—I think that should be done. Anything the Association can do to support Mr. Tyrrell should be done.

REPORT OF ENTERTAINMENT COMMITTEE, 1899.

Mr. President,—Your Entertainment Committee for 1898-9 beg to report as follows:

The fourteenth annual dinner of the Association was held at McConkey's Restaurant on the evening of 1st March, 1899. A large number of members of the Association, with their guests and friends, attended, and the members were especially pleased to have with them Sir Sandford Fleming, one of, if not, the oldest and most distinguished member of the profession in Canada. The guest-list also included Mr. Aubrey White, Assistant Commissioner of Crown Lands, Ontario; Mr. W. T. Jennings, President Canadian Society of Civil Engineers; Mr. C. H. Rust, City Engineer, Toronto; Mr. Kivas Tully, Department of Public Works, Ontario, and Messrs. F. W. Jarvis and J. S. Robertson, representing respectively the legal profession and the press.

The chair was taken by yourself, as President of the Association, and the vice-chair by the Vice-President, Mr. Bowman, and after all had had sufficient of the good things provided by "mine host" for the occasion, the following programme was carried out: Toast, "The Queen," proposed in loyal terms by the President and followed by the singing of the National anthem. Toast, "Canada," proposed by the President, responded to by Sir Sandford Fleming, who related a number of interesting episodes of his earlier days. Song, "The Maple Leaf." Toast, "Ontario," proposed by the President,


Mr. A. Niven
Mr. W. T. Jennings
Sir Sandford Fleming
President P. S. Gibson
Mr. C. H. Rust
Mr. G. B. Kirkpatrick
Mr. Aubrey White
Mr. Kivas Tully
Major Villiers Sankey
Mr. H. DeQ. Sewell
Mr. H. H. Gibson
Mr. H. K. Wicksteed
Mr. J. L. Morris
Mr. J. W. Tyrrell
Mr. Jas. Dickson
Mr. W. B. Ford
Mr. A. T. Ward
Mr. H. L. Esten
Mr. Benson Leigh
Mr. W. I. Mackenzie, Jr.
Mr. A. J. Van Nostrand
Mr. Henry Smith
Mr. J. S. Robertson
Prof. Galbraith
Mr. Harry Bennett
Mr. J. E. Fisher
Major T. Harry Jones
Mr. J. F. Whitson
Mr. A. P. Walker
Mr. A. J. McPherson
Mr. Angus Smith
Mr. H. Neelands
Mr. F. L. Foster
Mr. F. W. Jarvis
Vice-Pres. H. J. Bowman

responded to in eloquent terms by Mr. Aubrey White. Songs, Mr. Bennett, "The Flying Machine" and "Just One Girl." Toast, "Sister Societies," proposed by Vice-President, responded to by Mr. Jennings, Mr. Rust and Prof. Galbraith. Toast, "Learned Professions," proposed by Vice-President, responded to by Mr. Kivas Tully and Mr. F. C. Jarvis. Song, Mr. Niven, "The British Lion." Recitation, Mr. Jones, "Sergeant What's His Name." Toast, "The President," proposed by Sir Sandford Fleming, responded to by Mr. Gibson. Songs by Messrs. Sewell, Benson Leigh, and Mr. Bennett. Toast, "The Entertainment Committee," proposed by Mr. Morris, responded to by Mr. Walker. "Auld Lang Syne" and "God Save the Queen" concluded a most enjoyable evening's entertainment.

Your Committee consider themselves fortunate in being able to secure the services of Mr. Harry Bennett, a humorous vocalist, whose selections during the evening were very much appreciated. A diagram showing the names of members and guests present is attached hereto. A statement of receipts and disbursements has been filed in the office of the Secretary-Treasurer.

All of which is respectfully submitted.

A. P. WALKER,
Chairman Entertainment Committee.

REPORT OF COMMITTEE ON ENGINEERING.

MR. PRESIDENT,—Circumstances conspired to prevent the members of the committee meeting on February 28th, as per programme, but the committee has not been idle during its term of office, as is evident from the number of papers on engineering subjects prepared for the annual meeting.

The Chairman and the majority of the committee agree that papers descriptive of proposed works that could possibly be classed as "promoters' schemes" should not appear in printed proceedings of the Association.

In looking through the proceedings for the last few years there will be found papers on mines, power schemes, railway lines, etc., that in our opinion detract from the dignity of the profession, and we would suggest that the incoming Council send a circular to each member of the Association announcing that papers of this character are not desired, although matters of this kind may be discussed at the annual meeting.

WILLIS CHIPMAN,
Chairman.

PAPERS.

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

PROGRESS OF GOLD MINING IN THE CENTRAL GOLD BELT OF THE RAINY RIVER DISTRICT.

By H. W. SELBY,
Dinorwic.

Having read the interesting paper on the above subject in the Lake of the Woods District, by H. DeQ. Sewell, O. L. S., at the last annual meeting of the Association, I have deemed it right to draw the attention of the members to what is being done in the central part of the Rainy River District, of which I believe very little is generally known.

It may be interesting to know that this belt has an area, so far as prospected and surveyed, of about 2,200 square miles, extending south-west from Dinorwic, on the C. P. R. about 50 miles and about 40 miles northeast, with a width of about 24 miles. Within this area the formation is mostly Huronian.

A glance at the very excellent map of the district described, issued by the Crown Lands Department last year, will serve to assist in the comprehension of the enormous amount of work done in the short time which has elapsed since the first prospecting was done within this belt, and although many of the plans have not been fyled, still you will appreciate the fact that the poor fly-eaten, mosquito-tormented, and hornet-stung surveyor has not been idle, and that through perils by land and perils by water, and through many tribulations, he should be congratulated on furnishing the Crown Lands Department with so much valuable information at so little cost to the country.

It is a matter of history that before July, 1895, only a dozen mining locations had been surveyed within the belt here described, and to Mr. Gillon, O. L. S., of Fort Frances, and myself fairly belong the honor of being the pioneers in this work.

It is but fair to add that throughout the whole of this district very few locations were surveyed that were not prospected for gold, and, though in a few instances only ordinary indications were the result, still on the majority of them good panning veins are found.

In the spring of 1896 the prospecting element began to be very much interested in the Manitou District, it being the south-westerly portion of this belt. In the same spring another set of prospectors entered the country north-east of Dinorwic, now known as the Minnietakie District, and gradually the two have been connected by surveys, until now we see development work quietly but persistently going on from one end of the central gold belt of the Western Ontario gold fields to the other.

In August, 1897, I had the honor to be called to pioneer a new district, now known as the New Klondike, named so from the fact that placer mining was thought possible, and considerable excitement was created by the dirt in several gulches showing rich pannings. Nothing further has been attempted in placer mining, as the quartz veins, being of so rich a nature, all efforts have been turned towards their development. The results so far have not been disappointing, and some of us may live to see that district bearing its share in the honor and glory which the central gold belt is designed to receive; but the proverbial hesitation of Canadians to venture their money in untried localities is having its influence on the development of the country, which may be aptly illustrated by the following incident:

One day meeting a Yankee Irish prospector in his canoe, he was asked how he was making it go. "Och," he says, "is it how oime making it go, your asking? Well, not very good; Canada is too slow. We have lived just forty years too soon." Joking aside, if the wealthy men of Canada could conceive of the immense wealth which nature has stored up in their own country, instead of sending their money outside for investment they would keep some of it at least to develop this mineral wealth, which, as loyal and patriotic citizens is expected of them, and not remain under the stigma which they are by not only my Irish friend, but all those who have seen this part of the Ontario gold fields in its process of development.

I have shown you thus far how, in the short space of three years, this immense tract of land has been explored and what was thought to be the best of it surveyed; and I would be pleased to go into detail and describe each property and the improvements thereon, but that would take more of your time than I have any desire to occupy. Suffice it to say there are now which I know of 10 shafts down 100 feet, 20 shafts down 75 feet, 20 shafts down 50 feet, and many others from 25 to 40 feet. One shaft only has

reached the depth of 200 feet, which is on HW 419, in the New Klondyke, and owned by the Northwestern Ontario Gold Mining Company. This vein has developed from a stringer to a width of 5 feet, retaining its values. A stamp mill is to be installed during the coming season.

One stamp mill, "The Haycock," only has been erected until this winter the Barker Bros. put in a Tremaine steam stamp mill for testing location HW 339, on the Lower Manitou. The result has been so satisfactory that they have completed the purchase of the said property for $10,000.

In the Minnietakie section, on 105 S. V., development work was carried on last winter and part of the summer. A shaft was sunk 65 feet and a crosscut of 35 feet in solid quartz by the John Sykes Mining Co., and the assays proving so satisfactory the Company are now putting in a ten-stamp mill and a saw-mill to cut the lumber and timbers for the buildings required.

In the Upper Manitou section, "The Independence," HP. 387, has been constantly worked for a year. Three shafts have been sunk, one to a depth of 100 feet, and a crosscut of 17 feet in solid quartz, and a drift along the vein from No. 1 shaft to No. 2. The Company are now installing a 10-stamp mill, which shows that the results have been fully up to expectations.

There are rumors of other Companies putting in stamp mills the coming season, but the fact that so much work has been done and so few mills put in is to be taken as a good indication rather than otherwise. A stamp mill is not required, is a much larger expense to establish than people generally imagine, and if from any cause a Company ceases to operate condemns a property, until sufficient development work has been done to give a fairly correct idea of the ore in sight and its value. Here, again, comes in the lamentable cry, "Oh for some of the almost idle money of the wealthy to bring to light the unlimited mineral resources of Ontario!"

Reference has already been made to the fact that three years ago this mineral belt was practically unknown. Still, so much importance is attached to the future success of this district that the Government have spent about $10,000 in opening up roads and improving navigation; and to facilitate business and to meet the requirements of the district the C. P. R. has built three new stations at Dryden, Wabigoon and Dinorwic, with all the accompanying buildings, sidings, etc., and at Dyment sidings and a flag station, for the winter traffic to the New Klondyke.

In that time (three years) villages have grown at the above three places, stores, hotels, churches, schools, and all the necessary dwellings have grown up where three years ago the virgin forest reigned supreme. Steamboats run from all three places to assist in the work of opening up the country, which is slowly but surely

being accomplished, and with the unstinted use of pluck, elbow-grease, and capital, nothing can prevent the central gold belt of the Rainy River District from having a place among the great gold-producing areas of the world.

In conclusion, let me say, our mineral resources may be the best in the world or they may be worked more economically than any others, but we cannot expect foreign capital to become interested until Canadians show their confidence in their country by venturing to go down after the yellow stuff, and thus prove to the world what some of us are now satisfied would be the result.

DISCUSSION.

Mr. Tyrrell—I was personally very much interested in this paper. I know some of the properties, and I am glad to hear of their success.

I think, as the author of the paper is not present, we should depart from our rule and move him a vote of thanks, and I have much pleasure in doing so. Seconded by Mr. James Dickson, and carried.

Mr. Kirkpatrick—This paper has given us a great deal of information which will prove very valuable. Mr. Selby has done something that others have not done, giving us the exact location on which the development work is being performed. He mentions one, I think it is H. W. 339. I hope the owners may be successful, because they are going in pretty extensively. When I was in Rat Portage a couple of years ago prospectors were going back into Keewatin a couple of hundred miles. I understand Mr. Tyrrell went up with them.

Mr. Tyrrell—I think they did make quite a discovery up in Keewatin, but the great distance made it rather impracticable to work the property; that was the conclusion we came to.

The vein was only six inches when we started, and it looked promising, and I advised them to sink on it, and they did so, and it has been widening practically ever since. At one time they lost the vein at a depth of 100 feet, and they wrote down to me, asking what they had better do. I replied they had better not be discouraged too soon, but continue on for a few weeks at all events, and they would very probably strike it again before long. They did so, and found the vein again, and it has been widening ever since. The last report I heard was that they were getting an average across the whole width of the vein of $48 to the ton, which should give them reason to be encouraged.

Mr. Sewell—I always used to feel rather ashamed at being the only one who wrote on these subjects, and I am glad to see somebody else is going into it. I was, I think, the first to survey in the New Klondyke, and on one property we got a shaft down about 90 feet, on the Mastodon, but it has been full of water for, I think, about five or six years now. At the time there was some talk about a water power in that locality. In my mind one of the interesting features in our North-Western Ontario gold fields is water power. It is a means by which we can reduce the expenditure very much. In the New Klondyke, when I first knew it you could walk for miles without touching the ground. The engineers of the C. P. R. had been going over the ground, and in order that their lordships might have an uninterrupted view, they sent their cook boys on ahead and fired the forest, the result of which was you had to walk when you went surveying about five or six feet off the ground on these stubs. Now it is being covered with little jack pine and small scrub, but the timber is not of any practical value, which is a very material point. It is said that in British Columbia, at the Deer Park Mine, miners have been paying a dollar a pail for water to wash out their mill. They have actually had to carry it to the mill in buckets and pay a dollar a pail for it. Their pipes were all frozen and they had no water to go on with their washing. We have a good deal more water than they have, but still we need to make use of it, not altogether for washing for mill purposes, but to take the place of fuel. Electricity is being so developed that a distance of 15 or 20 miles is not anything out of the way to transmit power from our waterfalls, and I notice the Government has made very wise regulations in regard to those water powers; they can only be used and leased for actual bona fide use for mining or other purposes. Electricity will reduce the cost of mining in a great many cases fully 25 per cent., and this will often mean the difference between mining at a profit and not mining at all.

The writer of this paper says this gold belt is almost all Huronian. Now, that is as much as to say other rocks are not carrying gold. When I first went out west into that country, the Lake of the Woods was the only place where they supposed the gold was. Then they found there was gold in the New Klondyke, but still those were the early days. It was thought that the hornblende schists of the Huronian formation were the only gold bearing formations. Time went on and people came to the conclusion that if the granite happened to be up against the vein it did not injure it, and then they found if the vein got into the granite it was not any detriment. Now in some cases they get the gold only when they are in the granite. Take the celebrated Mikado Mine, they say it cuts across the granite. When they are in the granite

they get the gold, when they get out of the granite and into the Huronian schists they do not find any gold at all. Of course there are peculiar phenomena due to each particular locality. You cannot lay down any actual rule.

Dr. Dawson said, in his earlier treatise on the Lake of the Woods, there was a possibility of finding gold in the Laurentian, pure and simple, although it had not been found yet. He had seen some very nice looking veins. Now, veins are found in the old Huronian gneisses, the oldest rock which we have in Canada. They have it down at Island Falls, on Saw Bill, the Hammond Reef. The gold is not in quartz. It is in the old Laurentian rock. The rock is impregnated with gold.

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SURVEYING IN THE GOLD FIELDS OF ONTARIO.

By F. L. FOSTER, O. & D. L. S.
Mine Centre.

To members of our Association who have not made the mining districts of Ontario the scene of their professional labors, but who may contemplate doing so, a short article on the subject may prove interesting.

With a view to making it somewhat instructive as well, I have jotted down some memoranda based upon an experience of a year and a half in the Rainy River District, spent for the most part in the Lower Seine River gold fields, engaged in surveying and examining mining locations.

In the spring of 1897 I was induced by some speculative mining men, interested in the development of that part of Ontario, to open an office in the new settlement called Mino Centre, situated on the north side of Shoal Lake, a widening of the Seine River, seven or eight miles east of Rainy Lake. It is so called from its proximity to the central portions of the lately developed mining locations of the Lower Seine.

Although the feverish excitement of the previous two years had, to a great extent, died out, and most of the prospectors and mining speculators had gone to explore fresh regions, there were enough left to make business brisk at times and keep one moving about a good deal. This enabled me to examine a considerable area of country, the appearance of which seemed to fully justify the good accounts given of it by prospectors and others. By the geological maps issued by the Crown Lands Department, it will be seen that most of the mining locations at present surveyed occur in the belts of Kewatin schists, and though some of the best mines in the immediate vicinity of Shoal and Bad Vermilion Lakes occur in the Protogene and Gabbro rocks, in close proximity to the schists, it seems to be a general belief among prospectors that the Huronian rocks are the only ones worth exploring, the rest of the district having been ignored by them. From what one hears it would seem that this District has not been very widely or carefully explored.

Prospectors do not appear to have had the means necessary to thoroughly examine more than a comparatively small proportion of this large area. Even many surveyed locations are but imperfectly known, the owners being content with a superficial exploration, and the discovery of something in the nature of auriferous rock upon which to speculate, so that even in abandoned or forfeited locations good pay ore may be found by more effective exploration.

The Ontario and Rainy River Railway through this district, now in course of construction on or near the old C. P. R. line marked on the maps, will doubtless give a new impetus to prospecting in its vicinity, and will, by decreasing the present heavy cost of transporting mining machinery and supplies, greatly increase the value of good properties that might otherwise not be developed.

A surveyor of a speculative turn of mind may by assisting impecunious prospectors become part owner of locations more or less valuable.

A good property can often be secured for a small sum or a share acquired for making the survey and plan. This is frequently done with advantage to all concerned.

This brings me to a consideration of the value of a special study of practical mineralogy and geology. Of course all our surveyors know more or less about these sciences, but he who practises in the mining districts should spare no effort in applying this theory to a practical knowledge of the geological formations and minerals existing in the scene of his labors. If this is done he makes himself equal in knowledge and skill to many of the mining experts sent to examine mineral deposits and report upon partly developed properties by intending purchasers. A careful report from a surveyor accompanied by well drawn plans is often as valuable as one by the expert of wide experience. There is little or nothing that a highly paid mineralogist can do towards ascertaining the value of an incipient mine that cannot be done by our surveyors who have made the special study above referred to. An ordinary prospector, by the use of his pick and shovel, mortar and gold-pan, can readily tell whether a lead is worth developing or not, so a surveyor, equipped with a few assaying materials and testing apparatus, can make a better calculation of quantity and test of quality—one at least sufficiently accurate for a preliminary report in the initial stages of development, which can, if necessary, be in part, confirmed by a professional assayer. In this connection, I may say here, that the lectures and practical instruction given in the mining districts of Ontario, by highly efficient mineralogists,

under the authority of the Government, free of charge, to prospectors and others, are very greatly appreciated by all who receive them.

A course in the School of Practical Science is, however, very desirable, and should, I think, be taken advantage of by all who practice in these districts, adding materially to his professional prestige as well as knowledge—a matter of much importance in this sphere of action.

Books for reference and study, such as Prof. Chapman's "Minerals and Geology of Central Canada," his "Mineral Indicator," Prof. Lake's "Prospecting for Gold and Silver," etc., will be found useful if not necessary as constant companions.

A sufficient knowledge of hydraulics should be acquired by our surveyors to enable them to make an approximate calculation of the power to be developed from the numerous rapids and waterfalls on our rivers, as this will be an important factor in mining operations.

The transmission of this enormous power by means of electricity will, at no distant date, simplify and cheapen the process of mining in many places. In short, our surveying profession, in order to become a paying one in these parts, must be combined to a certain extent with that of the engineer and mineralogist. A survey of a location should, whenever early development or sale is desired, include sufficient data to allow a plan and notes to be made, showing the position of the ore vein or lode, its direction, dip and strike, a rough estimate of quantity and quality of ore; the topography, height of hills, position of lakes and rivers in its vicinity, position of waterfalls, their height and volume and rate of current, timber valuable for mining purposes, and in fact sufficient knowledge to enable an accurate preliminary report to be made. In cases where rapid surveys are required in order to secure title merely, this extra work is superfluous, and can, if desired, be done later on, but its value as a means of ready sale cannot be over-estimated, and should be done in the first survey if possible.

It may seem superfluous to mention camp and transportation outfit, as they differ but little from that used by any of our surveyors of wild lands, but to the few not accustomed to the practice under consideration, I may say that the first requisite for summer work in the region of lakes and rivers is one or two good Peterborough canoes, each capable of holding three men with camp outfit and provisions, and deep enough to carry this load over rough lake waters in heavy weather without shipping seas, and light enough to be portaged by one man.

The camp outfit may consist of two 7 x 9 tents of 8-oz. duck, with waterproof floor sheet for each; four tin camp kettles, fitted into each other so as to form one package; half-a-dozen knives, forks, spoons, and tin cups, the latter fitting in each other; small bags in which tins of pepper, salt, sugar, baking powder, etc., may be carried separately.

Provisions may consist of bacon, beans, potatoes, flour, biscuit, dried apples, sugar, tea, coffee, pepper, salt, yeast or baking powder; canned goods, consisting of tomatoes, beef, fruit of any kind, condensed milk, etc., according to taste. The total weight of these provisions should not exceed eighteen pounds for each day's consumption for a party of six men, but it is as well to have a few pounds over in case of accident or delay.

As to instruments, a small, light transit, with a three-inch limb and an expansion tripod is a good one for general use, and can be carried in its box over the roughest places without inconvenience or danger of being put out of adjustment. In the more important and widely extended surveys a larger one is, of course, necessary. A micrometer for summer work is the best instrument for traversing and getting distances across water stretches.

A small compass, with a four-inch needle and folding sights, gives good results when locations are small, the needle being only used for turning angles. It is almost useless to say that mining locations should be bounded by well cleared lines and have good-sized posts at the corners, very plainly marked with block letters and numerals. No Roman numbers ought to be put on posts, as they are apt to be puzzling to some people.

I have found in my practice that in order to secure prompt payment for surveys no trust should be allowed, either cash should be paid on delivery of plans, or an assignment in writing of an interest in the location should be demanded. It is an unfortunate fact that the majority of prospectors and mining speculators with which a surveyor has to deal are, as a rule, not men of the strictest probity, and although one meets with some of the opposite character, they are exceptions to the general rule. If I was writing a moral essay instead of jotting down a few hard facts, I would say something strong by way of warning against this lack of honor prevalent, I suppose, in most mining camps; gambling and the inordinate use of liquor being the principal causes as well as effects of this lax morality. As the life one leads in these half-civilized places constantly exposes one to the effects of these vices, I need hardly caution everyone to avoid both if he would retain his reputation, prosperity or health. During my short stay, several accidents, deaths, and murderous assaults have occurred in Mine Centre

and vicinity, caused by these vices and the lack of organized methods of preserving law and order. And then, too, so many false representations are made by holders of mining claims as to their value that one has to be constantly on his guard, and should take all accounts of "rich strikes" and "bonanzas" with some reserve, until a personal test of their truth is made. As a rule, nearly everyone is suspicious of his neighbor's veracity, and a reputation for strict honesty is only to be sustained by a fair and impartial judgment of all properties one is called upon to examine, apart from any interest he may have in them.

It is well known that this part of Ontario has suffered greatly in the estimation of capitalists and mining men in England, the United States, and Canada by the inflated accounts given by a few unscrupulous people interested in booming poor properties under false pretences with a view of making rapid sales at high prices. But the good old saying, "Magna est veritas, et prevalebit," will be found applicable here in time, and when the truth is known by actual development of its mineral wealth, this part of Ontario will in all probability take a high rank as a field for investment of capital.

DISCUSSION.

The President—Where do you bank your funds? Have you made your fortunes?

Mr. Tyrrell—We put it in barrels in the cellar.

Mr. Sewell—If you notice the map the Government has issued of that place the paper speaks of, there is intrusive granite, it has come up, it is post-Huronian, the Foley, the Lucky Coon, and the Golden Star, and the Olive are all on this intrusive belt. At the outer ridges of the Olive there appears to have been a volcano, and that has thrown it up.

Mr. Foster—All the Vermilion Lake region is supposed to be an old volcano, and in the olden times they say there was a high mountain round there, and by glacial action and other weathering it was brought down to its present level. The green Huronian schists found there are supposed to be lava. Those and the conglomerates are supposed to come from this crater. The plowing down of this action has caused the Plutonic rocks, the original granite, to be exposed and the schists to be only found on a portion of the district, so that in the highest portion, where this crater was, the Lau-

rentian rocks, gabbro and so forth are exposed, and form some valuable mines, amongst others the famous Golden Star.

Mr. Sewell—Is that Laurentian ?

Mr. Foster—Yes.

Mr. Sewell—Lawson says no. He says it is close Huronian. It is a matter of date. There are thousands of years between the two.

Mr. Foster—However that may be, these mines, the Golden Star and others, are peculiar. They are not far from the contact between the schists and this old rock, and another peculiarity of that and other mines in the vicinity is that they increase in value as they go down. In nearly all the leads that have been developed in that part of the country the rock has increased in richness, and the veins in width as they get deeper. This is a very important fact, and it does not occur in all parts of Ontario nor British Columbia.

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EXPLORATIONS.

By JAMES DICKSON, O.L.S.

Fenelon Falls.

Mr. President,—In presenting a paper on the above subject, it is not my intention to go to any great extent into details, but simply, from my point of view, draw the attention of this Association to a few of the reasons why more exploratory surveys should be made.

In the early history of the country an occasional line was projected into the unknown wilderness and made the base of future surveys. But it is only within the last few years, when the base lines in the Rainy River District were run and the more recent production of the western boundary of the Nipissing District to James' Bay, that explorations were reduced to anything like a system.

We are indebted chiefly to geological surveyors for our knowledge of the geography of our Province even in the vicinity of the settled portions. Those parties were generally in charge of a chief not skilled to any great extent in the art of surveying, the party consisting of, at the most, only three or four persons, the primary object being to get a knowledge of the mineral resources of the country, with a passing glance at its fauna and flora. Each party is assigned a certain district for a season's operations. They have not the requisite skill, nor are they furnished with the necessary instruments to either take observations, or make anything approximating an accurate survey. In fact, they are to do a maximum amount of work at a minimum of erpense. And I have no doubt when to their skilled eye a section of country shows no indications of mineral wealth, many objects of importance both from a scientific and a commercial point of view have been entirely overlooked.

The accuracy with which many of the lakes and streams have been laid down on plans by these gentlemen speaks volumes for the care they have taken in the discharge of their duties.

Other parties have at various times been intrusted with exploratory surveys in certain districts of rivers and lakes. But the smallness of these parties and the difficulty of transit made it

imperative to take the lightest and least accurate description of instruments. And the chief has been often compelled for self-preservation also to cover a maximum of territory in a minimum of time. Portions of his work have been done while seated in his canoe in a drenching rain, a driving snow-storm, or tossed at the mercy of wind and waves. His skill taxed to the utmost to preserve the lives of himself and party, leaving little time to devote to the primary object of the expedition.

Large sums of money have been expended in the prosecution of these surveys, and collections of valuable information stored up for for use of future generations, but a trifling addition to the outlay, small in proportion to the value of the results obtained, would not only have made these surveys much more accurate, but would have saved large expenditure in future. But in addition to what has been accomplished up to date a very large percentage of our west Province is still a sealed book except to the hunter and trapper.

I need scarcely point out to an audience such as this is, skilled in the use of the compass, how frequently the magnetic needle is deflected from its true course even when there are not the slightest indications of any mineral presented to the eye, nor how those variations box around, in short distances, from one degree up to a large arc of the circle, without the operator having the least idea that there is anything wrong, unless at each and every station he takes a careful back sight to some well defined object, a thing manifestly impossible with the staff and means at his disposal.

Should his traverse start at one accurately defined point and terminate at another equally well established, when he comes to plot his survey he may find himself miles out, with no means of finding out either where the error began or ended. But should neither the starting nor ending point have been accurately laid down, he may be out from beginning to ending, and either himself, if prosecuting the work further, or the one following in his footsteps, will not only perpetuate, but most likely increase, the error.

True observations for both latitude and longitude may be taken from time to time, but we all know how frequently consecutive days and nights may pass without either sun, moon, or stars being visible, and long distances passed over between observations, so even this does not meet the end in view.

A surveyor is instructed to proceed to a given point and project a line for a distance of fifty or one hundred miles or more. He has a numerous party, consequently a large store of provisions is necessary and his expenses for transportation a heavy item. He has no previous knowledge of the country, nor can he find

any reliable man who has. Along with his instructions he receives a map of the country on which are shown the principal lakes, rivers, and canoe routes, with as much accuracy as mortal man with the means at his disposal is capable of. Glancing over this map, which he assumes to be approximately correct, the surveyor soon fixes the route by which his supplies can be forwarded to points which will be either intersected by his line or adjacent thereto. He gives his packers the necessary instructions, together with a sketch of the route they are to pass over, also a hint as to the time at which he expects them to be at a certain point, takes an observation, and commences work. Some fine evening, when all virtue has gone out of both bacon and flour sack, and sundry other useful articles have also become exhausted, he makes the rendezvous, and instead of finding the much needed supplies they may be "miles, miles away," and starvation staring the whole party in the face before a junction of the two parties is effected, and the work may have to be suspended for days.

It has never fallen to my lot either to have charge of such a survey or to be even engaged on one, so that I can only theorize. But as some of the gentlemen present have, I should be much pleased to learn from them whether their experiences have proved my theory correct or otherwise.

I would suggest that the whole of the unsurveyed part of the Province of Ontario be divided into sections, and lines run due east and west and due north, at intervals of eighteen miles. Each section would thus embrace nine townships of thirty-six square miles each. Have the lines well opened out, well blazed, and mile-posts, either of iron or durable timber, and properly marked, erected, so that any person travelling through the woods and striking a line could locate himself accurately in a few minutes. During the progress of the survey, whenever a lake or river of any extent or volume was struck by the line, a compass and micrometer traverse of its shores could be made, if it was only for a few miles on either side. A couple, or, at most, three men, would suffice for this, and, from the points thus established, fairly accurate sketches of the intervening country could be made by any person at all skilled in woodcraft.

Were a system such as this, or one along similar lines, carried out, in the course of a few decades we would have an invaluable topographical map of the whole Province, and the value of the information thus obtained would be far in excess of the cost incurred.

I have no doubt but that the amount of money saved to miners and lumbermen during the last few years in the Rainy River Dis-

trict by having the recently surveyed exploration lines to locate their operations from has been more than the original cost of the lines.

It has been urged by some that the cash expended on many of the surveys undertaken by the Government in recent years has been thrown away, and, in so far as the Province has benefited, might as well have been sunk in the depths of the sea, and that the public should not be called upon to furnish funds for the benefit of a few lumbermen and miners. But they entirely overlook the large outlays those gentlemen have to make before they realize any returns, and the quantity of produce and manufactured articles they consume which are drawn from the centres of industry. I submit that if there are any undeveloped industries in any section of the Province, or hidden treasures in either our rocks, lakes, or rivers, it is the bounden duty of every Government to assist liberally in their development. There are few articles of either agriculture or manufacture that are not required to some extent in each and every community. Each section of country has generally some particular line of industry peculiar to itself, and it is only by a fair interchange of their various productions that nations and individuals obtain their wealth.

DISCUSSION.

Mr. Tyrrell—I think we are all agreed that it would be a very desirable thing if those exploratory surveys could be carried on in advance of the township surveys. The difficulty seems to be to get such a system under way. Has anything been done to bring the matter before the Government urging the desirability of such a move? If not, I think it would be very desirable that a Committee should be appointed and this matter pressed upon the Department of Crown Lands.

Mr. Dickson—There was something done, I think, towards having a topographical survey made of the whole Province.

Mr. Whitson—Each year the Government spends the small appropriation at their disposal advantageously, and last year two very important meridian lines were run, one from a short distance east of the Sault to its intersection with the main line of the Canadian Pacific, about 100 miles in length, and the other an extension of the boundary between Nipissing and Algoma to the Moose River.

I think Mr. Dickson's paper pretty well voices the sentiments

of all mining men and those who have had anything to do at all with the exploration, and the running of base lines within the last few years, and especially in the Rainy River District, was a great convenience to mining men. It is absolutely necessary that all mining locations should be tied on to some known point, and before the base lines were run in this District it was very expensive to lay out a mining location, but now it is easily done. No point is very far from a base line now. Timber limits are also now easily located.

Mr. Dickson—I would like to hear from any gentleman whether they have had much difficulty in forwarding their supplies to the different points on their lines.

Mr. Sewell—I always found by following a system you have very little trouble. Have one man responsible for the whole thing. I always manage to get along pretty well, I get some one who can talk Indian, or occasionally hire an Indian.

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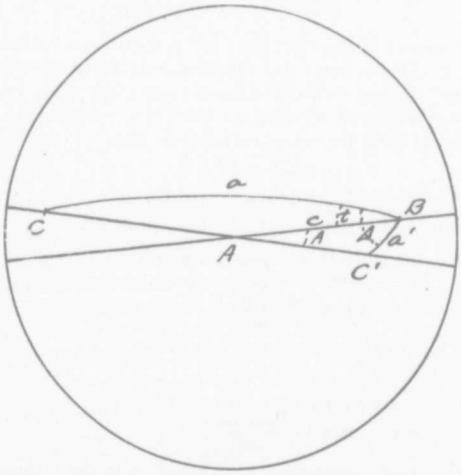
TIME AND AZIMUTH BY STARS, OBSERVED ON THE VERTICAL OF POLARIS.

By L. B. STEWART,
Toronto.

This paper contains the derivation of formulae for reducing transit observations for time and azimuth of stars across the vertical of Polaris.

The observation may be made as follows: The transit having been set up, the sight line is directed along the line whose azimuth is to be determined and the horizontal circle read. It is then directed to Polaris, and the time noted, and the horizontal circle



again read. Then, keeping the instrument clamped in azimuth, the time of transit of some other known star across the same vertical is noted. If desired, this operation may be repeated on some other star with the instrument in the reverse position, the times of

setting on Polaris and of transit of the other star being noted, and a second reading of the horizontal circle being taken. A second reading on the reference mark should also be taken. By this means the effect of errors of adjustment of the instrument will be nearly eliminated.

The latitude of the place of observation is also required in the reduction.

The above diagram is a projection of the celestial sphere on the plane of the horizon. AB is the meridian, A the zenith, B the pole, C′ the position of Polaris at the time of its transit, C that of the time star. Then if

ϕ = the latitude of the place.
δ = the declination of the time star.
δ' = the declination of the pole star.
p = the polar distance of the pole star.
t = the hour angle of the time star.
A = the azimuth of the pole star, reckoned from the north.
Δ = the angle CBC′.

we have from the diagram

$$c = 90° - \phi$$
$$a = 90° - \delta$$
$$a' = 90° - \delta' = p.$$

As the transits of the two stars are not observed simultaneously, the angle Δ differs from the difference of right ascension of the two stars by the interval of time between the two transits, that interval being reduced to sidereal time if a mean time watch has been used in taking the observations, so that

$$\Delta = (a' - a) - (\tau' - \tau) \qquad (1)$$

T′ and T being the observed times.

Then from Sph. Trig. we take the equations:

$$\sin \Delta \cot C = \sin a \cot a' - \cos a \cos \Delta$$
$$\sin B \cot C = \sin a \cot c - \cos a \cos B \qquad (2)$$
$$\sin A = \frac{\sin a \sin C}{\sin c}$$

which may be written:

$$\sin \Delta \cot C = \cos \delta \tan \delta' - \sin \delta \cos \Delta$$
$$\sin t \cot C = \cos \delta \tan \phi - \sin \delta \cos t \qquad (3)$$
$$\sin A = \frac{\cos \delta \sin C}{\cos \phi}$$

These equations contain the solution, but they must be transformed in order to adapt them for logarithmic computation, and to solve for t.

The first of (3) may be written:

$$\cot C = \frac{\cos \delta - \sin \delta \cot \delta' \cos \Delta}{\sin \Delta \cot \delta'}$$

then, introducing the auxiliary θ, such that

$$\tan \theta = \cot \delta' \cos \Delta \tag{4}$$

it becomes:

$$\cot C = \frac{\cos \delta - \sin \delta \tan \theta}{\sin \Delta \cot \delta'}$$

$$= \frac{\cos (\delta + \theta)}{\cos \theta \sin \Delta \cot \delta'}$$

Substituting the value of cot δ' from (4)

$$\cot C = \frac{\cos (\delta + \theta)}{\tan \Delta \sin \theta}$$

or

$$\tan C = \frac{\tan \Delta \sin \theta}{\cos (\delta + \theta)} \tag{5}$$

Substituting the above value of cot C in the second of (3), we have:

$$\sin t \frac{\cos (\delta + \theta)}{\tan \delta \sin \theta} + \sin \delta \cos t = \cos \delta \tan \varphi$$

Dividing through by sin δ and introducing a second auxiliary θ' such that

$$\tan \theta' = \frac{\cos (\delta + \theta)}{\tan \delta \sin \theta \sin \delta} \tag{6}$$

it becomes:

$$\sin t \tan \theta' + \cos t = \frac{\tan \phi}{\tan \delta}$$

or

$$\cos (\theta' - t) = \frac{\tan \phi \cos \theta'}{\tan \delta} \tag{7}$$

The equations (4), (6), and (7) determine t and (4), (5), and the third of (3) determine A.

The above is a rigorous solution of the problem, but as t and A are small angles they may be expanded in series, and by that means much more convenient expressions for practical use may be obtained.

To expand t in series write the first of equations (3) in the form:

$$\tan C = \frac{\sin \Delta}{\cos \delta \cot p - \sin \delta \cos \Delta}$$

$$= \frac{\sin \Delta}{\cos \delta \cot p (1 - \tan \delta \cos \Delta \tan p)}$$

$$= \frac{\sin \Delta}{\cos \delta} \tan p (1 - \tan \delta \cos \Delta \tan p)^{-1}$$

then expanding by the binomial theorem and substituting for tan p the expansion

$$\tan p = p + \frac{p^3}{3} +$$

neglecting powers higher than the third, this becomes on multiplying out and arranging

$$\tan C = \frac{\sin \Delta}{\cos \delta}\,(p + \tan \delta \cos \Delta\, p^2 + \tan^2 \delta \cos^2 \Delta\, p^3 + \tfrac{1}{3} p^3) \qquad (8)$$

Again, transposing the second of (3) and dividing by sin δ, we find

$$\sin t \frac{\cot C}{\sin \delta} + \cos t = \frac{\tan \phi}{\tan \delta}$$

Then, t being small, we have by expanding its sine and cosine and neglecting terms of a higher order than the third,

$$\left(t - \frac{t^3}{6}\right)\frac{\cot C}{\sin \delta} + \left(1 - \frac{t^2}{2}\right) = \frac{\tan \phi}{\tan \delta}$$

Then multiplying out and arranging

$$t \frac{\cot C}{\sin \delta} - \frac{t^2}{2} - \frac{t^3}{6}\frac{\cot C}{\sin \delta} = \frac{\tan \phi}{\tan \delta} - 1$$

$$= \frac{\sin (\phi - \delta)}{\cos \phi \sin \delta}$$

$$= \frac{m}{\sin \delta} \text{ (assume)}$$

t must now be found by a series of approximations. Thus, assume as a first approximation:

$$t \frac{\cot C}{\sin \delta} = \frac{m}{\sin \delta} \text{ or } t = m \tan C$$

then substituting this value of t in the second term of the above series, we find as a second approximation

$$t \frac{\cot C}{\sin \delta} - \frac{m^2}{2} \tan^2 C = \frac{m}{\sin \delta}$$

or

$$t = m \tan C + \frac{m^2}{2} \sin \delta \tan^3 C$$

Finally, substituting this value of t in the second and third terms, we find on reducing

$$t = m \tan C + \frac{m^2}{2} \sin \delta \tan^3 C + \frac{m^3}{6} \tan^3 C$$

Then substituting in this expression the value of tan C given by (8), multiplying out and neglecting as before terms of a higher order than the third, we have

$$t = m \frac{\sin \Delta}{\cos \delta} p + m \frac{\sin \Delta}{\cos \delta} \tan \delta \cos \Delta\, p^2$$

$$+ m \frac{\sin \Delta}{\cos \delta}\left(\tan^2 \delta \cos^2 \Delta + \tfrac{1}{3} + \frac{m}{2} \sin \delta \frac{\sin^2 \Delta}{\cos^2 \delta}\right.$$

$$\left. + \frac{m^2}{6} \frac{\sin^2 \Delta}{\cos^2 \delta}\right) p^3$$

In this series t and p are in circular measure, substituting
$t \sin 1''$ and $p \sin 1''$
for t and p, and dividing through by sin 1", we have (t and p being now expressed in seconds of arc):

$$t = m \frac{\sin \Delta}{\cos \delta} p + m \frac{\sin \Delta}{\cos \delta} \tan \delta \cos \triangle p^2 \sin 1''$$
$$+ m \frac{\sin \Delta}{\cos \delta} \left(\tan^2 \delta \cos^2 \Delta + \tfrac{1}{3} + \frac{m}{2} \sin \delta \frac{\sin^2 \Delta}{\cos^2 \delta} \right.$$
$$\left. + \frac{m^2}{6} \frac{\sin^2 \Delta}{\cos^2 \delta} \right) p^3 \sin^2 1'' \qquad (9)$$

in which

$$m = \frac{\sin (\phi - \delta)}{\cos \phi}$$

If the time star be observed below the pole, then m becomes

$$\frac{\sin (\phi + \delta)}{\cos \phi}$$

and the term

$$\frac{m}{2} \sin \delta \frac{\sin^2 \Delta}{\cos^2 \delta}$$

changes its sign, and t is the hour angle, reckoned from the meridian below the pole.

The third term of eq. (9) may always be neglected except where extreme precision is required. In the example worked out in the Manual of Dominion Lands Surveys, on p. 83 it amounts to about one-eighth of a second of time. The first two terms contain the equations used in the construction of the tables given in the Manual.

If the third term is to be computed, then the series may be written in the form:

$$t = m, m\, p + m\, m, n, p^2 \sin 1''$$
$$+ m\, m, (n,^2 + \tfrac{1}{3} + \tfrac{1}{2} m\, m,^2 \sin \delta + \tfrac{1}{6} m,^2 m^2)\, p^3 \sin^2 1'' \qquad (10)$$

in which

$$m, = \frac{\sin \triangle}{\cos \delta} \qquad n, = \tan \delta \cos \Delta$$

The azimuth may also be expanded in series as follows:—Writing eq. (8) in the form

$$C = \tan^{-1} \left\{ \frac{\sin \triangle}{\cos \delta} (p + \&c.) \right\}$$

and expanding by means of the series

$$\tan^{-1} x = x - \frac{x^3}{3} +$$

we have

$$C = \frac{\sin \Delta}{\cos \delta} (p + \tan \delta \cos \Delta\, p^2 + \tan^2 \delta \cos^2 \Delta\, p^3$$
$$+ \tfrac{1}{3} p^3 - \tfrac{1}{3} \frac{\sin^2 \Delta}{\cos^2 \delta} p^3)$$

and also by the third of (3)

$$A = \sin^{-1}\left\{\frac{\cos\delta}{\cos\phi}\left(C - \frac{C^3}{6}\right)\right\}$$
$$= \frac{\cos\delta}{\cos\phi}\left(C - \frac{C^3}{6}\right) + \frac{1}{6}\frac{\cos^3\delta}{\cos^3\phi}\left(C - \frac{C^3}{6}\right)^3$$
$$= \frac{\cos\delta}{\cos\phi}C - \frac{1}{6}\left(\frac{\cos\delta}{\cos\phi} - \frac{\cos^3\delta}{\cos^3\phi}\right)C^3$$

Then substituting the value of C given above, multiplying out, and reducing as before, we obtain

$$A = \frac{\sin\Delta}{\cos\phi}p + \frac{\sin\Delta}{\cos\phi}\tan\delta\cos\Delta\,p^2\sin 1''$$
$$+ \frac{\sin\Delta}{\cos\phi}\left(\tfrac{1}{3} + \tan^2\delta\cos^2\Delta - \tfrac{1}{2}\frac{\sin^2\Delta}{\cos^2\delta}\right.$$
$$\left. + \tfrac{1}{6}\frac{\sin^2\Delta}{\cos^2\phi}\,p^3\sin^2 1''\right) \qquad (11)$$

The third term here may also generally be omitted, but if it is retained the series (11) may be written in the form:

$$A = m_2\,p + m_2\,n_1\,p^2\sin 1''$$
$$+ m_2\,(\tfrac{1}{3} + n_1^2 - \tfrac{1}{2}\,m_1^2 + \tfrac{1}{6}\,m_2^2)\,p^3\sin^2 1'' \qquad (12)$$

in which

$$m_2 = \frac{\sin\Delta}{\cos\phi}$$

and as before

$$m_1 = \frac{\sin\Delta}{\cos\delta}$$
$$n_1 = \tan\delta\cos\Delta$$

Comparing equations (9) and (11), it is seen that if the third terms be neglected

$$t = A\frac{\sin(\phi - \delta)}{\cos\delta} \qquad (13)$$

$$A = t\frac{\cos\delta}{\sin(\phi - \delta)} \qquad (14)$$

If preferred, after finding the hour angle of the time star, that of Polaris may be computed by deducting t from Δ, and the azimuth of the latter star may be computed from the data: latitude, hour angle, and declination. Applying an equation similar in form to he first or second of (2) to the triangle ABC', we have

$$\sin t'\cot A = \cos\phi\cot p - \sin\phi\cos t'$$

which equation may be placed under various forms for practical use. Thus, writing it in the form

$$\tan A = \frac{\sin t'}{\cos\phi\cot p - \sin\phi\cos t'}$$

and dividing both numerator and denominator by $\cos \varphi \cot p$, it becomes

$$\tan A = \frac{\sin t' \sec \phi \tan p}{1 - \cos t' \tan \phi \tan p} \tag{15}$$

which is one of the equations given in the Manual for the reduction of azimuth observations. It requires subtraction logarithms.

Again, writing it in the form

$$\tan A = \frac{\sin t'}{\cos \phi \tan \delta' (1 - \tan \phi \cot \delta' \cos t)}$$

and introducing the auxiliary θ, such that

$$\cot \theta_1 = \cot \delta' \cos t'$$

or

$$\tan \theta_1 = \frac{\tan \delta'}{\cos t'} \tag{16}$$

it becomes

$$\tan A = \frac{\sin t'}{\cos \phi \tan \delta' (1 - \tan \phi \cot \theta_1)}$$

$$= \frac{\sin t' \sin \theta_1}{\tan \delta' \sin (\theta_1 - \varphi)}$$

or, eliminating $\tan \delta'$ by (16)

$$\tan A = \frac{\tan t' \cos \theta_1}{\sin (\theta_1 - \phi)} \tag{17}$$

Equations (16) and (17) give the solution.

Or, again, A may be expanded in series, thus:

$$\tan A = \frac{\sin t'}{\cos \phi \cot p (1 - \tan \phi \tan p \cos t)}$$

$$= \frac{\sin t'}{\cos \phi} \tan p (1 - \tan \varphi \tan p \cos t')^{-1}$$

Then, expanding by the binomial theorem, we have

$$\tan A = \frac{\sin t'}{\cos \phi} \tan p (1 + \tan \phi \cos t' \tan p + \tan^2 \phi \cos^2 t' \tan^2 p +)$$

and then, expanding tan. p as before and reducing, the expression becomes

$$\tan A = \frac{\sin t'}{\cos \phi} (p + \cos t' \tan \phi p^2 + \cos^2 t' \tan^2 \phi p^3 + \tfrac{1}{3} p^3)$$

which may be written

$$A = \tan^{-1} \left\{ \frac{\sin t'}{\cos \phi} (p + \&c.) \right\}$$

Expanding again as before and reducing, we have

$$A = \frac{\sin t'}{\cos \varphi} . p + \frac{\sin t'}{\cos \varphi} \cos t' \tan \varphi p^2 \sin 1''$$

$$+ \frac{\sin t'}{\cos \varphi} \left(\tfrac{1}{3} + \cos^2 t' \tan^2 \varphi - \tfrac{1}{3} \frac{\sin^2 t'}{\cos^2 \varphi} \right) p^3 \sin^2 1'' \tag{18}$$

The third term in this series will seldom amount to more than

a few seconds, and may generally be neglected. Its value evidently increases with the latitude, as also appears from the following table, which contains some of its values, p being taken for the year 1900:

	$t =$	$t =$	$t =$	$t =$	$t =$
ϕ	1 h.	2 h.	3 h.	4 h.	5 h.
20°	0.″24	0.″36	0.″31	0.″15	−0.″02
30°	0.36	0.54	0.45	0.17	−0.13
40°	0.64	0.93	0.74	0.19	−0.37
50°	1.28	1.85	1.40	0.22	−0.97
60°	3.13	4.47	3.27	0.29	−2.72
70°	10.79	15.33	11.01	0.42	−10.20

An examination of this table shows that this term attains a maximum positive value for an hour angle slightly exceeding 2h. and changes its algebraic sign at a little over 4h. By equating to zero the first derivative of the term with regard to t as the independent variable, and then placing the portion of the term within the brackets equal to zero, reducing in each case and solving for t, we obtain the two expressions

$$\sin^2 t' = \tfrac{1}{3} \cdot \frac{1 + 2\sin^2\varphi}{1 + 3\sin^2\varphi}$$

$$\sin^2 t' = \frac{1 + 2\sin^2\varphi}{1 + 3\sin^2\varphi}$$

the first giving the value of t, for which the third term of (18) is a maximum, and the second its value for which that term vanishes. In latitude 45 deg. N. it will be found by the above equations that these two values of t are, respectively,

$$2\,h.\ \ 4\,m.\ \ 21.8\,s.$$
$$\text{and}\quad 4\ \ \ 13\ \ \ 44\ 5$$

and these values change slowly with the latitude. The conclusion, then, is that in Ontario the third term of the series (18) may be omitted whenever an error not exceeding 5" may be neglected, and especially when the hour angle is in the neighborhood of 4h.

The above method of obtaining the azimuth of a line should be a very useful one for the practising surveyor. By providing himself with a list of the apparent places of about a dozen stars, taken from the Nautical Almanac, and so chosen that one is always available for observation shortly after sunset at any time during the summer, the surveyor will then be in a position to observe for azimuth at the time he considers most convenient, instead of waiting for the elongation of Polaris. The reduction of the observations by means of equations (11) and (13), the latter giving the watch correction, is not a very laborious matter.

The following observations were taken on March 29th, 1899, to find the azimuth of a line and the watch correction:

Pt. observed	*H.C.R.*	*Watch.*
Ref. Mark	45° 18′	
Polaris	73° 33′ 30″	8 *h.* 30*m.* 51*s.*
ζ Hydræ	"	8 24 43

The apparent places of the stars were:

	R.A.	*Decl.*
Polaris	1 *h.* 21 *m.* 21 *s.*	+ 88° 46′ 23″
ζ Hydræ	8 50 6	+ 6° 19′ 35″

The data then were:

$\Delta = 111° 13'$ (Eq. 1.)
$\varphi = 43° 39' 36''$
$\delta = 6° 19' 35''$
$p = 4417''$

To find the azimuth: eq. (11)

log sin Δ	= 9.96952	
" p	= 3.64513	
" cos φ	= 9.85941	
	13.61465	
" 1*st* term	= 3.75524	1*st* term = 5692″
" tan δ	= 9.04480	
" cos Δ	= *n*9.55858	
" p	= 3.64513	
" sin 1″	= 6.68557	
" 2*nd* term	= *n*.68932	2*nd* term = — 5″

$\therefore A = 5687'' = 1° 34' 47''$

To find the hour angle of the time star: eq. (13)

log A	= 3.75488
" sin $(\varphi - \delta)$	= 9.78280
" cos δ	= 9.99735
	13.53768
" t	= 3.54033

$\therefore t = 3470''$
$= 231s. = 3m. 51s.$

To find the azimuth of the reference mark:

Az. of Polaris	= 358° 25′ 13″
H.C.R. on Polaris	= 73° 33′ 30″
Az. of 0° of Circle	= 284° 51′ 43″
H.C.R. on Ref. Mark	= 45′ 18′
Az. of Ref. Mark	= 330° 9′ 43″

Azimuths are here reckoned from north in the direction in which the degrees of the circle are numbered.

To find the watch correction:

R.A. of time star	=	8*h.*	50*m.*	6*s.*
West hour angle	=		− 3	51
Sidereal time	=	8	46	15
Long.	=	5	17	35
Greenwich sid. time	=	14	3	50
Sid. time at Gr. mean noon (N.A.)	=	0	26	14
Elapsed Sid. interval	=	13	37	9
Corresponding solar interval (= Gr. mean time)	=	13	34	55
Standard time	=	8	34	55
Watch face	=	8	34	43
Watch correction on St. time	=			+ 12*s.*

The third terms in equations (10) and (12) in this example are found to be 0″ − 05 and 0″ − 44 respectively, so that they are safely neglected.

DISCUSSION.

Mr. Van Nostrand—It is some little time since I studied these formulae, and I do not just at first blush take them all in, but I think that a great many of us by reading the paper in the Report, and making a study of it, will be able to learn a convenient method of taking an observation. And I suppose those of us who have sat up all night waiting to get Polaris in elongation will thoroughly appreciate any method that will let us out of it.

Mr. Dickson—I do not think any of us are thoroughly capable of discussing this paper at first sight. A great many calculations have been made, and it is very carefully prepared, but it is only when it is printed in the Report and we sit down at home and study it out we will appreciate all its advantages.

Capt. Gamble—I do not think our Surveyors as a rule, when requiring the meridian, take observations of Polaris except at its greatest elongation; but with the information given us in this paper, one may choose a much more convenient time for obtaining the azimuth.

Prof. Stewart—I was tied to the method of elongation when in practice. If you have a reliable timekeeper it is most useful in obtaining azimuth from observation of Polaris at any time. But if you have not a good chronometer, by observing two stars on the same vertical circle the time is not necessary. The latitude, however, must be known, but it can easily be found closely enough for all practical purposes.

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MORE REMINISCENCES OF AN OLD LAND SURVEYOR.

By C. UNWIN,

Toronto.

Having been requested by the Chairman of the Biographical Committee, of which I am a member, to write in addition to those given in 1897 a few more of my reminiscences for the coming meeting, I will do my best to comply, although I fear they may possess little interest for my brother surveyors—perhaps it may prove not entirely uninteresting to follow me on a survey to Lake Superior and stay awhile at the Islands of Michipicoten and of St. Ignace.

In looking over my Diary for the year 1864 I find under 8th September that I, in company with Mr. H. R. Fletcher (a gentleman who had employed me to lay out some mining locations in the above district), left Toronto at 7 a.m. by the Northern Railway train, arriving at Collingwood at noon, and left by the steamer Algoma about 3 p.m., reaching Killarney at 7.30 on the morning of the 9th, Little Current at 11 in the morning, and Bruce Mines about 11 p.m. Probably most of you know that Killarney was formerly called She-baw-we-naw-ning, which puts me in mind of an unwilling stay made there in the summer of 1852 on my way to Manitowaning to fetch some pork which had been left there for me to be used on the survey of the Indian Reserve at Garden River. We were detained by head winds for some time, and when we got to Manitowaning found that the pork had been left on the wharf in the broiling sun and had become so bad that it could not be used. I heard a story of a Frenchman, one I suppose of a surveying party, who was starved to death at this same She-baw-we-naw-ning many years ago. He had been detained there waiting for provisions. This was during the winter, and the last four entries in his diary were (I do not remember the date, but will say): "—— day of ——,—Packmen not come yet; very hungry; eat one snowshoe." Next entry: "—— day of ——,—Still no packmen; eat other snowshoe." The next entry: "—— day of ——,—Packmen not come yet; eat one moccasin." And concludes his last entry with: "Packmen not come yet; eat other

moccasin; She-baw-we-naw-ning damn poor place." It is not so bad now, for it is a very important fishing station—in fact there are few, if any, better on Lake Huron.

10th. Arrived at Garden River about 9.12 in the morning, and remained about two hours taking in wood. While the wood was being taken in Mr. Fletcher, Mrs. McIntyre (wife of Mr. McIntyre, of Fort William), daughter and niece, and I went ashore and called upon Rev. Mr. Chance, the Church of England missionary residing at Garden River. John Lindsay, P. L. Surveyor, came aboard the steamer at Sault Ste. Marie. He was going to lay out some mining locations near Black Bay. Mr. Lindsay told me that Mr. Devine, the Chief Clerk in the C. L. Department, said that the locations might be laid out at right angles to the shore of the lakes or rivers, if not convenient to run them due north and south.

11th. Arrived at the mouth of Michipicoten River about 7 a.m., where left a mail bag and one passenger, Mr. Rankin, father of the gentleman in charge of the Hudson Bay Company's post at Michipicoten. Mr. Fletcher and several of the passengers went up to the post, and Mr. Fletcher brought a small canoe back with him. Arrived at Michipicoten Island about 2 p.m. Mr. Fletcher's boat, with five men, met us about a mile from the shore. Mr. F., I understood, had charge of a mine on the Island, and these men had been working under him. Walked around and examined the place. A fire had recently raged all through, burning up some of the houses.

12th. With five men left the mines to survey a ten-acre lot at Quebec Harbor, and searched for a line that had been run by P .L. Surveyor A. P. Salter some years back for Bonner's eastern boundary.

13th. Found Bonner's eastern boundary with pickets still standing; traced this line down to the shore and found a post about one chain north therefrom, etc., etc. Quebec Harbor is for its size one of the best harbors, if not the best harbor, on Lake Superior. Mr. Fletcher hired the schooner "Delia Wright," of Gosfield, to take us to Island of St. Ignace. She was 38 tons burden, and commanded by an old salt, aged about 70 years, rejoicing in the name of Lamphire; with him the mate, a fine, handsome Norwegian, named Solomon Tosteson; Jim, a half-breed Indian; and Julian, a Frenchman. We left Quebec Harbor about 9 p.m.; had a fair wind, but it was a very rainy night.

14th. Was very sick all last night, as was also Mr. Fletcher. I could not sleep down in the small cabin (it was only about 7 feet

square), so remained on deck all night and all next day. We got within a few miles of our destination about 8 a.m., but the wind got contrary and strong, and we were obliged to make for a harbor; tried Arran Bay, but being too foggy, missed it; tried the Pic, about 45 miles from Otter Head, and missed it, so tried Otter Head Harbor, and fortunately made it about 4.30 p.m., and anchored for the night. Had a most uncomfortable bed in the hold of the vesesl, on a box about 3 feet 6 inches long, and it was very hard. I do not see it mentioned in my diary, but I have a very vivid recollection of part of a night trying to sleep in the hold of the adorable "Delia Wright," on a bag of Liverpool salt, and a more uncomfortable or harder bed I never had, and I have tried a good many, viz.: balsam, cedar, and hemlock brush; granite, rock, and sand, the latter being an approach to Liverpool salt, but not as hard by a good deal; and, to make matters worse, there were a lot of domestic fowls loose in the hold which were not at all particular as to where they made their deposits.

15th. There being a head wind, we were unable to proceed, so remained at Otter Head all day, and, having nothing better to do, literally gorged ourselves with the finest blueberries that I ever saw, and our cook, thinking to cap the climax, gave us blueberry pudding for supper at night.

16th. Weighed anchor about 5.30 a.m., and having little or no wind, beat about Otter Head until about 6 p.m., when it freshened, and, being fair, we had a good run; a beautifully clear night; not having got over my repugnance to my limited quarters in the hold, I slept on deck.

17th. Arrived at Moffat's Harbor at noon and anchored; got under weigh again about 3 p.m., and reached Harrison's Landing at dark; rainy night; went ashore for a few minutes, but it was too dark to do or see anything to advantage.

Sunday, 18th. Walking on the shore looking for minerals, etc., having previously hauled the schooner to an old wharf. In the afternoon took out boat and moved a mile or two westward, where encamped. Took observation of Polaris about 7 p.m.

19th. With Mr. Fletcher and men coasting down the main lake. After dinner Mr. F. and some of the men went further up the bay, and I tried the variation of the needle at different places; found an immense deal of local attraction; in one place the needle pointed very nearly due east and west.

20th. With most of party making search for the south-west angle of the Hamilton location; found a stump flattened on three sides, with some lettering in red chalk, but could not make out what it was. Also found a spruce tree squared, with Sept. 5th,

1846, marked on it; presuming the chalking to have been done at the same time, it had stood the weather eighteen years.

24th. Completed the survey of location on the 24th; were most hurried; the captain of the schooner, being very short of provisions, urged me to come away, saying he would be obliged to leave me if I did not come to-day. Weighed anchor about 6 p.m.

Sunday, 25th. Had a good run all last night; wind continuing fair, until about 3 a.m.; then became nearly a dead calm until 11 this morning, when freshened and got quite blustering. We reached within about a mile or two of Michipicoten mines by 7 or 8 in the evening, but could not make them.

26th. Blew fresh from midnight; we were beating and trying to get a landing at the mines, but did not succeed; were quite close several times; abandoned the attempt about 8 a.m. The wind was so strong that it was not safe to try further, so made for Otter Head Harbor with stay foresail, having been obliged to take down the other sails; arrived at the harbor about 11 a.m.

27th. Left Otter Head this morning; wind being too strong to enable us to land at the mines, were obliged to go forward to Quebec Harbor, on Michipicoten Island, where remained all night. Mr. Fletcher and I encamped on the Island; rest of party remained in the schooner.

28th. Still unable to land at the mines. About noon some of Mr. Fletcher's men took his boat and went from Quebec Harbor to the mines.

29th. Schooner left Quebec Harbor early this morning and met the first load of passengers about two or three miles from the mines (these passengers were the wives and children of the miners who had been employed under Mr. Fletcher). Returned with large boat and canoe and brought off the remainder of the passengers. All on board a little before noon. Saw two American fishing boats, and spoke one of them. There were thirty people crowded into the little vessel—twenty-four from the mines on Michipicoten Island, four of a crew, Mr. Fletcher and myself.

30th. Wind continued fair but light until about 5 a.m., when we got opposite Montreal River; then beating off Maimanse all day, and between Maimanse and White Fish Point lighthouse until about 8 o'clock next morning.

Saturday, 1st October. Went ashore for a short time near White Fish Point lighthouse; continued at anchor until evening, when tried for about an hour to proceed on our journey, but being unable returned and anchored.

Sunday, 2nd. Weighed anchor about 3.15 p.m. The mate having called for assistance to raise the anchor, I left my sleeping place on the deck (where I had been made tolerably comfortable by the mate putting one of the sails about me) to assist, and while doing so some of the others hoisted my sail and with it my satchel containing my field-book, comb and brush, and razor, etc.—beards were not then fashionable even among surveyors. Seeing a propeller towards evening coming down the lake, making for the "Soo," I thought it a good opportunity of cutting the acquaintance of "Delia Wright" and her motley crew, for a time at least, so got one of the men with me to intercept the propeller with the canoe we had with us, and with some little difficulty managed to get on board. Our canoe was not seen until the propeller was nearly upon us; it proved to be "The F. W. Backas," of Chicago. We remained at Waiska Bay all night.

3rd. Left Waiska Bay early in the morning and overtook "Delia" about a mile from the entrance to the canal. Arrived at the "Soo" between 7 and 8 a.m. When I met Mr. Fletcher's men at the American side of the river, they were all looking very blue, his cheques to them having been refused by the store-keepers there. Came to the Canadian side about noon. When landing, one of Mr. Fletcher's men, who had been tasting some of Uncle Sam's whiskey I presume, slipped and fell into the river; he had his pipe in his mouth when he fell in, and retained it until he was fished out. The miners that Mr. Fletcher had working for him at Michipicoten Island were a pretty rough set, some of them Cornishmen; one of them threatened to murder Mr. F., not having received his wages; it was all I could do to pacify him. I told him that he was like them, engaged by a company, and was suffering as well as the rest. I don't know how they settled it at last, for I left them at the Canadian side of the river and came home by way of Detroit. I found that American bills were at a great discount at this time. I bought a few things on the American side: $1.50 American money equalled only 80c. Canada; $2 American money equalled only $1.20 Canada; 25c. American money equalled only 15c. Canada, etc.

4th. I left Sault Ste. Marie at 9 a.m. by steamer "Iron City" for Detroit; found the purser, a Mr. Stevenson, to be the brother of Mr. Stevenson, a merchant of Sutton Georgina, whom I knew. I also made the acquaintance of a Mr. Robson of London C.W. who had been working at Marquette; he was on his way home for his family to return with them to Marquette.

5th. Arrived in Detroit 5 p.m., and while there saw a very melancholy sight; there were heaps and heaps of cases piled on

the platform at the depot, containing the bodies of soldiers slain in the Civil War. I left by train for Toronto a little after 6 p.m., and fortunately met an old friend in charge of the Pullman car, who gave me the first good bed I had had for many days.

6th. Arrived in Toronto early in the morning of the 6th; had just time to refresh myself with a good wash and breakfast and to get to the meeting of the Board of Examiners, and receive the fees of Mr. James Warren and George Albert Simpson, who were this day admitted into the noble, but unremunerative, profession of Provincial Land Surveyors. I was then Secretary of the Board. Mr. Passmore, my predecessor, had kindly attended to my duties during my absence.

I fear the foregoing will have proved very dry; I wish I could have made it more interesting.

DISCUSSION.

Mr. Kirkpatrick—In 1863 I made my first survey on the Garden River, and I remember very well the depreciation in American money at that time. One dollar of Canadian money was equal to three dollars American money, and I had an Indian who hailed from an island just opposite Garden River, who had got very much mixed in his ideas about Canadian and American money. Being an American citizen, he could not understand how Canadian money could be any better than American, and he insisted on being paid in American money. The consequence was, as I could not persuade him to take Canadian money, I got him for a very small amount. When we were coming home by boat we found they had not raised the prices on the American side at all. You could stay for four dollars a day at any of the first-class hotels in the United States, so my two chain-bearers and I went down to Cleveland and to Niagara Falls, and put up at the International or the Cataract, and had a good time, and when we came back to Toronto I found it cost me less than it would have cost coming down on the old Algoma to Collingwood. I had not the same faith in the American money as my friend the Indian, George Opekosh or O-be-gosh!

Mr. Niven—Those names mentioned by Mr. Unwin are familiar to me. My first connection with She-baw-we-naw-ning was in the fall of 1863. I went up to survey a township on the Manitoulin Island. It was the first Government survey I ever had. Three surveyors went up at that time, four intended to go, but John Grant, of Belle-

ville, was left behind. The three were Mr. McPhillips, the father of the McPhillips' at Winnipeg; Mr. Joseph Hobson, who was then engineer of the Grand Trunk, and myself. Grant was not in time to catch the train, but the three of us went up in the steamer Rescue, which sailed from Collingwood. I remember passing Shebaw-we-naw-ning, or Killarney, and then we landed at Little Current; the starting point for myself and Mr. McPhillips was at Sheeprock Bay. Mr. Hobson had a township further up the lake, and he went up into West Bay in the Township of Bidwell. We worked there all winter, going out on the 20th November, and I got through my township about February or March. I had taken the precaution to write to the Government to tell them I would be through at a certain time, and asked them if I might go on with another township, and they replied that I might, until the opening of navigation. Mr. Hobson said nothing until he got through, and then went home by the ice, while I went on with the township of Billings, and I had the half of it done when Mr. McPhillips got through with his. Mr. Grant, who was left behind, came by Owen Sound. He hired a boat and had great difficulty in getting up, arriving about Christmas, having nearly been lost in the ice. We came down together in May. We camped out all winter. We had no stove in those days. We had our tents pitched, and then we built a cabin on top of the snow, and putting the fire in the centre thawed it out. We used to sit in the evenings there, and we had our meals in there, and when we wanted to go to bed we went out of doors into the camp. It was pretty cold sleeping. It was not as comfortable as nowadays, but not a single one of the party had the slightest cold or sickness of any kind. At that time I lived at St. Mary's, and a friend of mine there, a Dr. Wilson, said to me, "Mr. Niven, you had better have a box of medicine put up to take with you." I told him to go down to the drug store and put up what he thought was necessary, and he put up a box about a foot square. What was in it I do not know. I paid $4 for it, and we took it out and carried it all around and brought it home again unopened. I took it to the drug store again and asked him to take it back again, and he said he did not want it. I said, "Give me something for it," and he gave me a dollar!

Mr. Kirkpatrick—I may tell you what Mr. Niven in his modesty is silent about—that the surveys that were sent in by him and by Mr. Hobson at the time he speaks of are models to the present day. I show young men those plans and field notes, and they cannot improve on them very much.

Mr. Esten—I wish some of the older members in the Association would take in what we said in the Report of the Biographical Committee seriously, and turn their attention to writing papers as

to their reminiscences. Mr. Unwin has written twice, and I do not think we can induce him to write again. A great many of the members of the profession seem to think it a very good thing to have some sort of history kept, and I think this object might be fulfilled by members writing papers of this nature. As Chairman of the Committee, I would be very much obliged if some of the older members would take this into consideration next year.

Mr. Foster—Previous to Mr. Niven being up on the Manitoulin Island, I was on an exploration survey of the island, at least we intended to explore it. Mr. Hawkins engaged me to superintend the party, and we went up. Nobody seemed to know what the island was like, excepting a few hunters and the Indians there. My friend, Mr. John D. Evans, will recollect the circumstances vividly; he was with me, and so was Mr. Hawkins. The latter thought we could survey the island from end to end without a tent, taking only a little pork and flour. We got tents, but he objected to them! We waited a week or two and had a Council with the Indians, but they sent us back, and said they would not allow us to examine the island at all.

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

HIGHWAY CULVERTS AND BRIDGES.

By A. W. CAMPBELL,

Toronto.

The majority of Canadians, when visiting Europe, are impressed with the durability and solidity which characterizes the structures of that country. Private residences are built to withstand the wear of centuries. Cathedrals, public halls, libraries, and similar civic institutions are constructed, not merely for the present, but for future generations. Among the works marked by this durability are to be classed the public highways, with all that pertains to them. Canada, in this regard, presents a very unfortunate contrast.

It can justly be argued that Canada is a very young country, and that England is a very old country; that Canada is not a wealthy country, and that England is a very wealthy country. While England is, in a way, a very old country, yet it is not so much older than this country in the arts of civilization, which should teach our citizens and municipal councils the necessity for and the means of wisely spending money in permanent improvements. And while England is a richer country than Canada, that greater degree of wealth has been brought about, to some extent, by the very durability which we have so long avoided. Permanent improvements are the cheapest. Structures which need props and repairs within a year or two after they have been built, seem to be in a chronic state of starvation, with a ravenous appetite for money. Canadians have not yet entirely outgrown the idea that they live in a pioneer land where the needs of the present entirely overwhelm the future. In nothing is this temporary building more apparent than in our highways, and in no detail of our highways is it more striking than in the matter of bridges and culverts. At the same time there is no portion of the making of a road that offers more scope to the road maker than in providing substantial and permanent waterways. Instead of the handsome stone and concrete arches that span so many of the streams intersecting the highways of England, there are to-day in this country scores of wooden boxes and trusses—flimsy, disjointed, unsafe; the constant

source of accident, and the bottomless pit into which councils are annually throwing money in a vain endeavor to keep them in repair.

LOCATION.

Considerable attention is generally paid to the selection of a good site for a bridge, and an effort is made to decide in the interest of economy, usually with a considerable measure of success. There is, however, a tendency to cling to the line of original survey, rather than deviate the road slightly, when by doing so, much would be gained in lessening the dimensions of the bridge, securing firm foundations for piers and abutments, reducing the cuts and fills of the approaches of the bridge; all of which, while they may not decrease materially the first cost, very frequently are of the utmost consequence with regard to maintenance, and may decide for good or bad the usefulness of the entire roadway. The utility of a road with respect to hauling heavy loads, is not governed so much by the condition of the best section as by the worst; not so much by the level portion as by the steepest grade. Bridges, forming, as they do, a means of crossing valleys, are intimately associated with the problem of judiciously choosing between directness of route, easy gradients, and details of construction. The location of culverts is a matter of very common error. Water should be disposed of in small quantities, along natural water-courses, before it gathers force and headway. Instead of this principle being followed, water is frequently carried long distances by the roadside, past water-course after water-course, rather than build a culvert or culverts to carry it away without injury to the road. Where culverts are needed, they should pass directly across the road and carry the water away from it.

The size of bridge or size of culvert involves nice discrimination, in which local circumstances and the class of construction introduce various factors. For the size of waterway, no hard and fast rule can be given. Many existing culverts and bridges were at one time of sufficient size, but the clearing and draining and cultivating of the land now permits the water after a rainfall to reach the water-course in a shorter time with increased volume, causing submerged roadway and flooded roadsides, while culverts and bridges are swept away. The best guide to a proper size of waterway is an intimate acquaintance with the locality or the evidence of others who are, with respect to maximum rainfall, height of water line, previous experience as to floods, form and inclination of the stream and area to be drained, kind and condition of the soil, and similar details. Talbot's Formula, proposed more as a guide to the judgment than as an unalterable rule is at times very useful:

Area of waterway in square feet C. $\sqrt[4]{(\text{drainage area in acres})^3}$ acres) 3. C is a variable co-efficient, and the values given are: "For steep and rocky ground, C varies from 2-3 to 1, etc. For rolling agricultural country, subject to floods at times of melting snow, and with the length of valley three or four times its width, C is about 1-3; and if the stream is longer in proportion to the area, decrease C. In districts not affected by accumulated snow and where the length of the valley is several times the width, 1-5 or 1-6, or even less, may be used. C should be increased for steep side slopes, especially if the upper part of the valley has a much greater fall than the channel at the culvert."

Waterways should be neither needlessly large, nor of too small dimensions, involving on the one hand unnecessary expense for first construction, and on the other hand, injury to the road, washouts, expensive repairs, and delay to traffic.

MATERIALS.

The materials available for culvert construction in addition to timber, are sewer-pipe, concrete pipe, iron pipe, brick, stone, and concrete. Culverts are sometimes made of one of these materials alone, or of two or more in combination. When the dimensions of a bridge are reached, concrete and stone abutments and piers, with iron or steel superstructure; or stone, brick, or concrete, alone or in combination, are the materials gaining favor.

SEWER-PIPE.

For the small culverts, sewer pipe is very economical and durable, if well laid. To render them secure against the test of a Canadian climate, they should be laid with a good grade, and the ends protected with concrete, stone, or brick headwalls, with deep aprons. The joints should be made water-tight with cement. These precautions will provide against the action of frost and will prevent the culvert being undermined by water passing along the outside of the pipe, either from the ends or through the joints. Care should be taken to excavate a concave bed for the pipe to rest in, always laying the spigot ends up grade. The pipe at the outlet should be set flush with the surface of the ground. If set higher than the surface the fall of water will wash out a depression and will in time undermine the end of the culvert. A too rapid grade will cause the same result. It is frequently well to cobble-pave the outlet, where this undermining action is likely to occur.

CEMENT-CONCRETE PIPE.

Excellent culvert pipe of concrete can be manufactured cheaply in any gravel pit under the immediate direction of the municipal

engineer. The pipes are three or four inches in thickness, according to diameter, which latter may safely and conveniently reach three feet. The implements required are of the simplest kind. The most important are two steel spring cylinders, one to set inside the other, leaving a space between the two equal to the thickness of the finished concrete pipe. By "spring-cylinder," it may be explained, is meant such a cylinder as would be formed by rolling an iron plate into a tube without sealing the joint. With the smaller of these cylinders the edges overlap or coil slightly; but are so manufactured that the edges may be forced back and set into a perfect cylinder. These two cylinders, with joints flush, are set on end, the one centrally inside the other, and on a firm board bottom. The concrete, made of first-class cement and well-screened gravel, is then tamped firmly but lightly into the space or mould between the two cylinders. The tamping-iron used to press the concrete into place is so shaped as to fit closely to the cylinders. The concrete is allowed to stand in the mould for a few hours, when the cylinders are removed; the outer and larger cylinder by inserting an iron wedge into the joint, and forcing the edges apart; the inner cylinder, by inserting the wedge into the joint and turning the edges so as to allow them to again overlap, returning to the shape of a coil. The outer cylinder having thus been made larger and the inner one smaller, they can readily be taken away, and the concrete pipe is then left until thoroughly hardened. Just such a number of pipe as are actually required fo rthe season's work need be manufactured; the implements required are inexpensive, and the pipe may be made by the municipality for actual cost, which, after a little experience, can be reduced to a very small amount. Culverts of concrete pipe are laid in a manner similar to those of sewer pipe.

ARCH CULVERTS OF STONE AND CONCRETE.

There is no departure which would more enrich the highways than the general use of stone and concrete for the construction of bridges and culverts. They cost more in the first instance, but the longer life, the fewer repairs needed, the greater convenience, the lesser liability to accident, render them in every way desirable. Concrete and stone are the only materials with which really permanent work of this nature can be constructed. Bridges and culverts of rubble masonry have existed in Scotland and Ireland with scarcely any repairs for more than a century, since before the time of Telford and Macadam. Concrete bridges and roadbeds built by the Romans nearly 2,000 years ago are still in use, in spite of efforts to destroy them in military operations. The cost of this class of work is constantly decreasing through the cheapening and improv-

ing of cement, through the lessened expense of procuring stone and crushing it, and through growing experience in the use of cement. In Scotland it is common for farmers to contract for rubble concrete bridges, provide the stone, and hire masons to do the work. In this way the entire expenditure is kept in the locality, among the people who pay the taxes, and is, therefore, in spite of a slightly greater cost, not unpopular. Up to forty foot spans, this construction is not difficult.

In the construction of a stone arch the first consideration is the foundation. The depth to which the excavation must be made will depend chiefly upon the span of the arch, and the nature of the natural soil on which it will rest. The chief object is that it shall be secure. If bed rock comes to the surface it may be safe to rest the base of the arch upon it without any further excavation. A firm hard-pan may exist a short distance below the surface of the ground. But a quick-sand, or other insecure footing, may necessitate the sinking of piles, or the placing of a wide, and perhaps deep, concrete base. But the foundation must be sufficient to provide that the washing of water cannot undermine it, that the lateral thrust of the embankments cannot move it, nor that the weight of loads cannot cause it to sink. No more definite rule can safely be given than to make the most of local circumstances, with always a fair margin for safety. Full-centre arches—that is, entire semi-circles—are easily formed, possess great strength, and have little lateral thrust, but with wide spans, they necessarily rise to a correspondingly great height, and cannot always be employed. A segmental or flat arch will lessen the rise, but has a considerable lateral thrust, which necessitates very strong abutments. A compound arch, made up of a number of different circles, when rightly proportioned, combines the advantages of the two, reducing the height, and at the same time having an excellent appearance. The thickness of the arch and abutments depends on a number of details, the chief of which are: the form and size of the arch, the quality of the material composing it, and the character of the workmanship. The haunches of shoulders should be built from the spring of the arch half way to the top.

With regard to the masonry, first-class hydraulic cement should be used. The arch stones should be full-bedded in cement, and each course afterwards thoroughly grouted. Each stone should be cleaned and dampened before being placed in the arch. Improperly dressed stones should be re-cut, as no hammering should be allowed after the stones are set. The ring-stones should be dressed into a wedge shape, so that they will radiate truly from the centre of the circle, and should be so dressed that the joints need not exceed three-eights of an inch in width. The ring-stone should be of such thickness as to expose ten inches on the inside

or face of the arch. The exterior of the arch should be flushed with a one inch coat of cement and the surface then smoothed off.

Arch-culverts and bridges of cement-concrete can be more cheaply constructed than can masonry arches, and, if careful workmanship is employed, are quite as serviceable. They are formed by constructing a curbing and thoroughly ramming the concrete into it in successive layers. The manner of mixing the concrete depends on the character of the cement used, some cements being slow setting, others quick setting; some will set well in water, while others will not; some will allow a considerable proportion of water to be used in forming the mortar, while other cements should be but slightly moistened. One feature in connection with concrete culvert work is that, with the curbing and centres in place, any intelligent workman can, by following the instructions of the engineer, lay the concrete. Manufacturers complain that masons, in the great majority of cases, entirely disregard the instructions given them with respect to the mixing of cement, and follow their own methods of mixing common mortar; while a man totally unaccustomed to work of this description will obey instructions carefully and minutely. Concrete cannot be mixed and put in place like common mortar, and by overlooking this fact much concrete work has failed, and has brought the material into disrepute in some localities.

BRIDGE ABUTMENTS.

The most substantial substructures of bridges are of either stone or concrete. In their construction sufficient excavation must at first be made to properly contain the abutment, and this earth may be refilled again so as to form approaches to the bridge. The excavation completed, when concrete is used in whole or in part, the portion thus constructed must be boxed and curbed in a substantial manner the exact size and shape required. After the concrete has set this boxing is removed and earth filled in solidly around the face of the abutments. Hammer dressed stone should crown the concrete to form a bridge seat.

Concrete should be composed of first-class cement; a clean, sharp, silicious sand, entirely free from earthy particles and coarse enough to pass through a twenty-mesh and be retained on a thirty-mesh sieve; clean screened gravel, the largest not to be more than two and one half inches in diameter; or in place of gravel, broken stone that will pass through a two-inch ring. These materials should be mixed in the proportion of one of cement, two of sand, and three of gravel or broken stone, with just sufficient water to form a plastic mass. The sand and cement should first be thoroughly mixed when dry, then water added to make a thick paste,

and this thoroughly mixed again. This mortar is then spread out and the stone or gravel added, when the whole is mixed together until every stone is thoroughly coated with mortar. When this is done the concrete may be put in place and should be spread out and pounded until the excessive moisture appears on the surface.

DESIGN OF IRON BRIDGES.

The design of iron or steel bridges commonly erected may be classified under: The plain beam or girder; the beam truss; the suspension truss; and the bowstring or arch truss. The first of these is well understood; the second comprises those trusses in which both bottom and top chords are essential; the third includes those inwhich the upper chord only is necessary; the fourth is not properly a truss, but an arch, in which the horizontal tie takes the place of fixed abutments. The style chosen should be governed by circumstances and economy; but apart from this any design is good so long as it can be accurately analyzed as to the character and amount of strain in all its parts. On the other hand any design which cannot be so analyzed should not for a moment receive consideration. The course pursued by some, indeed most municipalities, in erecting iron bridges is likely, however, to result disastrously, and throw iron and steel into disrepute. A council advertises for tenders. The companies responding supply their own plans and specifications. Thus far the procedure is entirely satisfactory. The difficulty arises when the councils accept the lowest tender without obtaining the advice of an experienced builder of iron bridges as to the plans and specifications submitted. Cases have occurred in which a difference of five dollars has nfluenced a council to accept a tender for a bridge which manifestly, to a man of experience, was worth less than the other by several hundred dollars; and which was indeed unsafe, offering every likelihood of failure with attendant loss of life and great expense for reconstruction. It is difficult to understand the action of councillors, shrewd in other matters, in the construction of bridges and other public works proceeding with such apparent disregard for the true interests of those whom they represent. A small sum spent in securing reliable advice is as much a matter of economy in public as in private affairs.

Mr. Morris—Referring to the work of Municipal Councils and their inspectorship of municipal bridges, if you look at the map of the Province you will see that the county in which I am engaged

as engineer (Renfrew) has probably larger streams than any other county in the Province—the Madawaska, Petewawa, Bonnechere. These streams are all crossed by large bridges, and I have had the superintendence of most of those bridges, and find great difficulty with regard to Municipal Councils. Each Council or each Councillor has some friend who wants to make a plan for them. Their engineer is not notified, they have the plan prepared, and then they ask their engineer to see the work carried out. The contract is let before the plan is submitted to him, and he has either to repudiate it altogether, or follow it as best he can.

There is a bridge about 300 feet long over the Madawaska, where the engineer was instructed to make a report as to an iron bridge with stone abutments, and piers, costing about $9,500; or a wooden bridge with stone abutments, costing altogether about $6,000. The Municipality induced the Government to give them a little help and showed the report to the engineer. They afterwards got their local contractor to bring to me a sketch of the kind of bridge they wanted, a cheap one. I reported that the bridge was not satisfactory—that is, as a permanent bridge. It was strong enough, but the timbers and other parts were not satisfactory, and I took it on myself to suggest changes. They appointed their own inspector and built the bridge. The Government inspector, in inspecting it, found out it was not according to the plan on which the Government would grant their vote, and now the municipality is looking to the engineer to explain it. The engineer should have refused in the first place to make a plan of a bridge of that kind. The bridge is strong enough, but not the class of bridge for crossing over such a stream. The municipalities often say they have the bridge that is satisfactory, and they want one the same as it. But we can hardly blame Councils altogether for the bridges. A case is on record of three different bridges—one at Indian Branch of the Madawaska, one over the Muskrat River at Pembroke, and one in the Township of Pembroke. They are built on a plan made by the Public Works Department of this Province, for the outlying districts. The bridge has timbers from 14 to 16 inches in size for the main braces, and without any counter braces. In the one over the Muskrat, the flooring is of light stringers, put on resting on a cross beam. The three bridges were built by a contractor who has built this class of bridge throughout the country, and his idea was they would suit those different places. The flooring has given way in all three cases, and accidents involving large costs are occurring.

I built a bridge over the Indian River nearly adjacent to the one built over the Muskrat on a different plan—that is, as Mr. Campbell has just stated, where the main braces and all the heavy materials are spliced and where they are bolted. The bridge I

condemned over the Muskrat in the town only lasted ten years and cost something like $5,000. The timbers are condemned because they contained a great deal of sapwood.

I have come to the conclusion that throughout the older parts of this Province we must find some other material besides pine timber. We have either to use iron altogether, or fall back on cedar. Over the smaller streams I put three cedars, deep bolted, and cross-braced across, making one solid piece about two and a half to three feet in depth, with spans 20 to 24 feet. Such a bridge will last 40 or 50 years, built altogether of cedar. The covering is six to eight inches thick, and that is the only part that will require renewal from time to time. The span will practically have to rot away before the bridge will become dangerous.

If we all had strength of mind enough to refuse to make any plan, or accept any recommendations from the Councils as to the style of bridge and allow them to appoint another engineer from time to time, then we would be in a better position.

Mr. Campbell—I can appreciate the references made by Mr. Morris, to the effect that local engineers are, as a general thing, cramped by the limited cost in the construction of all these works. For that reason he is to some extent dictated to by the Council as to the class of bridge which must be built. It is one of the weaknesses in the municipal system which I think we have to educate the people out of. In the vicinity of Pembroke, and possibly in a good many of the municipalities in the northern part of Ontario, cedar timber such as Mr. Morris specifies can be readily secured at a reasonable cost, and it makes a first-class structure. In the older townships, however, and in the more distant parts of the Province of Ontario, where this material has disappeared altogether, and where they have to go outside for the purchase of all kinds of material, lumber and timber which they used to find right in the neighborhood of the bridge, having to be brought now from the northern part of the Province. I say that it is not economy at present prices to use material of a perishable character, but that it is the duty of the engineer to strive as far as possible to extend the limit of cost allowed him, or the appropriation allowed him for doing work of a permanent character upon one structure at least. Object lessons in every municipality are necessary and desirable. I know in one county where about eight years ago they commenced the construction of iron and steel bridges with concrete and stone foundations. These were looked upon as being very expensive at the time, but after a few were constructed the people saw they were durable, and they saw the wisdom of making use of this kind of material.

The next question was that of flooring. Flooring, they said,

was perishable. This plank costs in the neighborhood of $16 to $17 per thousand delivered at the work and about $25 per thousand upon the bridge, and one bridge which I have in my mind now, in the County of Elgin, used to cost about $400 to floor it. About every five or six years this had to be renewed. The next thing is for the Councils to say what they can substitute for this one particular part of the perishable structure. This year they are specifying for vitrified brick laid upon patent steel lattice work. This vitrified brick will be used as paving brick, and laid in cement, and for the ordinary travel over the bridge it should last for at least 50 years, possibly for a century.

The President—We are told that these iron and steel bridges have to be painted every third or fifth year. If that is neglected, how long will it take a quarter inch plate to rust through ?

Mr. Campbell—I refer to the question of painting in my paper. It is said that if an iron bridge is painted the first summer after it is erected, and then after three years, if proper material is used the evaporation is small and it should stand seven or eight years without re-painting, but I think they should be kept properly painted.

The President—Suppose they are neglected and not painted, how long will quarter inch plates last ?

Mr. Campbell—It would take a good many years to eat them through, but it would not take long to weaken them so as to affect the limit of safety required in the original specifications. I think ten or fifteen years would weaken them sufficiently to render them dangerous.

Mr. Morris—Do you not find if you leave paint off wooden bridges they will crack and that allows the moisture to get in ? Even when the timber is green it does not seem to crack so much if you paint it.

Mr. Campbell—If you leave the under side of the stick free, I suppose it would be well to paint the other three sides, leaving the under side unpainted. Perfect seasoning would then take place.

The President—I have had a good deal of trouble with iron bridges. I find that it is almost impossible to get corporations to paint them. I have a bridge now under my charge about 300 or 400 feet long and 100 feet high, I have put in the estimates year after year requiring an appropriation to paint the bridge, but I cannot get it. We are told by all bridge companies if you do not paint these bridges they will become dangerous, and we are told wooden bridges if protected from rot will last forever. You cannot use iron without gases or acids reaching and rusting it. An-

other peculiar thing is this, when iron bridges are built the paint you put on is in the majority of cases metallic oxide, linseed oil, and turpentine. You plaster that over the bridge, and you have got a good coat of rust to start with. I wrote to a number of bridge companies about this before recommending iron bridges, and I got various replies. One was that there was no such thing as good paint on the market—no paint that will stand. You have to renew it, brush it off with steel brushes, and re-paint it. If you cannot brush it off why it needs less paint.

On Yonge Street, at York Mills, one iron bridge put up cost about $15,000. I could have put up a wooden bridge there for $1,500.

Our practice in bridge building in the County of York is to cut all timber up to five or six inches in thickness and never to paint it, but we cover it with galvanized sheet iron very carefully, and we put in an iron chord, just a single bar with turn buckles, because you find carpenters in country places who as a rule get these works do not cut it down so fine but you have to get it drawn up by turn buckles. Some bridges have been up twenty years now. We take a little care in putting in the joint where the main braces go into the stringer into the chord braces, lining that with galvanized iron. Mr. Bowman and I examined one of these bridges that had been carried away by a big freshet. The wood was as white as the day it was put up, the joint was as white as that table, having the galvanized iron in the joint.

We must have iron bridges, I suppose, because lumber is getting dearer and poorer every year, but we must get our Councils to understand that painting has to be done. We cannot build wooden bridges much longer. I would not recommend a wooden bridge over 50 or 60 feet, in any case.

In reference to our drains, the difference between Canada and England is that we have much severer frost in this country; nothing can withstand it, and this requires a great deal of drainage. Our laws for draining lands and roads are very defective.

Mr. Bowman—In my part of the country people have pretty well decided to give up using wood for bridges, and they have a great many iron bridges in the County of Waterloo. Some of the older railway bridges are examples of how long an iron bridge will last. Take the bridges on the Grand Trunk which have now been in place for nearly 45 years, and they have been strengthened from time to time on account of the heavier loads, but the same old material is still there and the stone foundations used in the majority of cases are still in good condition where properly looked after.

The use of brick on the Grand Trunk was not very satisfactory for culverts. We found along the old Grand Trunk when they first built it they adopted the methods used in England and put in a great many brick culverts. They are all right in the interior

through the large embankments. The Councillors in the County of Waterloo are putting down some expensive stone piers and abutments under their personal direction, as Mr. Morris mentioned. They do not require an engineer for anything of that kind. They will spend $5,000 or $10,000 in putting down stone abutments where possibly, if they had an engineer in charge of the work, it would be done for half the money with concrete, and it would be a better job, too. I would like to ask Mr. Campbell what difference he finds between the cost of concrete and the best stone, for abutments. It seems to me one is less than half of the other.

Mr. Campbell—Take Western Ontario; stone is not to be found there in the vicinity of the work, but gravel is easily found in abundance, in which case the cost of concrete foundations is not more than about one-half of that of masonry. For concrete $5 is a low estimate, $9 is a maximum, while masonry will cost you $14 per cubic yard.

Mr. A. J. McPherson—I have had a little experience in Municipal Council work. I remember a case last year. The Township Council of North Dumfries built a bridge, some four or five spans of 100 feet, for $2,000. It was a very cheap structure, and when it was done it looked cheap. Just at the present time, on account of the way the piers were built the ice has dammed against the end of the bridge and practically made an ice jam. It will be somewhat interesting to see the result of this. The bridge was built under the Council's personal supervision.

The President—You see the advantage of this new Bill; it will cut all these gentlemen out from doing this kind of work.

Mr. McPherson—We had also an iron bridge to put up in the Town of Galt. We put steel trusses in and floored it with white oak. We can get white oak in that section easily. We got it last year at $17 per thousand, and the mason work that we put in was dimension stone masonry; we had it done for $6.75 a cubic yard. It is Longford stone. We had quite a bit of competition. It was well advertised and the prices went up to about $15 per cubic yard. We had a law suit in the town about three years ago. Mr. Bowman was acting as one of the expert witnesses. A road had been cut down some ten inches so as to allow the water to be diverted from its first course, and it cost the town something about $1,000 before it was settled. They decided to put in a surface drain to drain the section. This we put in for something like $600, so we found law suits in excess of that sum somewhat expensive. These are instances of mismanagement by Municipal Councils.

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RAILWAY LOCATION WORK.

By J. D. EVANS,

Toronto.

When running preliminary or trial lines for railways it is customary to use the transit. In a country more or less wooded and broken a more expeditious method is with an ordinary surveyor's compass, but to do so in the usual way of prolonging a line with the sights, but more particularly in a section where there is local attraction, would not be sufficiently correct, as the line must be straight.

To overcome the effects of local attraction and other errors of alignment incidental to running with the sights, the lines can be run with pickets by the eye, or, better still, with the aid of a binocular field glass, thus insuring the lines being reasonably straight from end to end, but if in passing over a sharp ridge or narrow, deep valley, where, owing to obstructions, the line cannot be seen for a sufficient distance, an angle can be introduced and thus avoid a possible error in alignment.

To ascertain the angle of deflection, a hub is driven in the ground in the usual way. A compass is set over it (preferably a 4 1-2 in. compass with a 3 1-4 in. needle and folding sights set up on a Jacob staff), and the bearing taken of the line to the rear, and the bearing noted in the field-book as the back sight. The bearing of the forward line is then taken from the same point and entered in the field-book immediately over the back sight entry as the fore sight. These are placed, say, on the left hand side of the page of the field-book. From these can be computed easily the angle of deflection, which is then placed on the right hand side of the page in the usual manner. The angle thus formed is sufficiently correct for all practical purposes and the possible error from local attraction eliminated.

A line run in this manner can be done by a good picketman. The chainmen can keep up near the end of the line marking the broken distances on the hubs, while the transitman, or, as in this case, the compassman, follows, reading the bearings of both lines at each turning point or deflection angle and taking the topo-

graphy. Meanwhile he carries his compass, thereby saving an extra man to carry the transit.

In order to check the angles and prepare for plotting from bearings, the bearing of the first line is assumed to be correct (if it has not before been correctly ascertained), and the bearings of all the lines recalculated from the deflection angles.

DISCUSSION.

Mr. Foster—I have used the same method in traversing, and when sides exceed even 30 chs., and with the distance measured by a micrometer across quite a sheet of water, possibly 15 to 30 chains, I have found it plot in to half a chain, and, strange to say, the interior angles when checked would come within ten or fifteen minutes.

In running out small mining locations a quarter of a mile a side, 40 acre locations, I have often come out within three links and sometimes a link and a half.

The President—I have run lines for a mile and a quarter for stakes, and run close to the side of the stake. I have spent two days in running a line, and when I got through to the rear, cutting through swamps and over hemlock ridges, have come out beside the stake.

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THE CALCULATION OF STRAINS IN BRIDGE TRUSSES.

By JAMES WARREN.

Walkerton.

While all our large bridges require very difficult and intricate calculations and a knowledge of the higher mathematics, yet many of our smaller bridges can be calculated for and designed with an ordinary knowledge of certain principles, by one who has not studied the subject thoroughly, nor had the privilege of attending our School of Practical Science or such like institutions. The determining of the strains in our ordinary bridges is very simple and within the grasp of those who have not had the advantage of higher training. The design of this short and crude paper is to show the manner in which I run over the strains, etc., of plans and designs submitted to me by our County Council when receiving proposals for building bridges, and I add a calculation for a Whipple truss for an illustration of calculation.

Our bridges are now chiefly made of steel, it having superceded iron to a great extent, and will soon almost entirely supercede wood. Steel being so much stronger than iron, a bridge can be built with much less weight than formerly, yet the design must be carefully made, so as to have the required strength, as the loads are much heavier than formerly on account of so many traction engines being used. In order to properly calculate the strains on each part of the bridge, we must arrive at some way of determining how much of the weight is transmitted to each abutment, and how much is carried or sustained by each member thereof. If a weight is in the centre of the bridge, then one half is borne by each abutment, but if the weight is 30 feet from one end of a bridge 100 feet long, then 7-10 of the weight is carried by the abutment nearest the weight, and 3-10 by the other. In this way we can determine how much of the weight has to be carried by each abutment, but we must also find out the weight that is carried by each member or the strain on them. The tendency of the weight is to act perpendicularly, but it does not always act so in each case, as in some members it acts horizontally and in others diagonally.

This can be illustrated very simply by having a weight hanging by a cord, which if allowed to be free, the strain on the cord is equal to the weight, but if we have a weight, say 100 lbs., hanging by a rope from the top of a high wall, and we place a strut of five feet between the rope and the wall, twenty feet below the point of support, then the strain is more than 100 lbs. on the rope, or if we place a strut thirty feet long horizontally from the same point (our rope being long enough), then the strain on the rope is still greater. These strains are in proportion to the sides of the triangles formed. This experiment may be made on a small scale by an ordinary spring balance, if such can be obtained. The proportion in the cases cited are as follows

20 ft. : 5 ft. : : 100 lbs. to 25 lbs., strain on strut.
20 ft. : 30 ft. : : 100 lbs. to 150 lbs., strain on strut.

and by the same proportioning we find the strain on the rope to be 103.05 lbs. and 180.25 lbs. respectively, and proportionally to any other weight or load used both on rope and strut. So, if we want to find the strains on any horizontal member caused by a diagonal member, we multiply the vertical components by the tangent of the angle the diagonal makes with the vertical, and the strain on the diagonal by multiplying the vertical component by the secant of the same angle, and we have the tangent and secant calculated. They are used as constant multipliers in the whole of the calculation, for each panel of the bridge, that is, if the diagonals and struts are of the same length as in the Pratt or Whipple trusses.

The strain on each member of the bridge varies as the load is moved, but each panel must be able to carry the weight placed on it according to the position of the load. While the vertical components differ in each panel, yet the tangent and secant remain always the same in the Pratt, Whipple, or Howe truss, as the diagonals are always of the same length and inclination.

Let us now take a Pratt truss and run through the calculation.

Take a bridge 150 ft. long, 10 panels 15 ft. each:
and try to apply the methods :

Dead load - - -	800 lbs. per foot.
Live load - - -	1500 "
	Total 2,300

Panel D. L. = 800 × 15 = 12,000
Panel L. L. 1,500 × 15 = 22,500 = 34,500 lbs.

Panel D. L. per truss - - 6,000 lbs.
Panel L. L. per truss - - 11,250 = 17,250 lbs.

The tangent and secant found are as follows and are used as constant multipliers of the vert. components:

Pan. 15, height 20 $\therefore$ tan $= \frac{15}{20} = .75$

Ab. $= \sqrt{15^2 + 20^2} = \sqrt{625} = 25$. Sec. $= \frac{25}{20} = 1.25$

The weight of the structure must be estimated before the calculation can be made, and is supposed to centre at the lower panel points, and the weight of the truss then need not be taken into account here, and to simplify the calculation the D. L. and the L. L. may be taken as one quantity. In the web strain the D. L. is uniform and extending over the whole bridge, while the L. L. is only at one part, so that the strain on each has to be determined separately. To ascertain the chord strains we have at each panel point the truss weights 17,250 lbs., and there being nine of these to be supported by the structure and spaced equally, one-half of the entire load goes to each abutment. F being the centre, we have half going from this point to each abutment. As the load cannot travel directly by the tie-rods, it must go diagonally and vertically along the diagonals and struts, so that each diagonal and strut gets half the load. The same will apply to the load at E, besides carrying the load from F, then the parts at E have to carry 1 1-2 F, etc., etc.

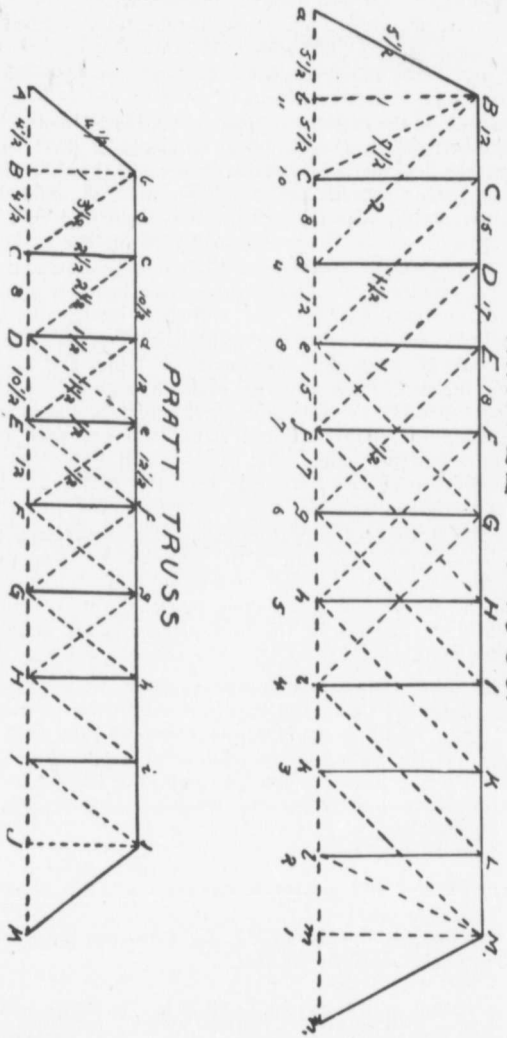
We get the strain on the bottom chords by multiplying the vertical component by the tangent of the angle A, b, B, in the same way as by the weight at the wall, and multiplying by the loads as marked on the sketch. We see, then, that the compression of the top chord and the tension of the bottom chords are equal at the corresponding members: bc = CD, cd = DE, de = EF.

There are other points further that ought to be explained, but as it would make the paper too long I just add the calculation of a Whipple truss, which is made a little different than that for the Pratt truss. Yet the same general principle is used, and the result may be relied on. I enclose herewith two sketches for reference, in which the black lines represent tension and the dotted lines represent tension.

CALCULATION FOR WHIPPLE TRUSS, SPAN 180 FEET.

D. L., 800 lbs. per lineal foot. L. L., 1,600 per lineal foot. 12 panels, 15 ft. each. Height, 25 feet.

$15 \times 800 = 12{,}000 =$ 6 tons pan. Load D.L. } 18 Tons. pan. load,
$15 \times 1{,}600 = 24{,}000 = 12$ " " L.L. } Total load.


WHIPPLE TRUSS.
PRATT TRUSS

$\frac{15}{25} = \tan\theta = .6$ ‖ $aB = \sqrt[2]{15^2 + 25^2} = 29.1547$

$\frac{30}{25} = \tan\theta' = 1.2$ ‖ $Bd = \sqrt{30^2 + 25^2} = 39.0512$

$\frac{29}{25} = \sec.\ \theta = 1.166$ ‖ $\text{Sec. } \theta' = \frac{39.0512}{25} = 1.562$

$aB = 5\frac{1}{2} \times 18\tau \times 1.166 = 115.4\tau$ compression.

$bB = 18\tau$ . . . . . 18τ Tension

$BC = 1.166\ [2\frac{1}{2} \times 6\tau + \frac{31}{12} \times 12\tau] = 1.166 \times 46 = 53.6\tau$ "

$Bd = 1.562\ [2 \times 6 + \frac{25}{12} \times 12] = 1.562 \times 37 = 57.8\tau$ "

$Ce = 1.562\ [1\frac{1}{2} \times 6 + \frac{21}{12} \times 12] = 1.562 \times 30 = 46.9\tau$ "

$Df = 1.562\ [1 \times 6 + \frac{16}{12} \times 12] = 1.562 \times 22 = 34.4\tau$

$Eg = 1.562\ [\frac{1}{2} \times 6 + \frac{13}{12} \times 12] = 1.562 \times 16 = 25.0\tau$

$Fh = 1.562\ [0 \times 6 + \frac{9}{12} \times 12] = 1.562 \times 9 = 14.1\tau$

$Gi = 1.562\ [-\frac{1}{2} \times 6 + \frac{7}{12} \times 12] = 1.562 \times 4 = 6.3\tau$

$Hk = 1.562\ [-1 \times 6 + \frac{4}{12} \times 12] =$ a minus quan. $\therefore$ not requ'rd

$Cc = 1\frac{1}{2} \times 6 \times \frac{21}{12} \times 12 = 30\tau$ compression

$Dd = 1 \times 6 \times \frac{16}{12} \times 12 = 22\tau$ compression

$Ee = \frac{1}{2} \times 6 \times \frac{13}{12} \times 12 = 16\tau$ compression

$Ff = 0 \times 6 \times \frac{9}{12} \times 12 = 9\tau$ compression

$Gg = -\frac{1}{2} \times 6 \times \frac{7}{12} \times 12 = 4\tau$ compression

$ab = bc \quad 5\frac{1}{2} \times 18 \times .6 = 59.4\tau$ tension

$cd = 8 \times 18 \times .6 = 86.4\tau$ tension

$de = BC = 8 \times 18 \times .6 + 2 \times 18 \times 1.2 = 129.4\tau$ tension

$ef = CD = 8 \times 18 \times .6 + 3\frac{1}{2} \times 18 \times 1.2 = 162.0\tau$

$fg = DE = 8 \times 18 \times .6 + 4\frac{1}{2} \times 18 \times 1.2 = 183.6\tau$

$EF = FG = 8 \times 18 \times .6 + 5 \times 18 \times 1.2 = 194.4\tau$

Check—on above, Max. Chord Strain:

$$= \frac{Wl}{8h} = \frac{(18\tau \times 12 \text{ pan})}{8} \times \frac{(12 \text{ pan} \times 15)}{25} =$$

$$= \frac{972}{5} = 194.4\tau \text{ as above,}$$

showing the calculation to come out correct.

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SOME INCIDENTAL BENEFITS FROM THE GROWTH OF FORESTS.

By THOS. SOUTHWORTH, Clerk of Forestry, Ontario.

Toronto.

Mr. Chairman and Gentlemen,—On considering the true meaning of the title of my subject, it has occurred to me that what are the main and what the incidental benefits of forest growth to the community depends largely upon the point of view. The guardian of the public health would probably have no doubt that the principal use of forests was to purify the air by absorbing carbon dioxide and exhaling oxygen, and in regulating the temperature.

The scientific agriculturist would be inclined to think that the chief function of a forest was to serve as a windbreak and shelter for farm crops, and assist the subterranean irrigation, while the old-fashioned farmer will be equally certain that the only use of trees is to furnish fuel and fencing, and they should only be grown so long as they are cheaper than substitutes; failing in this they should be cleared off to provide pasture or plowed fields. The engineer will be inclined to regard trees growing in mass to be chiefly valuable as a regulator of stream flow and a flood preventative, while the artist will look at them mainly from an aesthetic point of view, as making or marring the landscape, according to their presence or absence and thereby contributing to the sum total of human happiness.

Many land surveyors, I have no doubt, frequently have occasion to regard a forest as an unmitigated nuisance, especially when it is composed of Ilex verticillata, or black alder, and lies in the line of march.

As an official of the Government, interested in maintaining the Provincial revenues from sources remote from direct taxation, I have to admit that my own point of view is largely an utilitarian one that regards the forest as a source of wealth to the Province and to the people, but I fully recognize the importance of the other, and what I shall call the incidental benefits, benefits so great and so important to the general welfare of the community as to make it desirable that forestry should be an affair of the State rather than of individuals, with whom present financial neces-

sities may cause a sacrifice of future profits and result to the detriment of climatic conditions.

Before going into the matter of the incidental benefits of forest growth, allow me briefly to refer to what I consider the main question from the standpoint of Provincial revenue, and the maintenance of the extensive industries dependent upon forest products. The Provincial revenue received last year from woods and forests by way of ground rent and timber dues was over $981,000. This represents the production of a large amount of timber, and if we add to this the large quantity of fire-wood, railway ties, pulp-wood, and about 375,000,000 feet of timber cut yearly on lands not controlled by the Crown, it will be seen what a very important part in the industrial life of this Province is played by our forests and their products. The number of men employed in the woods, on the streams, and in the saw-mills, apart altogether from those engaged in other industries dependent in part or wholly upon the forest, runs into the thousands, while the capital employed represents many millions.

It is not necessary for me to go into the many reasons why permanent forest industries must be dependent largely upon State control, that is, I think, pretty well understood by everybody nowadays, but I desire to point out what the present forestry policy of the Government means to the future revenue and the industrial life of the Province.

FOREST RESERVES.

The Forest Reserves Act of 1897-8 proposes to set apart areas of non-agricultural lands to be withdrawn from settlement and kept permanently the property of the Crown for the purpose of growing successive crops of timber. If these areas had to be cultivated and planted to young trees, at an expense of about $15 an acre, the amount of money required would be very great, and if the amount thus expended, with interest, were added to the annual cost of care and protection of the young trees it is doubtful if the resultant crop would show a very large profit on the transaction. True, the crop would be larger than in a forest grown under natural conditions, as was the one we are now harvesting, and a shorter time would be required to enable it to reach a state when it would be profitable to cut it. At the same time the initial expense and annual charges would be so great as to render the project of doubtful financial success on any large scale in this country, where only the more valuable products of the forest have a market value.

Fortunately for us, however, this is not necessary to provide future crops of trees and of the sorts experience has proved to be the most valuable. To do this will require the expenditure of very

little money, but more time. I hesitate to make any remarks as to how we are fixed in the former commodity—it is more or less a political subject, on which doctors differ—but we are rich in the latter. How much money we can invest in re-foresting without borrowing I will not attempt to say, but we have plenty of time. The nation never dies, or hardly ever, and we are a young nation, with millions of acres of land valuable for growing trees, of little value for any other purpose, so we can afford to wait to allow nature to restore the magnificent forest removed by axe and fire from these lands. And nature is already doing the work; not as evenly as we could wish nor with a crop of pure white pine, our most valuable tree, but she is doing the work just the same. I had occasion this past summer to examine a tract of several thousand acres that had been lumbered over, and burned over several times. Over this tract I found a vigorous growth of poplar, birch, white pine, red pine, tamarac, cedar, maple, and other trees. In some places there was very little pine, but over most of it there is a crop of pine numbering from 200 to 700 trees to the acre and growing very fast. Much of it is now 6 to 9 inches in diameter, and I estimate that in 50 years there will be a very heavy crop of pine ready to cut, not less than 50,000 feet B. M. to the acre. I do not mean that it would be wise to cut that much at that time, but it could be cut.

On much of the abandoned farm lands in New England 50,000 feet to the acre is now standing, and two years ago the Rathbun Co. cut 100,000 feet to the acre over quite a tract in Grimsthorpe. I mention this to show that my estimate is not excessive. The stumpage value of that pine 50 years from now will be worth not less than $4 per M, and is likely to be worth more. At this figure the pine timber on much of this land 50 years from now, if protected and cared for, will be worth $200 per acre, which represents a present cash value, at 3 per cent. compound, of $45.62 an acre, and this land is generally considered of no value.

INCIDENTAL EXPENSES.

The main benefit to be expected from these reserves consists in the Provincial revenue and the maintenance of industries dependent on them, but in addition to this the incidental advantages from the presence of these masses of trees are of vast importance to the people of this country. Concerning these factors in forest value there is room for considerable diversity of opinion, and this diversity exists. It is claimed by some forestry advocates that forests materially affect the rainfall, while, on the other hand, it is claimed that it is not so, but that the rainfall affects the forests. While there can be no doubt of rainfall affecting the forests, it is

not equally certain that the presence of forests influences the amount of rainfall. It is a case of not proven, although to my mind the evidence mainly goes to show that if the total rainfall is not influenced by tree growth, its distribution is. We know that trees take up immense quantities of water from the soil and transpire most of it through the leaves. The moisture thus transpired from a large hardwood forest is very large, though difficult to estimate accurately, as the amount varies with the thickness and number of the leaves, amount of water in the soil and other conditions. A conservative estimate, made by F. B. Hohnel, a German scientist, of a fifty or sixty year old beech forest, for the season of growth, places the transpiration at 1,972,000 lbs., or 986 tons of water per acre. Some authorities make the amount much larger than this, but in any event there is sufficient to lead one to believe that the atmosphere immediately above a forest must be so charged with moisture as to hasten precipitation in clouds that may come in contact with it. That forests exercise a beneficial influence on the climate of the neighborhood there can be no doubt. The temperature of the air in the forest is cooler during the day and warmer during the night than in the open field. Consequently air currents are set in motion by this difference in temperature, cooler currents coming from the forest during the day in the lower strata and warmer air during the night from the upper strata, thus equalizing the temperature and increasing the humidity of the air. This is aside altogether from the mere windbreak action of the forest, which is of considerable importance.

WATER SUPPLY.

The aspect of forest growth most likely to appeal to the members of this association is its effect as a regulator of our water supplies, and a factor in flood prevention. Even here there seems to be a difference of opinion and a Western States writer a short time ago claimed that the presence of forests in the mountains prevented the snow from drifting into immense banks and then gradually thawing all summer, keeping up a constant supply of water for the streams. Without disputing this statement, for it cannot possibly apply to our own Province, which is not mountainous, I may state as an accepted fact that the main factor in our great wealth in water-powers and navigable waters are the great forests. At the risk of repeating what you may already know better than I, I desire to point out some ways in which the forests serve to regulate the flow of streams and prevent alternate flood and drought. Speaking generally, the stream flow can only reach a percentage of the rainfall in the catchment basin. If the water does not fall either as

rain or snow there can be no streams; but, granted a certain precipitation during the year, it may be gradually given off to the streams, making them reasonably constant in volume, or it may run off quickly, causing a flood and subsequent drought. Our streams are fed in two ways, by underground springs, and by the run-off from the surface of rain or melted snow. Springs occur generally where a layer of porous sand or gravel lies between an impenetrable subsoil and the surface soil. The rain-water runs under this top soil through the sand or gravel, and as it cannot penetrate the subsoil it is forced out through an opening in the top soil and goes to add to the volume of the nearest stream. It will readily be seen that a larger quantity of water will reach the gravel layer if the surface is covered with forest than would be the case in the open field, as most of it would run off the surface after rain, in the latter case, instead of soaking into the soil. Most of us have known of springs that have become dried up in the summer, that years ago, before the woods had been removed, were perennial.

In the same way the forest serves to regulate the water running from the surface into the streams. Concerning the extent of this action of the forest a great deal has been written pro and con, and volumes of figures have been compiled to show that the removal of the forest had little or nothing to do with stream flow. At the same time I think we are all pretty well convinced that Captain Eads, the famous engineer, was right when he remarked concerning the building of the jetties at the mouth of the Mississippi River, that he was working at the wrong end of the stream. The very nature of a forest floor covered with small twigs, leaves, and sponge-like soil, indicate the mechanical action that dams the water and allows it to run off slowly. Branches die and fall to the ground. Trees do likewise, and in falling across streamlets would form dams and create small reservoirs of water against the time when it would be needed. The roots of trees also form conductors that allow the water to penetrate the subsoil deeply, and add to the subterranean supply. Remove these forests and the rainfall rushes off to the streams, which are soon in flood and soon dry up. The snow exposed to the full force of the wind and sun follows the same course, and large sums are being spent all over the continent to prevent the disastrous floods that now cause so much damage and loss of life, but which were not known in the earlier days when this was really a "wooden country."

At Brantford, I believe, they are spending a large sum of money to prevent the annual flood of the Grand River, doing so much damage. It is worth noting that the county of Brant has only about 7 per cent. of its total area classed as woodland, and of this, much is not true forest land, but is pastured and the soil beaten hard. Most of you know something of the vagaries of the river

at Belleville, which nearly every spring causes anxiety as to the amount of damage it is likely to do in flood and in summer is so dry as to cause the remark by a traveller who saw it last fall from a Grand Trunk car that "it looked like a first rate place to put a river in."

A concrete case of the effect of forest denudation on stream flow has been furnished by W. C. Caldwell, M.PP. Mr. Caldwell is a lumberman and a mill-owner, and as his business interests were affected, he made careful notes of the occurrence in his diary at the time. The watershed of the Clyde River was swept by successive fires in 1875-6-7, a large territory being affected. The water supply was gradually affected from 1880 to 1885. From 1885 to 1892 the flow of water was so reduced that in 1886-7-8-9 and 90 the mills on the Clyde were short of water in August and September, something unknown until that time. In the meantime the new crop of poplar, birch, etc., had reached quite a size, and in 1890 began to affect the water supply and restore the evenness of flow. Since 1893 there has been an abundant supply of water, and Mr. Caldwell has no doubt it is due to the effect of the new forest that has followed the fires. Failing this new forest, a constant supply of water could only have been secured by a costly system of impounding reservoirs.

I feel that I owe the members of the Association an apology for wearying them by these rambling remarks on a thread-bare subject, but will simply urge in extenuation that in many of the older counties the percentage of forest is far too low, and you, gentlemen, are able to accomplish much in restoring the proper balance.

TREE NAMES.

Before sitting down, I would like to refer to a subject discussed last year—the proper naming of our forest trees. I think you all agreed with me that the local names were sometimes confusing. Well, I still have a complaint to make. I had the privilege of looking over a report made by one of your prominent members recently, and in it he refers to a tree which he calls "Pitch" pine. As the Pitch pine—Pinus rigida—is not native of this Province, I have not yet learned whether he means Banksian or Jack Pine, Norway or red pine, or whether he classes all undergrown, scrubby pines, of whatever sort, by that name. I suppose I might have asked him and found out, but preferred to do so in this way, as I believe he last year expressed himself as thoroughly in favor of the correct naming of our forest trees.

DISCUSSION.

Mr. Morris—In regard to the growth of white pine, where the trees are from six to eight inches, the statement is made that in 50 years 500 trees will give about 200 feet to the tree, 100,000 feet to the acre.

I know a case where in about 25 or 30 years a patch of about ten acres of what they call cypress, a small white pine, increased from two or three inches in diameter to from twelve to fourteen inches in diameter. The land is a sandy soil, and I am sure that after 50 years growth those trees will give a much larger return than you state in your paper. Those trees that are six to nine inches in diameter now I have no doubt in twenty-five years will give the quantity of lumber you mention. It may depend upon the soil, but white pine grows best usually in a light sandy soil. They grow as a rule on the higher lands in the sandy soil. Fifty years I thought was a long period to give a tree to grow to about sixteen or seventeen inches in diameter. I do not know whether the growth would be much slower at that size than when from six to nine inches.

Another point is in regard to the pitch pine. We find what we call the pitch pine when we get up west of the surveyed territory now. The present surveys in Algoma and Nipissing stop about where the pitch pine began. When you get up towards Missinabi you get into the pitch pine, but there is a pine on the plains in a great part of this country where the land is very poor, a scrubby pine, not a pitch pine, but it is called pitch pine. The limbs begin at the ground and they grow very stunted. It is not the pitch pine we get further north.

Mr. Southworth—There is no true pitch pine in the Province as a matter of fact.

Mr. Morris—It is a pine, a scrubby pine, which we find in the northern latitudes, before you get out of the heavy timber of any kind, a pine that grows with a scaly bark on it.

Mr. Southworth—I think that is the jack pine.

Mr. Morris—Yes, it is the jack pine. Sometimes it is called pitch pine.

Mr. Southworth—And also other pines are called pitch pine.

Mr. Morris—The pitch pine is a small scrubby pine which grows up in burnt districts where red and white pine have grown before.

Mr. Southworth—We have really only three pines native to the Province.

Mr. Dickson—In regard to this scrubby pine, I used to think it was pitch pine, but I believe the proper name of it is jack pine. I find it scattered over all the northern parts of the Haliburton district, extending out to the Ottawa. Large tracts of it occur down to the Petewawa. Up here it is called jack pine, and in the North-West and Manitoba it is called cypress, or "cypres." Out in your district, Mr. Morris, at the north end of Wendigo Lake, a little west of the portage on the north boundary of the Township of Fitzgerald, I found a growth of timber I believe to be jack pine. I found also a growth of timber, perhaps 50 or 100 trees, as much as fifteen inches in diameter and 50 feet high, I thought was pitch pine.

The President—In reference to this prospective growth of pine, Taylor Bros., on the River Don, have an extensive plantation, and they figure on $4 an acre for their land per year.

Mr. Southworth—$4.20 an acre is the net revenue for all the timber country in Saxony. This is the highest return in Europe.

As to the growth of white pine, I would like to say my estimate is an extremely conservative one. Government officials are not in the habit of exaggerating these things, because they are too apt to be called down.

Then as to the district between the Madawaska and the Missinabi waters, when this pine is growing an inch in two and a quarter years it is very rapid growth. I do not estimate on 500 trees an acre, because the land would not stand that number. In the German method every tree gets an adequate space for itself. In this case it is not so. Some places are blank, and some very thick; you cannot get an ideal forest to grow under natural conditions.

At any rate, all through that section I am quite convinced that 50,000 feet to the acre 50 years from now is a very moderate estimate, and I think my estimate of stumpage values at $4 a thousand for white pine is extremely low also. I mention that simply to accentuate the value of these lands, considered utterly valueless. They are worth over $45 an acre to-day, and no one wants them. But it is not proposed to plant. The necessary expense would be so great as to put it out of court, I think, entirely; but there are some of the blank spaces it is a question whether the rangers in charge of this territory might not be able without very much expense to take a little pine seed with them and possibly fill in where some of the plants are not now growing properly.

Referring to the remarks of Mr. Morris regarding these pines, we have really only three kinds in the Province—white pine, red

pine, and the jack pine. I have an idea, just as he says, that there is another species of pine growing in the open, and it is scrubby, and the branches grow down close to the ground. It is indiscriminately called pitch pine, and it may be white pine or jack pine or red pine. The branches always grow down, and as the tree grows they drop off.

Out in the district of Algoma this despised jack pine that is not considered of any value except for fuel and very little for that, makes a very respectable timber tree. I have seen it at Point of Pines, west of Sault Ste. Marie, as large as sixteen and eighteen inches in diameter, and with good clean trunks up to 30 and 40 feet, and it is being sawn for lumber up there and also sold to the railways for ties. It gives a very serviceable, durable timber for the purpose I am told. I have an idea, as suggested to the School of Science, this timber will be found useful for street paving blocks after the English method, and I think that Prof. Galbraith and his staff have promised to take the matter up and test it and see if it is suitable for that. We have immense quantities of it, and it may yet be a valuable tree. This accentuates the desirability of a proper nomenclature for our forest trees.

The white pine has five needles, the red pine two and the jack pine two.

Mr. Dickson—I would like to ask Mr. Southworth what his opinion is about black walnut. There are some sections of the country where it is becoming exceedingly scarce. Could it not be grown over the country ?

Mr. Southworth—Black walnut will grow almost every place in the southern part of the Province; it is grown up as far as Guelph. But it takes a long time to grow black walnut to maturity. A large proportion of the wood is sapwood, which is not very valuable, it is the heart wood which is of value. I do not think you can grow black walnut from the nut and make it commercially valuable in less than 75 or 80 years.

Mr. Bowman—I have seen in Waterloo County black walnut such as you see in New York State, and equal in size, planted from the nut, probably planted somewhere about 1810, and the trees are now large. I think your estimate of 75 years would give you a good big tree about 18 to 20 inches in diameter.

Mr. Southworth—There is this peculiarity about woods: they are unlike most merchantable commodities that become more valuable when they get scarce. This is not the case with wood. Black walnut is not worth as much as it was 15 years ago. It has been

put out of fashion, and they have substituted oak for it. Black birch will take the place of oak without any doubt, in a few years—it is replacing it now very largely, and is sold under the name of Southern Mahogany.

Mr. Tyrrell—I think as Mr. Southworth is not a member of our Association, we might very properly depart from our rule and move a vote of thanks to him as the writer of this valuable paper. I move a vote of thanks. Seconded by Mr. Sewell, and carried unanimously. Mr. Southworth replied to the vote expressing his appreciation of the attentive hearing his paper had been accorded.

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

A TRIP TO THE YUKON AND RETURN.

By LEWIS BOLTON, O.L.S., D.L.S.

Listowel.

MR. PRESIDENT,—My intention is to give you a short sketch of my trip to the Yukon District and return, and some of the things that I saw while there.

Starting from my home in Listowel in the first week of May last, I purchased a ticket per G. T. Railway and the Great Northern to Vancouver City. I need only say that it was a most delightful trip across the Rockies and the Cascade Mountains in Washington Territory. The scenery was very fine, and I fear that I would fail were I to attempt a description thereof. I had Mr. J. W. Wilson, an old miner, as a travelling companion, who had, some ten or twelve years before taken this same trip into the Yukon country. We took a Tourist Sleeper, and provided ourselves with eatables to last us through to the Coast. We arrived at Vancouver safely, making good time, without any mishaps. We remained here some two or three days, visiting friends and relatives, and indulged in a day's fishing on the Coquittlam River, where my nephew and I succeeded in catching a fine lot of mountain trout. Where is the surveyor who does not enjoy a day's trout-fishing? Here we completed our outfits and took passage on the beautiful ocean steamer "Tartar," owned by the C. P. Railway. We had a very enjoyable trip up the coast on what is called the outer course—that is, going to the west around the point of Vancouver Island, keeping it to our right hand. The smaller vessels take the inner course amongst the islands, where they are protected from the ocean swells. From Vancouver to Skagway is a panorama of scenery on a magnificent scale, and peculiarly charming, into which rare and elusive effects have entered. Marine sketches, land and water combinations, here depressed and there bald and broken shores, backed by recurring benches, densely timbered, and away over all, far off and high up, have risen majestically the tops of mountain ranges, giving on the whole sweep of vision that indefinable charm which "magnificent distances" alone can lend. At times your impressions would be, as it were, dreaming—now weird and calm, and again exhilarating. Sea fowl innumerable, gulls, ducks, geese, and others, were continually with

us. Frequently our attention would be diverted to a spouting whale or a shoal of porpoise. On many of the mountain sides glaciers of considerable dimensions could be seen, from which small icebergs had broken and gone floating southward. We called at Fort Wrangel, our only stop between Vancouver and Skagway. Having an hour or so at our disposal, we took a turn through the village. It was on Sunday, and the inhabitants were in their holiday attire. The aborigines were quite numerous. A number of totem poles were standing, giving the place a weird appearance. All the buildings had been put up with an eye to cheapness, and uncertainty as to long occupation. We were very much entertained during our short stay. We passed several Indian villages and their burying grounds, which were decorated with streamers of different colors and numerous totem poles. We arrived at Skagway early one morning, and then the bustle commenced. There were from one to two hundred on their way to the Yukon country on board, necessarily causing considerable commotion in landing. First, we had to pass customs, after that we made search for a hotel or stopping place. My friend and I selected the Pacific and found it a very comfortable place. After remaining here a day to get information as to which would be the best route to Bennett and as to other matters, I decided to go by the Chilcoot Pass. My friend intended remaining at Skagway a few days, so I packed my transit into shape for carrying, leaving my tripod and other baggage to go later on by pack train, and started for Dyea, crossing the small bay by ferryboat. I landed in Dyea about noon. After lunch I started up the trail for the pass, hoping to reach Sheep Camp by evening, which I did. This place was certainly what I expected to see—a rough frontier stopping place. Nobody was living here for the benefit of his health or for the love of the mountain scenery around it. They were there for all they could make out of the travellers on their way to the Klondyke. Restaurants, stores, hotels, etc., were numerous, and during the past winter, no doubt, did a rushing business. Everything was quiet when I passed through, the rush of travel having been in March and April. After partaking of a hearty supper, I repaired to my "sky bunk," and slept soundly, getting up at an early hour, as I wanted to make Bennett early that evening. The trail from here to the Summit was much steeper than what I had traversed the afternoon before, and my pack of forty pounds or more began to get quite heavy, but to Bennett I had to get. After about two hours' travel I arrived at what is called the "scales," or foot of the steep ascent to the Summit. This is the place where that snowslide covered up so many people and destroyed so much property last spring. Two men had been dug out a day or so before I arrived there, and their bodies were being taken to Dyea by the aerial tramway.

It was supposed at the time that there might be more people beneath the snow, as there was then a great depth, and only the hot sun of the summer months would reveal what was still hidden beneath the snow. This steep ascent would probably be from ten to twelve hundred feet in height, measuring on the incline. Steps had to be cut in the ice and snow to enable one to climb up, and every hundred feet or so you would be asked to contribute twenty-five cents towards the expense of cutting these steps. A life-line was stretched from top to bottom, so that in case you slipped and fell you could lay hold of this line and save yourself from sliding to the bottom. Arriving at the Summit we saw provisions and outfittings of all kinds stacked up like cordwood, as high as it could be reached. Some outfits you could just see the tops of, sticking out of the snow. No person seemed to know what depth it was there, as almost every day less or more fell. There was a report that a man had stacked his outfit there and had gone back to Dyea on business, and on returning a short time after found that his outfit had been covered up. He had taken the precaution before going back to take certain measurements, so that he would know just where to dig for it. After locating his point, he commenced to dig, and shortly came to an outfit, but it did not prove to be his. He then dug on until he came to the third one, which was found to be his. This, however, I will not vouch for, but such is the story told, and not altogether unlikely. This would be about the middle of May. From this point the descent is truly rapid, and lots of snow and ice, but very soft and slushy. The creeks were beginning to break through the snow, and at times there was danger of dropping into holes, whereby you might get very wet. Crater and Long Lakes were getting covered with slush and water, making the travelling very difficult. I arrived at Lake Linderman about noon, and was very much surprised to see the number of people there living in tents and building boats by the hundreds, preparing to go down the river to Dawson and other points. Lake Linderman was open at the head, where the creeks were running in, but the ice on the body of the lake appeared to be sound, and people were travelling on it. I concluded that if it held them it would hold me. I took care to follow on the track of a sled with dogs and a heavy load, and arrived at a point where the lake was open from there to the other shore at Bennett, and took passage in a small boat, landing in Bennett before 5 o'clock p.m., somewhat tired and footsore walking on the rough ice. Bennett at that time was a city of tents—I might say thousands of them, all sizes and shapes. The inhabitants were very busy whip-sawing lumber and building boats. I would say that there would be at least ten thousand people at Lakes Linderman and Bennett preparing to go to Dawson and other points. I remained here about a month assisting my

nephew, Mr. Hawkins, who had the contract from the British Columbia Government for the survey of the town sites of Linderman and Bennett. About the 25th or 26th of May the ice gave way in Lake Bennett, and the people commenced to make their way down the river towards Dawson. At first it was slow work, there being so much ice in the lakes.

It was very difficult work laying out these town sites. The tents were so thick on the ground that we had to wait until a great number of them had started down the river, and even then we had to get the assistance of the Mounted Police. Occasionally we would come across some tent-owner who was not inclined to lower his tent for our accommodation, but on sight of the policeman he very quickly changed his mind. The town site of Linderman had been laid out by some American surveyors, and town lots sold in many of the American cities, but after our police took possession of the Summit at Chilkoot Pass it was abandoned. Bennett is situate in a very picturesque spot at the head of navigation on Lake Bennett. The lake is very narrow, and the mountains on either side are very high. Those to the south are snow-capped until late in the season. The water in Lake Bennett is at its lowest in spring. Many will wonder at this. The snow on the mountains melting in the hot months of the summer causes the lake to rise. Wild flowers were quite plentiful when I arrived there, the lupin being the chief one, and it would be seen almost amid snowbanks. After completing the surveys of Bennett and Linderman, we started for Dawson, in what is known as a knock-down boat, purchased at Vancouver in pieces and put together at Bennett. We also had a Peterborough canoe, which we intended for going up small streams prospecting, etc. There were four of us and about two and a half tons of provisions, etc. The first day we went as far as the mouth of the Windy Arm of Lake Tagish. The next day Mr. Hawkins and I paddled up Windy Arm to complete the traverse of this part of the lake, in order to establish the sixtieth parallel, it being the boundary between British Columbia and the North-West Territory. We found the arm of the lake to be worthy of its name, and were forced to land our canoe and foot it over the mountains and rocky shore seven or eight miles to commence our survey. We then had to traverse the shore northerly until we reached the intersection of the parallel with the shore of the lake, at which point we arrived at midnight, marking a spruce tree with the proper markings to denote such position. This survey had been made to determine whether certain timber limits that had been located were in British Columbia or North-West Territory. After completing the survey we started on our return trip over the rough, rocky shore to our canoe, arriving there about 2 o'clock in the morning, hungry and tired. We finished the remainder of

our lunch and shoved out our canoe and set sail for camp. Having a fair wind, we had a very pleasant trip to camp, arriving there at about 6 o'clock in the morning, just twenty-four hours from the time we started. We took a short nap while the men loaded the boats, and then started down Lake Tagish, calling at Tagish House, a police station, to register. Every person had to stop at this point and give the name and number of his boat and the names of those that accompanied him. Nothing of particular note occurred in our travel until we reached White Horse Rapids, about which there has been so much written. Here there are two horse tramways—one on either side of the river. We decided to take the left hand side, and let our boat gently down to a point where the tram started, and only a few feet from the head of Miles Canon. Here we arranged to have part of our load taken around on the tram-car and the rest taken down through the canon and rapids in our large boat, in charge of a pilot. I decided to walk around, the distance being about four miles, rather than go through the canon and rapids. The rest took chances and went down, and very much enjoyed the trip, according to their account, but I noticed they were quite wet when they arrived at the foot of the rapids. Before leaving the head of the canon I took a seat on the top of the bank at a point where I could see the boats pass through the canon. I had a good field glass, and enjoyed a half hour exceedingly. Boats of all sizes, from a small skiff to large-sized scows, carrying ten to fifteen tons, were passing all the time. One party while I sat there had a very narrow escape while passing through. On entering the canon he either got rattled or made a wrong stroke with his paddle, and ran his boat bow foremost against the wall of the canon and went in sidewise, and before he could get righted the boat struck the other side of the canon and proceeded stern foremost. Part of the time he would be out of my view on account of the height of the waves, and then he would appear again, you would think almost in the air. The boat took another lurch for the side of the canon, striking it and wheeling around right end foremost, and finally shot out at the other end of the canon, the occupant thanking his stars that his boat was right side up and that he was in it. It was rather exciting, and were a person to sit there and watch for a long time it would be a great strain on his nerves. At the White Horse Rapids, about three miles farther down, is another sight-seeing point. Hundreds of people line the banks, watching the boats passing through the canon and down the rapids, very few succeeding in passing without getting thoroughly ducked with spray. I sat for a long time on a rock within fifty feet of where the boats passed, and could see their occupants' countenances while passing through. Some appeared considerably excited, while others were laughing and seemed to thoroughly enjoy the ride.

While sitting at this point I heard a voice up the river, and on turning around I saw the steamer "Ora" coming down at a very rapid rate, crowded with passengers, cheering with all their might. By this time the banks were lined with spectators for almost miles to see the steamer pass through. After she had passed through safely there was a cheer went up, almost deafening. This steamer was built at Bennett during the latter part of the winter and early spring, and after making a few trips from Bennett to the rapids the owners decided to run her from the rapids to Dawson, in connection with the "Flora" and "Nora," they remaining above and running between the rapids and Bennett. After loading our boats we again started down the river for Lake Tagish. That evening we camped at the mouth of the river leading into the lake, in company with hundreds of others on their way to Dawson. Early next morning we set sail, expecting to have a merry trip across the lake, a distance of about thirty miles. At first we had but a very light wind, but by eight o'clock it began to freshen up, and everybody had all the sail up that he or she could muster, and it now became a race for the other end of the lake. By this time the lake was literally covered with craft of all kinds, sizes and shapes, some of which were built on the lines of large hog troughs, and others almost as beautiful as the gondolas of ancient Venice. The people occupying these were from almost all parts of the globe, and seemed to have all been affected by the common craze for gold. When we arrived at the middle of the lake it was a sight long to be remembered, and to complete the grandeur of the scene the pretty little white steamer "Ora" passed through our midst and soon left us in her wake. Every person was straining a point to pass his neighbor, and, with the assistance of the strong wind, were making very fast time. When nearing the northerly end of the lake, which is much more narrow and shallow, the waves became much higher and the small craft began to experience rather a rough time. One canoe, in which the Rev. Mr. Lyons and his companion were, capsized, and Mr. Lyons was drowned, his companion saving himself by clinging to a crevice in a rock until rescued by another boat with very much difficulty. We were very much pleased when we were able to turn our boat into the river and once more into smooth water. Up to this time we had done but very little fishing, and decided to tarry for a short time at the first place offering such sport. Arriving at an eddy in the river, we ran our boat ashore and got our tackle—two took the Peterborough and a troll, and the cook and I took small lines. I selected a small eddy to try my luck in, but found the brush on the bank rather troublesome, but after breaking a few off I decided to cast my flies for a skip, and soon succeeded in raising a commotion in the water. Two and sometimes three at a time were common. The cook came to,

my rescue just in time to save my rod and line, as I had fastened onto three very large Arctic trout, and with his assistance landed them safely. We now had all we could carry, and returned to the boat, finding that I had been the only one successful in catching any fish. That evening we had a grand feast of fresh fish. From this point down there was nothing of particular note excepting passing through the "Five Finger Rapids," which is easily done if proper care is taken to keep your boat in the current and in the right channel. Very few Indians are to seen along the river. At the mouths of all the streams running into the Yukon were villages of tents, owned by prospectors who were up these streams prospecting, leaving their wives and children to take care of their belongings until their return. There were all kinds of reports as to great strikes on certain creeks, but on careful enquiry it was found to be untrue. The trip down the river was like a holiday picnic. At every turn of the river we would make new acquaintances. We travelled somewhat faster than the average voyageur. The scenery on the lower part was quite equal to the upper part. The mountains were not quite so high, but the grass had grown more and the mountain sides were like flower gardens, and were even more brilliant than ours in Ontario.

Fort Selkirk was at last reached, and we halted for dinner. The banks were so crowded with boats that we were unable to land near the village, and therefore did not see much of it. A few log buildings covered with dirt comprised the barracks of the Mounted Police, but there were hundreds of tents of all colors and shapes, and the red-coats could be seen promenading the banks of the river. We tarried here but a short time, having still about 180 miles to Dawson. From this point commenced what are known as the Ramparts, which appear like huge towers built of masonry, being in many places so regular. Prospectors now began to come up the river, and could be seen towing their canoes with small outfits, the current being so strong that they were unable to row them, and proved at best a very slow process. We arrived at Dawson in the evening of the 29th of June, making the trip of over 500 miles in eight days. Dawson appeared very pretty at a distance. On turning the head of the river it appeared as nestling on the mountain side and at its foot. Everything appeared white and distinct, with the mountain background. There were thousands of tents, many even on the top of the mountain. It was estimated at the time of our arrival that there were between twenty and twenty-five thousand people there. We secured a place near the police barracks to put up our tents, and at the close of the second day we were established in Dawson ready for business. Our first work was the survey of a Government concession on Hunker Creek, about fifteen miles out from Dawson. We packed our

instruments out and completed the survey in about a week, and returned to Dawson from the mouth of Hunker Creek by small boat, plied by two young men who took freight up to that point and passengers down to Dawson. We rented a small room above a restaurant for an office, paying $100 a month therefor. The building was made of scantling covered with canvas. After completing the plans of the survey we made our headquarters at the Forks of the Eldorado and Bonanza Creeks, about twelve miles from Dawson, and between there and Dawson I spent the summer, surveying claims, etc. To speak of the richness of the individual claims would be hard to do, but suffice it to give you a few of the notable ones. No. 2, above on Bonanza, is probably one of the richest. It now has been floated on the English market for the fabulous sum of £450,000 by the owner, Mr. Alexander McDonald, known as the Bonanza King. He was interested in some one hundred and twenty claims. Nos. 4, 5, and 6, on Eldorado, are also very rich, and are known as the Berry Mines. One day while passing I called to see the owner, Mr. Berry, who was at the time in the bottom examining a part that was considered not to be worth washing. While watching him he struck his pick against a nugget that proved to be worth $140. It has been estimated that about a million dollars have been taken out already, and the claims are not nearly worked out. The "Lancaster," a bench claim opposite No. 3 Eldorado, is considered to be one of the richest bench claims. It is claimed that two men can take out $1,800 to $2,000 a day with one rocker. One day while visiting the mine we offered the owner $150 for a small wheelbarrow of dirt that was standing by the rocker, but he would not accept it, and found on washing it that it yielded about $250. French Hill is also considered to be very rich. Some of the claims (one hundred feet) having been sold for as high as $20,000. Most of the claims on Eldorado up to No. 30 are very rich, most of them being valued from $200,000 up to $500,000, and some were more. Part of the Bonanza is also very rich, but is more spotted. The bench claims along the Bonanza are in many places quite rich, and during last summer a great deal of gold was taken out. The gold on the Bonanza is considered to be worth considerably more than that of Eldorado, being much finer. I cannot say anything in reference to other creeks, so far as my own observations go, as my work was principally on those two creeks, only visiting Hunker once, and then not when it was being opened up.

The summer was delightful, sunny days and cool nights. Many of the miners slept during the midday heat and worked in the cool at night, there being plenty of light. One could read in a tent at any time during the night. Wake up at whatever hour of the night, you would hear the "wish wash" of the rocker, and the

rattle of the gravel off the shovel, and the tramp, tramp, tramp of the miners and others coming and going to Dawson for provisions, the night being the most comfortable time for travelling. The weather during my stay (which was about three months) was delightful—very little rain and very little cloud. Two weeks in July were quite hot, but with that exception it was all that one could desire. Towards the latter part of September it turned a little cool at nights, and I decided to arrange for my return before the close of the month, and took passage on the steamer "James Domville," that had been plying on the lower river during the summer and was intending to winter on the Upper Yukon. They had advertised to go to the White Horse in six days, but did not arrive at that point until fourteen days had been spent, a good part of which had passed while on sand-bars, and tied up against the bank for repairs, etc. Our captain knew more about the smell of a whiskey bottle than he did about navigating the Yukon River. We had paid $100 for passage to White Horse, and were paying $1.50 for meals, so a matter of two weeks or so on board the boat was quite a consideration. At the end of six or eight days from the time we left Dawson many of the passengers refused to pay anything more for meals, as they had exceeded their time, but the captain said they had to pay or go without. However, the larder began to get rather low, and the meals consequently poor, and there was a general kick, and most of them did not pay. Our berths were rather small, six berths in a state-room 7 by 7. Only one could dress or undress at a time. There were about one hundred and fifty passengers, chiefly miners going home after a year and a half's trial in that frozen north, to visit their families, intending to return in the early spring and some on the ice in late winter. We had a full quota of gamblers, both male and female, who indulged in that every night until the tables were required for the morning's meal, and then slept through the day. The weather during the return trip to "White Horse" was cool but fine. Some nights there would be a slight fall of snow on the mountain tops, but on the first peep of the sun it would melt away. We arrived at the White Horse Rapids early one morning to find that the steamer "Flora" had been gone about an hour. Perhaps the passengers were not disappointed! We then gave our captain credit for stopping five miles down the river the night before so that we would miss this boat and have to remain until the return of the boat some three days later. The captain had a very stormy interview with some of the passengers before disembarkation, and had to retreat to his pilot house and arm himself with his gun in order to save himself a cold bath in the river. Our stay of three days at "White Horse" was very irritating, considering that we could have caught the other boat if our captain had done his duty.

Here we had to pay $1.50 to $2 for meals and had also to pay for sleeping on the soft side of a plank on the floor of the hotel, or stopping place, but by this time we were used to being held up, and took it as a matter of course. It was a bright hour when the steamer was sighted, and a glad shout went up from many throats, and in a short space of time we were all ready to board the steamer, in fact much sooner than they were ready for us. We had to walk a single plank in order to board her, and a misstep meant a cool bath in ice water. In a short time we managed to get on board and obtain our sleeping berths, about 2 feet 6 inches by 6 feet each, made of hard spruce lumber, not even a straw tick in them. However, we were now so anxious to see the Pacific coast, and the prospect of so doing became more apparent, we were satisfied with anything as long as it was moving in the right direction. Our chances for meals in this craft were rather uncertain, The table had to be filled some nine times before the passengers were supplied. Some went without rather than participate in a scrap for a seat thereat. Most of the distance from "White Horse" to Bennett is through lakes which are literally covered with water-fowl. Many of the passengers indulged in shooting at them, very seldom killing any. We arrived at Bennett at noon of the second day from "White Horse," glad to once more put our feet on terra firma, having been so long on the water. After dinner we hurriedly made arrangements with the representative of the Arctic Express Company to take our baggage to Skagway at ten cents per pound, guaranteeing their delivery there the following day on the arrival of the evening train from White Pass City. After completing this, we started on foot for the "Log Cabin," some eight miles distant on the trail towards Skagway, via the White Pass. Some of the passengers went via the Chilkoot Pass, in order to see it, but I had come in by that way, and preferred going out by the White Pass. We arrived at our destination at dusk, and after a lunch, as such it was, we decided to try sleep. My companion and I were assigned the lower bunk of the series, at the end of the cabin. These bunks had been built with small poles, on the top of which was laid a not very thick blanket, no tick or mattress, with a light blanket to cover us. It is needless to say that I kept most of my clothing on. I found on getting in that the poles were not all of the same size, and that a larger one had been placed about the middle of my share of the bunk, on which I tried to balance myself for an hour or two. Failing in my object, I got up and sat by the stove in a comfortable chair, catching short cat naps until an early hour in the morning, when I woke the landlord to get us some breakfast. We started at early daybreak for White Pass City, where we intended taking train for Skagway, a distance of twelve miles or so. By some means I got separated from our

party and trudged it alone. The day promised to be fine, but by the time I began to ascend the mountain side clouds began to appear about the summit, and as I rose up its side I found myself being enveloped in them, and was completely shut in, not being able to see more than ten feet or so ahead of me. Snow and rain began to fall, and with what had fallen the day before I was more than ankle deep in mud and slush, which was not very comfortable with short boots. I arrived at the summit about midday, and I supposed that the air would soon clear after passing it, but such was not the case. The fog or cloud hung there until I had gone down several miles on the other side. The scenery no doubt would have been most excellent had it been clear. On arriving at the junction of two canons the fog began to clear away, and I was able to discern men and horses on the mountain side, working on the railway. This point was the grandest that I had seen, and I stood for a moment taking in the sights. By this time my feet and legs began to feel somewhat tired, and going down the sides of this steep canon was somewhat difficult, and I was glad when I arrived at the bottom, where the trail had been very much improved. The keeper of a restaurant at that point invited me to come in and have dinner with some of our party, but having taken something on the other side of the summit I passed on. Shortly after one of our party overtook me on horseback, and told me that a chunk of rock had passed through the roof of the restaurant and broke through the floor immediately behind some of our party, who were taking dinner, not hurting them, but at least giving them a fright. The trail now became pretty good, and although tired I made good headway. The scenery along the bottom of this canon was very fine, and under other circumstances would have been very much enjoyed, but with the fear of some rock coming down the side of the mountain from where the workmen were blasting, one was in constant dread. I arrived at White Pass City in due time for the train, and enjoyed myself feasting on some fine apples that I had purchased at five cents a piece, being the first that I had eaten. I heartily enjoyed this ride of twelve miles or so on the train, even if I had to pay twenty-five cents a mile therefor. We arrived at Skagway about 6.30 p.m., and on enquiry found that my baggage, with others, had been left behind. After "cussing" the railway officials and their agent at Bennett especially, we repaired to the Pacific Hotel, where we found comfortable quarters at a reasonable figure. We had now gotten beyond Klondyke impositions, and were able to get a first-class square meal for twenty-five cents and a comfortable room for fifty cents to a dollar a day. I remained here a week, not of my own will, but was forced to do so on account of my baggage being detained. I found Skagway very much improved since spring. it having the appear-

ance of a civilized town, having waterworks, electric light, etc. This place, in my estimation, is destined to be one of the largest cities on this coast, being the terminus of the railway leading to that large tract of country known as the Yukon and Lake Atlin District. From this point I took the steamer "Utopia" for Seattle, on which we had a very pleasant trip, rescuing the passengers of the wrecked steamer "Bertchel," who had been detained on an island for over a week. We arrived at Seattle on Sunday afternoon, and enjoyed the trip down the coast that day very much, as the vessel was close to land and the towns and villages were easily seen from the deck of the steamer. I remained in Seattle one day visiting friends and enjoying the sights of the city. This city is certainly one of the finest on the Pacific coast. From here I took train to Vancouver, where I remained a day or so on business, taking the C. P. Railway to Chicago. I very much enjoyed the sights through the mountains, which are well worth the cost and time spent in taking the trip through them. From Chicago I took the Grand Trunk Railway to Listowel, calling on my way at Kingsville and Detroit, arriving home just six months from the time I had left in the spring, having gained considerable knowledge besides what little I had gathered of the yellow metal.

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SURVEY OF THE BOUNDARY LINE BETWEEN ALGOMA AND NIPISSING DISTRICTS.

By A. NIVEN,

Haliburton.

In the year 1896 the Department of Crown Lands decided upon running an exploration line to James Bay, and upon looking at the map of Ontario the boundary line between the Algoma and Nipissing Districts having been at that time run to a point 30 miles north of the C. P. R., seemed to be the most suitable line to run.

In the Revised Statutes of Ontario, 1897, this boundary line is described as follows:

"Commencing at the waters' edge of the Georgian Bay, near the most westerly mouth of French River, in the production southerly of the east limit of the Township of Humboldt; thence due north along a line formed by said produced limit the east limit of said Township of Humboldt, the limit between timber berths numbered 59 and 67, 60 and 68, 61 and 69, and along the east limits of the Townships of Waters, Snider, and Rayside, and continuing due north to the northerly limit of the Province of Ontario.

The line here described would strike the south-westerly shore of James Bay some distance south-easterly of the mouth of Albany River.

The east boundary of the Township of Humboldt was run in 1892 by O.L.S. W. Galbraith, the length of the township being 11 miles, 18 chains, 67 links. Immediately north of Humboldt the line between timber berths 59 and 67, six miles, has not yet been run. The line between timber berths 60 and 68 and 61 and 69, by O.L.S. Wm. Bell, in 1873; the east boundary of Waters, by O.L.S. Burke, in 1883; the east boundary of Snider, by O.L.S. Isaac L. Bowman, in 1883; the east boundary of Rayside by O.L.S. Isaac L. Bowman, in 1884; the east boundary of Lumsden, by O.L.S. Laird, in 1887.

In 1888 O.L.S. Proudfoot ran the line from the north-east angle of the Township of Lumsden 18 miles north, and then ran a base line to the west.

In 1896 the writer was instructed to commence where O.L.S. Proudfoot left off, and continue the line north 100 miles. This

was done, the line being surveyed to a point 120 miles north astronomically from the north-east angle of Lumsden. Posts were planted at every mile and an iron post every three miles. The latter were of 1 1-4 in. gaspipe, 3 ft. long, pointed at the bottom, closed at the top and painted red, and the numbering was made continuous from Lumsden, the 120 mile post being in latitude 48 deg., 27 min., 54 sec. north.

In 1898 the writer was again instructed to carry the line on to the Moose River. This was also done, the line being surveyed to a point four miles beyond the Moose River, or to a point 300 miles north of the north-east angle of the Township of Lumsden, being about 312 miles north of the C. P. R.

The C. P. R., both main line and Sault Branch, crosses the boundary line in the Township of Snider and about four miles west of Sudbury. It will thus be seen that, with the exception of six miles immediately north of Humboldt, the line has been run a distance of about 353 miles from Georgian Bay. The longitude of the line, taking the Ontario and Quebec boundary line to the 79 deg. 31 min. west, is about 81 deg. 04 min. west. If produced south it would pass west of Owen Sound, west of Stratford, east of St. Mary's, east of London, east of St. Thomas, and strike Lake Erie about five miles east of Port Stanley.

The distance from the Township of Humboldt to Lake Erie is about 227 miles. If continued north it would probably strike James' Bay about 60 miles north of its present termination and about 45 miles south-easterly from the mouth of the Albany, making the total length of the line across Ontario about 640 miles.

The latitude of Moose Factory is given by Mr. Ogilvie as 51 deg., 14 min., 42 sec. north. The line, therefore, if continued to 312 miles would be about due west of Moose Factory, and distant therefrom about 20 miles.

Beginning at Proudfoot's base line, 30 miles north of the C. P. R., the line passes through a broken and hilly white and red pine country, filled with lakes to the 42nd mile, where it enters a comparatively level tract to about the 54th mile. The upper Wahnapitae River was crossed on the 41st mile. The height of land between the Georgian Bay waters and those of the Montreal River being crossed at the 50th mile. From the 54th to about the 100th mile the line again passes through a hilly and rocky country. At the 54th mile the line passes within a mile of the west branch of the Montreal River, running into it at the 68th mile, crossing it three times, and leaving it flowing easterly on the 71st mile. The height of land between the Hudson's Bay and St. Lawrence River waters is crossed on the 76th mile, Sinclair's exploration line of 1867 on the 86th mile. A noted land mark along this part of the line is Mount Sinclair, about seven miles east of the line and a little to

the south of Sinclair's line. It is said to be 1,500 ft. over the surrounding country. Numerous lakes were also met with between the 72nd and 95th miles. A little beyond the 100th mile we enter upon the good land, the level country that extends to James' Bay, and for the remaining 200 miles of the line the country is almost as smooth as the lawn in front of the Parliament buildings. The country may be said to be an inclined plane, falling to the north, but so gradually as to be imperceptible to the eye. For over 120 miles the line runs through a splendid tract of farming land, clay soil, often covered with black muck. Parts of it might be called swampy and parts of it muskeg, but taken altogether there are not many places in Ontario where a line can be run for the same distance through such an even uniformly good tract of land.

From about the 230th mile to the north end of the line the country is largely muskeg, but along the banks of streams, where the water can get away the land and timber is good.

The timber along the line from the 100th mile is chiefly spruce, tamarac being next in order, and poplar where the land is dry, with white birch, balsam, and balm of gilead. There is very little cedar in the country, generally only a fringe along the rivers. The spruce is from four to fifteen inches in diameter, and thick on the ground. Along the 170th to the 175th mile considerable scattering white spruce is to be found. There is no white or red pine beyond the 100th mile. I saw a few trees at Abitibi Lake on my way north, and some along the eastern boundary of Ontario, between Abitibi and Temiscamingue Lakes.

Lake Abitibi is said to be 850 feet above sea level.

The Abitibi River is generally from five to fifteen chains wide, but before entering Moose River half to three-quarters of a mile wide. The water is muddy, the current strong, and there are numerous rapids and falls. The line crosses it at the 179th mile, flowing north-west, and at the 288th mile flowing north-east. The latter crossing is about 15 miles from its junction with the Moose.

The Moose River was crossed on the 296th mile, where it was a mile wide, current strong, water shallow and muddy, shoals and rocky in places, only navigable for canoes during first week in October. I went down from the Abitibi crossing of the line to Moose Factory, about 35 miles, in seven hours, but it took two days to come back.

On the 276th and 277th miles we ran across a bed of gypsum. The surface of this formation was very uneven and full of holes and caverns, dangerous to walk over in places. We called it "the Holy Land." We camped there over a Sunday. Soap would not dissolve in the water, and it made abominable tea. Game was scarce along the line. A number of beaver were met with north of the Abitibi River; a few prairie chickens were seen, and not

many wild geese. It is said that they are not as plentiful as in former years, the stubble fields of the North-West having proved a great attraction to them.

The Hudson's Bay post of Moose Factory was established over 200 years ago, and has a population of about 500 during the summer months, when the Indians come in from their hunt.

The Moose Factory people know they are in Canada, and some of them believe they are in Ontario, but whether in Nipissing or Algoma is a matter of indifference to them, and I was told that the only magistrate there holds a commission for Thunder Bay. They get all their goods from England by the ship that comes in August and anchors in the Bay, ten miles from Moose Factory. Armour's pork and Manitoba flour, that has been twice across the Atlantic, sell there, the former at $27 per barrel and the latter at $10. Dry goods, boots, shoes, etc., can be had almost as cheaply as in Toronto. All kinds of vegetables and flowers were growing in the garden of the Bishop of Moosonee when I was there on the 7th of October. The tide water rises at Moose Factory from three to fourteen feet, according to the direction of the wind on James' Bay. During the spring flood the place is almost submerged. I left there on the 8th of October and travelled every day (two Sundays excepted) till the 27th, when we reached Abitibi Lake. We found the lake frozen and had to remain four days till the ice was strong enough to go upon, then between walking on ice and along shore and across points in the bush, and canoeing open stretches of water, we reached Lake Temiscamingue on the 24th of November and Toronto on the 28th, having had many hardships and narrow escapes. I regret to say that a halfbreed Indian from Lake Temiscamingue, who had been with me four years, was drowned at midnight on the 5th of November, in Lake Abitibi, the bark canoe in which he was with five others having gone down after colliding with a large piece of floating ice.

It was my intention to have connected my line with Moose Factory for the purpose of getting the longitude, but it was so late in the season when I reached Moose River with the line there was no time to do this. I checked the latitude as given by Mr. Ogilvie, only differing from him a few seconds.

DISCUSSION.

Mr. Sankey—I assure you it has given me a very great deal of pleasure to listen to the reading of this paper.

I have been asked since my return from that country to write a paper, but I did not think the information I had gathered during my very quick trip would warrant my doing so, especially when I knew Mr. Niven was making a survey and could tell us accurately what he had done.

The trip I took was for a totally different purpose, viz., to get a general knowledge of the country and to endeavor to find out if it were possible to reconcile the different reports that have already reached Ontario of the country through which Mr. Niven has travelled. The line Mr. Niven has run may be looked upon as the central longitude of the country that has been treated of in a great many reports. It was not until after I returned to Toronto that I was aware that so much had been printed and published about the very territory that Mr. Niven now tells us about; it is a strange country to most of us, although we are Ontario Land Surveyors. And with the exception of one or two reports I happened to get hold of I had very little information to guide me as to where I was going or how to get there. I have found out since there is one gentleman who has made that country a special study: I refer to Mr. Borron. He, I believe, was considered a mining engineer a great many years ago. But his principal duties up in that country were those of a stipendiary magistrate, and from away back in the seventies up to late in the eighties he has made trips along almost every river that runs into the basin of the Moose. I have succeeded in looking up some of the reports of that district; there is a very good collection of them in the library of the Parliament Buildings. Mr. Borron is now living in North Toronto, and his knowledge of that country is certainly most valuable to the Province. Much of it has been published in reports to the Government, and in printed pamphlets.

I started at the head of Lake Temiscamingue and went up Canoe River into Canoe Lake, a long lake of little importance as far as I could see. It is in the Province of Quebec, and the timber has been nearly all cut off about it. A large amount of good pine has been taken out of the country and gone down the Ottawa. Further on I came into Barrier Lake and then into Long Lake. We found nearly all the timber had been taken out about there. When you get up to the head of a north-east branch of Long Lake you turn into a small bay and then go up a small creek about 400 or 500 yards long. Then a small muddy lake appears about three-quarters of a mile long; this is the head waters of that point of the Ottawa basin. A portage of a mile and a half over a small gravel ridge brings you into a small lake, very muddy and marshy, with scarcely any current in it until you near the north end of it, and then you see the water running to the north. We soon got into

Island Lake, a lovely lake as far as scenery is concerned. I do not think I have seen its equal in Canada. The neighboring country is high, with hills 800 to 900 feet above the surrounding country. We then came into a lake called Upper Lake, and then into the east end of Lake Abitibi. This lake lies east and west with some deep bays north and south. I do not think the plans to-day convey any adequate idea of the lake. If you take a canoe and paddle unless the wind is favorable, you will likely be delayed four or five days before you get across. I was pretty fortunate. I had the wind a little in my head going out in the morning, but towards the middle of the day the wind went down and we got over the wide crossing before night. That night the wind got up, and the following day we had to stay in camp until about three o'clock. We continued the next afternoon making a portage to get across. We went down the river, and then turning north-east we walked across the height of land where the water runs into Lake Temiscamingue by way of Blanche River. The timber is as Mr. Niven says, birch, spruce, poplar, more spruce than anything else in that country I should say. We came upon many tracts of brule, located in undulating country, and with some very simple form of drainage it would make a reasonably good agricultural country. There is very little rock showing. We went up Black River for 25 miles; a stream from three chains to a chain and a half wide. There are one or two very good water powers on the river, and some rapids, but it is not a river that could be looked upon as a highway. Still, it is not a hard river for a surveyor to travel on. Further on we crossed a spur of land into the basin of the Frederick House or Nighthawk Lake. Through this basin Mr. Niven's line ran until he made his first crossing of the Abitibi River. I then went along the Frederick House River, and struck a river between Nighthawk Lake and the Frederick House, and going down the river I connected with the Abitibi River where the maps show a rather sudden bend to the west. I understand in that particular place the Abitibi River itself is very rough with some bad rapids. From the junction of the Abitibi and Frederick House River, which might be some six or seven miles to the west of where Mr. Niven's line crossed, the river itself is a good one to travel on, and the country is undulating. After 26 miles on the river you come to a series of terrific rapids where the rocks come right up to the surface. You find more than rapids, really chutes, that no canoe could live in. You then reach the Canon Portage, where the river that has been reasonably wide, four or five chains in places, suddenly narrows into 70 or 80 feet, and the water goes through between two big walls of rock. I had the opportunity of going down along the whole course of this, and I saw some of it. At the head of the

portage, the highest part, you will be probably 200 feet above the water, and I am informed in some places the rock is almost sheer down to the water. The northerly end of that canon is one mass of rocks and troubled water, and the scene is magnificent. When you get down to the bottom of this you get into gravel banks, and the country is a great deal more hilly, the ground being from 180 to 200 feet above the river. You soon come to an outpost of the Hudson's Bay Co. called New Post. Further on you have fairly good travelling on the river, and then you come to the Otter's Portages. There are two. These resemble the canon I have already described. The portage is probably about three miles long, and when you get to the bottom of that you come again into the river, where it widens out. The water is shallow and the current swift, and we found it, if not dangerous, certainly difficult. The Indians I had with me did not know the river, but we got through without much trouble. One thing strikes me as peculiar—that Mr. Niven did not find any sudden step or jump off in the country to correspond with the canon and the Otter's Portage. On the river there is decidedly a big jump down, whereas from Mr. Niven's experience it appears to be a more gradual descent. His line, of course, is possibly 25 miles or more east of the Canon Portage, and I suppose he would have approached the Otter's Portage, 18 or 20 miles back.

I went on down to Moose Factory and spent several days there making some soundings and a rough exploratory survey of the mouth of the river—that is, out beyond Moose Island. Moose Island is the highest island in the river. It is near the middle, about a mile and a quarter of river to the south-east of it and possibly a mile and a half to the north-west of it. There is a whole cluster of islands and shallows. Almost from the mouth of the Abitibi River northward until you get out to the sea it is one continued series of shallows and islands down the middle of the river. The amount of material that the ice brings down every season is vast. When you get past Otter's Portage and strike the first islands in the Abitibi River they are principally of a limestone formation, of a more or less friable rock and gravel, and the nose of every island is broken off. You can see ice marks on the trees 30 feet above the summer level of the water, where the bark has been knocked off the last spring. There was no drift wood along the shores of that river, and this naturally accounts for the very shallow mouth there is to the Moose. There is a narrow channel when you leave the mouth itself. The ship they have there, the "Mink," has to be lightened, and it takes all the men and women and all the cattle and horses they have there to haul that ship up. That is done once a year to get her out of the way of the ice. When you get out of the mouth of the river there are wide shallows that at low water are bare, and

covered at high water, but the main channel is not over three feet deep until you get far out.

However, a little dredging and a little improvement would make that channel, as a tidal port, perfectly feasible for vessels not drawing over 16 or 18 feet of water. Beyond that, I think the expense would be very great. The English ship arrived there when I was at the Moose. It was a good many miles out. I could see her sails and masts. I was sorry I could not wait to see some of the English sailors and smell tar once more, but I had been advised, the water was falling so fast, that if I wanted to get home without any trouble (this was about the 28th of August), I had better leave. I came home by way of the Missinabi River, that is the west river running into the Moose Basin. Some people say it is the Moose River. Others say it is the Mattagami. If you get any man living on the Missinabi he will call it the Moose. This river I found for 150 miles extremely shallow, worse in fact than the Abitibi although the water was not quite so rapid. No portages, but you have to wade up the river and haul your canoe up with a line. In some places there are deep pools and then long stretches of very shallow water until you arrive at the long portage. On all these rivers there is a long portage. You climb up a pretty nasty portage and go along the level, and do not seem to drop down nearly as much as you got up. Then you get into better paddling. We travelled five or six days further before we got into anything like nice travelling. At the same time I am quite satisfied that anyone coming back from Moose Factory should come back by this river, because, starting from the Moose, as Mr. Niven did, even if it is as late as the 8th of October, you would get the worst 150 miles over in the early time, and then as you came on you would not have the danger of the big lake Abitibi. You might have to wait until the ice set, and once it did set it would stay. When you get towards the end of the trip, to the head of Lake Missinabi, you are near a Hudson Bay post, where food can be obtained. There are also more Indians and other people along that river than along the Abitibi. The Missinabi is a long lake, but not very wide, and then when you reach the end of it you are at the C. P. R.

I think it would be advisable for our Association to get hold of different reports, maps and other information of this country and embody them in some way in our report. Care would be necessary, to see how far the information was reliable. Possibly we might get assistance from the Government or people interested. A combination of the various routes and means of going through this country and its resources would be a matter of very great interest to the public at large to-day, especially if we look upon James' Bay or the Hudson Bay as the sea port of Ontario. From a military

standpoint it is undoubtedly the proper entrance and safeguard of this Province, if any accident did happen to our communication between here and Montreal.

Mr. Niven—In reference to what Mr. Sankey remarked, that he expected that we would have found some jumping off place on the line, I may say that there was one place where we went down a little hill, and before we went down the hill, looking across the valley as far as we could see we thought we were going to get up upon another hill. But after running about 20 miles we could not find the hill, and we discovered it must have been a bluff of trees back on the high land I spoke of.

Mr. Sankey—In going up the Missinabi we also struck the bed of gypsum Mr. Niven speaks of, and one or two layers of lignite about the same latitude he mentioned. The deposit I saw along the river would extend possibly from a mile to three-quarters of a mile on both banks. Mr. Carter—There is a large deposit on the French River, just east of Mr. Niven's line, nearly as large as on the Missinabi River, which I have also seen.

Mr. Sankey's trip was more like mine than Mr. Niven's, as we both worked along the river.

The deposit of gypsum I mentioned on the French River is about 30 miles up from the mouth and it is nearly in a line with the deposit on the Missinabi River, and they are similar in quality.

I might mention that at New Post, on the Abitibi River (it is about 40 miles from its mouth), the water rises 29 feet and the width of the river increases about 100 yards then, so that there is a great volume of water going down every spring. One foot below the Factor's house there, marked at a log lying at the verandah, was the highest point the river had gone.

As to the limit of pine, Mr. Niven speaks of seeing some on the Abitibi Lakes. We found the same thing at Frederick House Lake, nearly due west. Mr. Sankey omitted to mention going through there, that there was a very long and tortuous creek, probbably 20 miles or more, where we had to get through logs. Mr. Niven's men went through and cut the logs, and we came through about four days after, and Mr. Sankey's men went through still later. It took more than a day extra on account of the logs. We gave that creek the name of Stick River.

Mr. Kivas Tully asked in regard to putting through a railway whether a good terminus could be found at the mouth of the Moose.

Mr. Sankey—The difficulty is this, with regard to the Moose River and all the branches of the Moose, in the spring of the year

all the ice that forms on these lower stretches of the river before any falls are reached, finds its way down to the Factory.

If you make a wharf or harbor at the mouth you are putting it where the ice may cut it out in the spring.

If a river can be found in the Bay where the fall is close to the sea it would be the place to put a wharf. When you get the ship in to the wharf it will be safe and the wharf will be safe, and the ice above the fall will rot and not do any damage coming down. You must look for the mouth of a river where a ship would not suffer. The north wind blows up a terrific sea, and a wind blowing for a few days down the bay will create such a sea that no ship could stand it. You must get into some shelter. Perhaps we may have to go to the east or south to the great Nottawa River, for the best harbor.

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THE PAYNE RIVER DRAINAGE WORK.

By T. H. WIGGINS,
Cornwall.

On the 20th day of April, 1896, the Council of Finch appointed me to make an examination, prepare plans, etc., and to report upon the drainage of certain lands in their township, in accordance with a petition signed by six interested parties. These lands were along the banks of the Payne River and its tributary, Beaver Creek.

Shortly after receiving the appointment I examined the lands of the petitioners to estimate the work necessary to relieve them from being overflowed and to make them useful for agricultural purposes; and found that the probable cost for deepening, widening, straightening, etc., two miles of the Payne River and three-quarters of a mile of Beaver Creek would be over $10,000. The proposed improvements of the lower mile of the Payne River I estimated to cost $6,132.50.

The drainage basin contained an area of 24,900 acres, of which only 336 acres were low land directly benefited by the work. The drainage area of 20,409 acres comprised 14,081 acres in the Township of Roxborough, 1,563 in the Township of Finch, and 4,765 in Osnabrook Township. This low land was of very little use in its present condition, being principally swamp and beaver meadow. I asked myself would an engineer be justified in making an assessment to drain lands for an amount almost sufficient to purchase the area to be benefited. This question, however, was settled in my mind when the adjoining Township of Roxborough appointed me to make a survey, etc., of the Payne River, in their township, in accordance with a petition of the land-owners along the river extending to nearly the source of the drainage basin.

The estimated cost of the extension in Roxborough was over $14,000, thus making the total cost of Payne River and Beaver Creek drainage work over $24,000, for a work extending about eleven miles.

Very much speculation was indulged in during the survey and while the scheme was being laid before the people, by those who were interested and who would be assessed for the cost. Some of the remarks made were interesting and original. "It will swamp the county," said one. I answered that our aim was the very reverse of swamping the county. "I'm going to give my farm

away and move out of Ontario, where they have no Reformers to make bad drainage laws," said a Tory. "What nature has done cannot be bettered," was a statement from an old farmer who had lived for 60 years in a little log shanty surrounded by stumps with a frog pond at his door. "What are you here for, measuring my high land, which requires no drain?" "Have I got to pay for digging a canal through McMillan's land?" "Are you going to dig a canal through that hill and leave the river for a frog pond to drown my cattle and make us pay for it?" etc., etc. The drying of the adjacent wells was another cause of complaint.

The farmers, however, in the drainage basin, generally speaking, were intelligent and knew the benefits to be derived from surface drainage, but tile drainage is a matter almost unknown in this section except as a medium for draining cellars.

The assessments for benefit varied from $2 to $10 per acre, and for outlet liability from 5 cents to $1 per acre.

The by-laws for raising money and carrying on the work were provisionally adopted in March and April, 1898, and the work was let to contractor J. T. Gagnon in July of the same year for about $2,500 less than the estimated cost.

None of the persons assessed carried appeals against the assessment further than the Court of Revision, composed of members of the Council, and I think the reason why there were so few appeals and why they were so readily dropped was that the lands assessed were all carefully measured and the drainage area exactly defined.

During the months of August, September, October, and November the contractor excavated in round numbers 109,000 yards of earth and 700 yards of loose and solid rock, without the use of steam machinery. The contractor's prices were: 20, 14, and 15 cents per cubic yard for earth excavation and 45 cents and $1 for loose and solid rock excavation, $6.50 a yard for masonry in bridge abutments (of which there were about 100 yards), $75 and $100 per ton for iron used for bridges, and $14 per thousand feet, including the material and construction, for cedar for culverts.

The disposition of the material from the cuttings is a very important feature in drainage work, and in order to have the contractor do this work well my assistant or I were on the ground very often.

The work is not yet completed, but we hope to have it done before the 1st of July, 1899.

At the lower end of the work a cut of 200 feet long and 6 feet deep was made, which lessened the distance 1,500 feet. This cut necessitated the construction of a 40 ft. span bridge. My first idea was to construct the bridge of two 30-inch steel web girders, but as a through bridge was required in order to get a sufficient

water way, I reported in favor of a truss bridge. Two small 20-ft. span bridges were constructed, with iron beams (25 lbs. per lineal foot). The iron work was furnished by the Dominion Bridge Co., of Lachine.

In making calculations for the capacity of the drain, I assumed a rainfall of 2 1-2 inches per day, and that 1 inch per day would reach the stream. I measured the volume of the stream at different points during heavy rains and freshets.

The lower portion of the work was through a narrow valley or river channel with banks about 25 ft. above the bed of the river and 50 to 75 ft. wide. The cutting here was 25 ft. wide at the bottom and the side slope 1 1-2 horizontal to 1 vertical (the slope of the slides throughout). Trees and shrubs grew abundantly on both sides of the valley, making it very picturesque, but when about 300 ugly-looking large boulders were uncovered I feel quite satisfied that it did not look very picturesque to the contractor, who felt that the work was draining his pockets as well as the land of the farmers.

At one point in this valley, in the centre of the excavation once the site of an old mill-dam a little island had been formed by debris brought down by the river. This old dam had been built over 80 years ago, yet the timber in the lower portion of it was in a remarkably good state of preservation, and showed mortises nearly as fresh-looking as when cut. Some fine specimens of beaver cutting were also found at this point.

Last fall the efficiency of the drain in freshets was an agreeable surprise to the owners of the once low lands along the work, and the expenditure of $24,000, I feel assured, will enhance the value of lands in the County of Stormont $85,000.

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FIELD TILE DRAINS.

W. F. VAN BUSKIRK,
Stratford.

The primary object of making field tile drains is for the purpose of removing the drainage or hydrostatic water of the soil. The upper surface of this standing water, technically known as the water table, varies in height in different soils and with the quantity of water that may percolate through the soil by gravitation.

The design of drains necessary to lower the water table will, therefore, vary with the soil and with the quantity of water to be removed. It will be evident also that the design should be such that the drains will not cost more than is warranted by the nature of the work they will be required to perform.

The construction of tile drains in all cases should be such as to secure the maximum of efficiency, since the laws that govern the flow of water are unchangeable.

Carelessness and ignorance of proper methods of doing work are expensive in the end, and the amount supposed to be saved by employing cheap labor, with interest at an exhorbitant rate, becomes a first charge upon the profits of the investment.

A glance at the papers on farm drainage contained in the Reports of the Superintendent of Farmers' Institutes, indicates a want of knowledge of this important branch of farm management. It is, no doubt, true that the neglect of drainage is in part due to the frequent failures to make it pay, but it must be also that the many advantages of thorough draining of all soils are not known.

Our client, the farmer, does not yet realize that the drainage lore of but a few years ago is as much out of date as the flail and the cradle.

The study of thorough drainage as a branch of agriculture has kept pace with other branches of the science, and the uniform certainty of results which obtains in all other industries can be arrived at only when the practice of the art is based on principles in harmony with the laws that govern the operations of nature.

It is obviously impossible in a paper of this kind to discuss the physiology of plants, and their relation to the soil and its moisture. A statement of a few of the known facts may, however, be of value in directing attention to the subject.

The ordinary farm plants require for their development a proper supply of food and moisture and a favorable temperature. These requirements can be controlled to a more or less extent by efficient field tile drains.

The food and moisture are, to a large extent, obtained from the soil, and as the surface of the water table is the limit for healthy root growth, it is evident that the drains should be laid at a depth sufficient to afford room for the economical development of the plant.

It has been thoroughly established that the roots of most of the ordinary farm plants will, under favorable circumstances, penetrate the soil to a depth of upwards of four feet; and it may be taken for granted that a four foot depth of soil is the minimum for profitable production.

The roots, root fibrils, and root hairs of healthy plants penetrate every available space between the particles of soil, and extract from the soil and the air contained in its interstices the oxygen and mineral constituents of plant food.

Vigorous growth requires, therefore, a finely pulverized soil, free from drainage water, in order that the spreading delicate mass of roots may be in contact with the moist particles of earth and the air.

This condition of soil is also favorable to the action of bacteria of nitrification, by the agency of which the nitrogen of organic substances, the ammonia of the soil and manures, and the atmospheric nitrogen is made available for plant food.

It may be mentioned that the popular theory, that the free nitrogen of the atmosphere is appropriated directly by plants, is entirely erroneous, and practical inferences from it are misleading.

The bacteria of nitrification are aerobic, that is, requiring air for their development. They also require heat, and cannot live in a cold, undrained soil.

Heavy soils, in a saturated state, are injured by working, or by the treading of cattle, as they are thus rendered more compact, and when the water is removed by evaporation they become hard and tough and do not readily absorb water again. Thoroughly drained soils, on the other hand, are not thus injured, but are rendered capable of holding more water than before by about 20 per cent., as their hygroscopic and capillary properties are increased. The decrease in evaporation through drawing off water by drains saves an enormous amount of heat, and the increase in the hygroscopic property actually increases the heat of the soil. Thorough drainage, therefore, not only increases the depth or mass of soil from which the roots gather food and moisture, but also increases both the food, moisture, and heat in all parts of the

soil. The plants in cultivation are thus provided with strength to resist all unfavorable seasons. Warmth is provided to resist frost, and moisture is stored for use in dry periods.

The requirements of a good drain or system of drains are:

1st. That it will keep the water table low enough to prevent damage to roots or soil.

2nd. That it will work at all times without deterioration or loss of efficiency.

ARRANGEMENT OF DRAINS.

The natural surface drainage system of the tract to be drained should be studied and made the course of the main drains. Lateral drains leading to the main drains should in all cases be laid directly down the slopes in the lines of greatest descent. Laterals thus laid share the work equally, and water does not escape from them in its passage. A drain laid across the line of slope takes in water from the upper side only.

In case of a very flat valley receiving water from slopes on either side, it is sometimes advisable to lay two main drains in place of one of large size. Such drains can be laid near the foot of the slopes, and may have the gradient increased by running the head ends into the rising ground. The flat valley can then be drained by small independent drains.

FALL.

The fall or gradient of drains should be as uniform as it is possible to make it, and if at all possible of increasing descent to the outfall, in order to avoid the deposit of silt. Wherever it is found necessary to make a change from a very rapid gradient to a rather flat one, it is advisable to put in a silt basin to prevent deposits and an overflow pipe to prevent a washout.

Nearly all authorities on drainage recommend a gradient of not less than three inches in 100 feet; but in many localities such a requirement is out of the question. Drains can be made to work well with less than one inch in 100 feet, but it is needless to say, that such an inclination requires extreme care in grading and pipe-laying.

All tile drains should be laid to exact grade, otherwise the depressions in grade will become partly filled with silt, and the effective waterway thereby decreased. The theoretical grade line should be transferred from the stakes by means of boning rods, and in case of large-sized pipes on a flat grade, a straight edge should be used, bringing the whole invert of all pipes to exact grade.

DISTANCE BETWEEN DRAINS.

For thorough drainage, with drains laid to a depth of four feet, the distance between drains should be: For clay soil, 20 to 30 feet; for light soil, 35 to 40 feet; for gravelly soils, 40 feet and upwards.

Where drains are laid at a less depth than four feet, as is sometimes the case in draining roads and foundations for sidewalks, etc., the drains should be placed closer together than as above suggested.

PIPES AND LAYING.

Tile pipes should be thoroughly hard burned, not warped or out of shape in an way whatever; one bad pipe may destroy a long length of drain. Where drains are laid under roads and foundations this is of great importance. All pipes used should be round, and when laid in the trench each separate pipe should be turned until the top fits closely against the end of the previously laid pipe, making a close joint at the top.

Where branch drains enter, junction pieces should be used, if procurable, if not, it is well to place a length of larger sized pipe over the joint.

FILLING IN THE TRENCH.

After laying the pipes, a layer of a few inches of fine earth or clay should be filled in carefully over and around the pipes, care being taken that all open joints are stopped with small pieces of sod. Fine earth should then be filled in lightly to a depth of one foot; over this, ordinary soil should be filled in, and the surface layers thoroughly well tamped and consolidated.

The object of covering the pipes with clay or fine earth is to prevent water flowing in streams into the joints between the pipes, and the object of tamping is to prevent water flowing through fissures in the trench directly from the surface of the ground to the tile.

Water enters a well laid and properly working drain through the bottom and sides of the joints between pipes, after flowing along the top of the permanent water-table to the drain.

Drains laid as above described will not, for a time, take in and carry away water as quickly as those covered with gravel, stone, or other loose material; but they will, after a time, thoroughly aerate all parts of the surrounding soil, since the gradual vertical flow of water from the surface of the ground to the water-table, and thence along the water-table to the drain, will tend to make the whole mass of soil porous.

Drains of this character do not easily become stopped, and may be considered a permanent improvement.

DISCUSSION.

Mr. Bowman—With regard to the depth of tile drains, it is hard to convince farmers that it is necessary to put them as deep as four feet. They think it is throwing away money to put a drain down more than two feet. In the older parts of the Province tile drainage is being carried out more and more every year, and if one were to visit a farm he had known twenty years ago you would probably find the surface of it very much changed. Where there were small creeks, pot holes, swamps, by means of tile drains those have all disappeared, and the farmers are wakening up to the fact that they can reclaim a great deal of what they used to consider was necessarily waste land.

Capt. Gamble—How deep do they put the tile drains generally ?

Mr. Van Buskirk—Farmers put in tile drains themselves, and they put them in just so deep that the plow will not disturb them. To put in tile drains properly requires levelling, and in the West the draining will be finished before many years, except repairs, and that does not require a great deal of work. It is very important that the surveyors should take an interest in this question as to proper tile draining and teach the farmers, going round to farmers institutes and telling them the facts of the case.

My former partner, Mr. Davis, read a paper last year on the use of large tile drains in covering ditches. We have put in large tile drains, 12 to 14 inch, ordinary field tile. As to what has been said of water getting through the body of the tile itself, I do not believe that at all. When I was first working at it I got a good many different kinds of tiles, and I put in a cement bottom in the drain and filled the tiles with water, and if it took as long to get in as it did to get out of those tiles you would not get any water off the farm.

You make the top of the tile perfectly tight by turning the pipe around in your hands until it fits exactly at the top, then cover that joint with clay so that the water will not come in from the top of the tile—so the water comes in from the sides. It does not bring sediment into the pipe if it comes that way.

Mr. Bowman—It is a popular misconception about drain tiles, as to the water getting through them. A good many farmers think the water gets in through the pores of the clay. An eminent authority on draining, the late Col. Warring, gave his opinion that if fields were tiled with glass pipe they would operate just as successfully as with ordinary field tiles. The water all gets in at the joints. The water rises from below really.

Mr. Morris—Did you never have the pipe covered with pea-straw or something to prevent the sediment from working down through, so as to fill the pipe. I do not mean the smaller branches, but the main drain, that is to your outlet.

Mr. Van Buskirk—You cannot make them perfectly tight; it is well to put a small piece of sod over. I would do away with the pea straw idea, because that leads to porous covering all the way up and the water will get directly from the surface running in to the tile, and will bring the sediment into the drain.

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1—BRIEF HISTORY OF PERCH DRAIN DREDGING WORK, TOWNSHIP OF SARNIA.

J. H. JONES.

That the chief object for which this paper has been written may, perhaps, be better understood, the writer desires, by way of introduction, to give a brief account of the natural condition of the lands in the Townships of Sarnia, Moore, Enniskillen, and Plympton, the waters from which flowed into the Perch Creek (or "Riviere aux Perches," as it was called in the early days), and also a short history of the means adopted from time to time for their drainage.

Originally the Perch was a slow, sluggish stream, and the land on either side of it for a considerable distance was marshy and swampy throughout the greater part of its whole course. About four miles from the mouth of the stream it entered a small body of water known as the Wawanosh Lake, about one thousand acres in area, and about eighteen inches deep at summer level.

The lake was soft and "gruelly" at the bottom, and surrounded on all sides by a dangerous quagmire. It was a perfect duck-hunters' paradise in the early days, there being swarms of ducks of every variety the year round, except the winter months, besides geese and swans galore in the fall and spring. There were also large cranberry marshes in the neighborhood of the lake.

One of my most vivid recollections of the old Perch is of a lovely Sunday morning in the spring of the early forties. The mouth of the Perch was literally alive with "suckers," and the writer was told not to spear them because it was Sunday. Temptation too great—caught in the act of spearing the first sucker—marched home a prisoner—made study Watt's hymns on Sabbath desecration and disobedience to parents for the rest of the day—blew a gale of wind from the north by Monday morning—no suckers. Following week "grub" short in consequence.

The total area drained to the Perch and Wawanosh is as follows: Township of Sarnia, 18,500 acres; Township of Moore, 5,000 acres; Township of Enniskillen, 1,400 acres; Township of Plympton, 1,100 acres; making a total of 26,000 acres.

The first move that was made in the way of draining Lake Wawanosh was done in the year 1837 by a person named Cull, who cut a small drain, for some reason of his own, on lot 24, Front

Concession (see Diagram), from the bank of Lake Huron straight south, through the thick rose bushes, perhaps 80 or 90 rods, or sufficiently far to let the water through from one of the marshes connecting with Lake Wawanosh.

Subsequently this drain enlarged itself very materially and wore back some fifty rods further south into the marsh. The next step that was taken was by the Municipal Council of the Township of Sarnia, who instructed Senator Vidal, P. L. S., to report as to the best method of draining Lake Wawanosh, and he recommended the construction of a drain nine feet wide at the bottom, and in its present location, to connect with the Cull drain on lot 24, the surface level of Lake Wawanosh at that time being about eleven feet above Lake Huron.

This report was adopted, notwithstanding that some thought that more satisfactory results would be obtained by making a cut straight north on lot 36, through the sand hills into Lake Huron. Shortly after the adoption of Senator Vidal's report, the Council commenced to put it into effect; but was strongly opposed by some of the parties interested, and to avoid further trouble the municipality got a special Act passed in 1857, authorizing them to drain Lake Wawanosh and also empowering them, among other things, to sell the reclaimed lands. The work was then proceeded with, and this drain, comparatively speaking, dried Lake Wawanosh, and the Sarnia Council subdivided the lake bed and sold the land.

Nine years afterwards they continued the drain further south, and also improved the Perch Creek bed up to side road 12 and 13. Nothing more was done until the year 1871, when the Ontario Government undertook the drainage of the Township upon the requisition of the municipality. Among other works, the Government materially deepened and enlarged the Wawanosh and Perch drains, and extended the work to the town line of Moore. This work was a great improvement on the past, and very beneficial, but in course of time it got very much out of repair and entirely inadequate for the purpose for which it was designed, principally in consequence of the very largely increased drainage works constructed by the neighboring townships, and by the Township of Sarnia itself, making use of the Perch drain as an outlet.

Law suits for damages were threatened, and indeed commenced against the Township of Sarnia by owners of lands all along the Perch drain, and in consequence the Municipal Council were forced to take action, notwithstanding the strong opposition of the owners of the upper lands, who, of course, could not see why they should be asked to contribute.

The Sarnia Township Council, therefore, instructed the writer to examine the whole Perch drain and report. At an early period

HURON
G. T. R.
MAIN LINE
CREEK
LAKE LOTS
GORE
DRAIN
CREEK
MARKS
DRAIN
ROAD
MAIN
DRAIN
LINE
TOWN
TOWN
LINE
G. T. R.
W. DIV.
DRAIN
WILLIS
CREEK
DRAIN
DRAIN
LINE
DRAIN
DRAIN
LINE
TOWN
DRAIN
ENNISKILLEN
VIII
VII
VI
V
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III
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XIII
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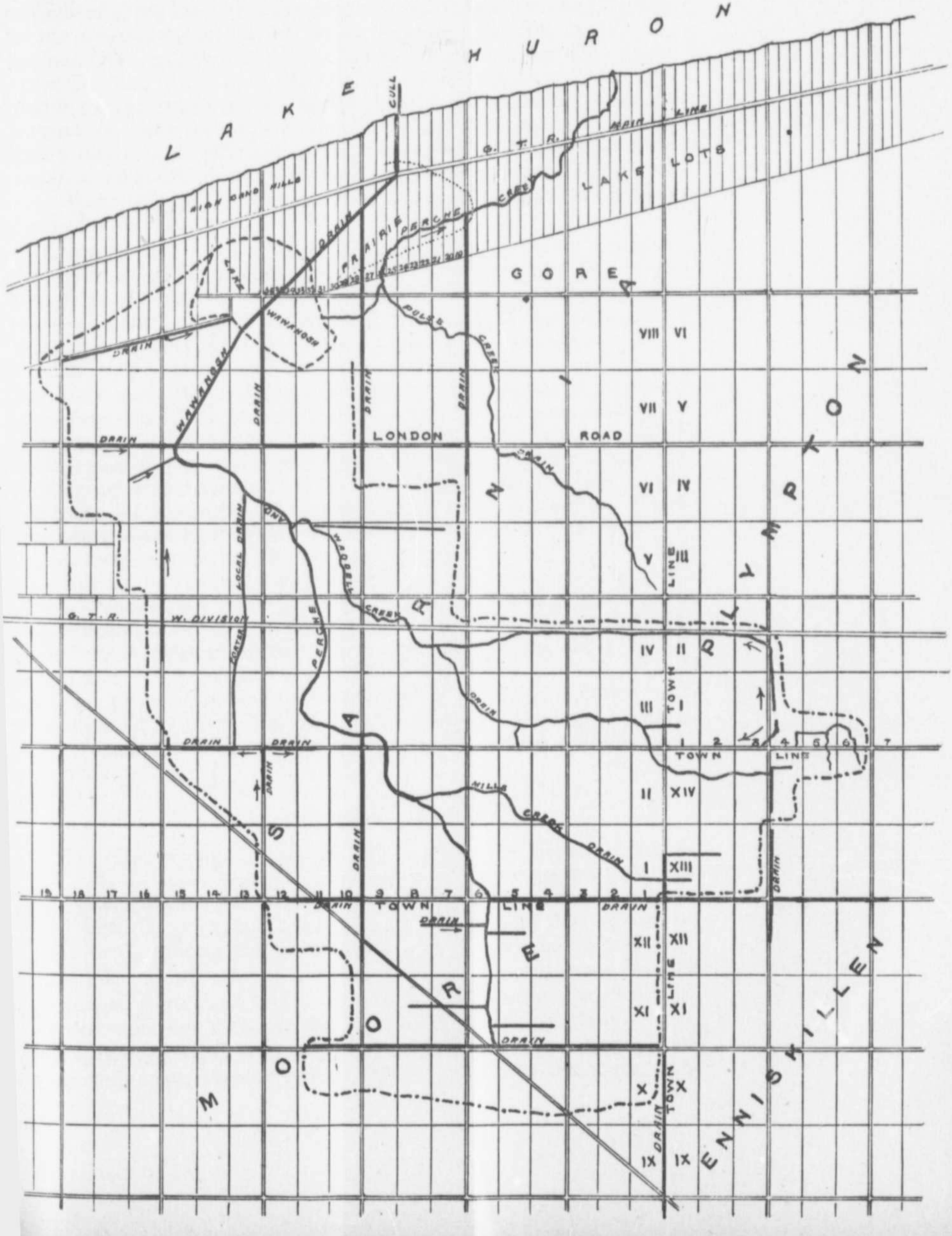
LAKE HURON
CULL
G. T. R. MAIN LINE
LAKE LOTS
HIGH SAND HILLS
DRAIN
PRAIRIE PERCHE CREEK
LAKE WAWANOSH
GORE
PULSE CREEK
WAWANOSH
LONDON
ROAD
SARNIA
PLYMPTON
LOCAL DRAIN
PERCHE
WADSELL CREEK
G. T. R.
W. DIVISION
FORTER
TOWN LINE
MILLS CREEK DRAIN
MOORE
ENNISKILLEN
VIII VI
VII V
VI IV
V III
IV II
III I
II XIV
I XIII
XII XII
XI XI
X X
IX IX

in this investigation it was quite manifest that ordinary repairs would be entirely insufficient to accomplish what was needed. It seemed clear, to begin with, that if anything at all was done to the old drain, one of the most essential improvements would be a very decided enlargement of the drain through the deep cut from the margin of Lake Wawanosh to the "Cull," a distance of a mile and a quarter, of sufficient capacity to give free discharge for the water, so that there would be no "backing up" and flooding the old Wawanosh bed, which is only eight feet above the present level of Lake Huron.

Surveys were made in every direction that seemed by examination to be at all practicable, with a view to a new outlet that would also form a "cut-off" for the low lands, but formidable obstacles were met with on each route besides the cost of constructing at least one expensive bridge across the Grand Trunk Railway.

For these reasons it was finally decided to report in favor of the old course, in the belief that better results would be obtained at a very much less expenditure than any other route, taking all the present circumstances into consideration. Plans, specifications, and report were prepared, therefore, recommending the deepening and widening of the old drain, commencing at the centre of lot 10, in the 3rd concession, thence to the outlet. From the head of the new work to Waddell's Creek, the new cut to be 20 feet wide in the bottom, about 7 feet deep, with a fall of 7 feet per mile to the railway, and 3 1-2 feet per mile the rest of the way. From Waddell's Creek to the north side of the lake, 28 feet in the bottom, about 9 feet deep, with a fall of 2 feet 3 inches per mile. From Wawanosh to the outlet, 30 feet bottom, about 13 feet deep, and 1 1-2 feet fall per mile.

This proposition was submitted to the Municipal Council, and was adopted by them, and after a good deal of "kicking" by some of the upper townships the by-law was finally passed, and the work advertised.

THE DREDGING.

The first attempt to let the work proved to be unsuccessful. Some six or seven tenders were received, but the person to whom the contract was awarded, upon second thoughts, refused to proceed with the work, and paid forfeit. Then a good deal of controversy arose among the knowing ones, who said that it was very doubtful, indeed, whether the work could be performed with a dredge, so as to at all satisfy the requirements of the specifications. At this time even Mr. Lister, the then Township Solicitor, who throughout advised the municipality with his usual ability and good judgment, seemed to lose faith, and said to the writer, "If

this method of doing the work fails, you are assuming a grave responsibility." The reply made was, "This work must be done with a dredge, or not at all." It was also strongly urged that the estimated cost, namely six cents per cubic yard, was altogether too low, without taking into consideration the formidable obstructions occasioned by the two Grand Trunk bridges, and the heavy work near the outlet. The estimate was made strictly in accordance with what appeared to be in the township's interest, and experience proved it to be sufficient.

After considerable delay, a bargain was at last made with Pollard, Goff & Co. to construct a new dredge at the upper end of the work, and to complete the whole contract of 8 3-4 miles, including the construction of the dredge, at an average cost of five dollars and a half per rod.

In a couple of months the dredge was completed and ready to commence March 30th, 1896. The dimensions of the dredge were as follows: Length, 72 feet; width, 22 feet; 34 feet over all; 4 1-2 feet deep. Two floats at bow, each 25 feet by 8 feet; 3 anchors, 12 inches by 14 inches; crane, 50 feet in length; dipper arm, 33 feet; reach of dipper arm and crane, 48 feet; dipper, 3 feet 4 1-2 inches by 2 feet 9 1-2 inches by 3 feet 9 inches; boiler, 11 feet by 42 inches; nominal h.p., 45; cylinders, 8 inches by 12 inches.

When running she required two crews of six men each all told for twenty-four hours, and consumed 4 1-2 cords of soft wood in that time. Two dipper loads would be landed on the dump each minute when she was doing her best, and each move, which took three or four minutes to make, advanced her about eight feet, with ease and dispatch with the crane. Green stumps of all sizes were shattered with dynamite and also quickly taken out of the way with the dipper and a strong chain.

From the point of commencement to the G. W. D. of the G. T. R., a distance of 470 rods, the cutting was through ordinary stiff clay. The average progress made on this section was 18 rods per 24 hours, removing about 85 cubic yards per rod. No dams were necessary across the stream, the water supply from above being amply sufficient to carry on the work.

When the railway was reached, the bridge had to be passed, which is 28 feet span, and 12 feet from the under side of the girder to the water. In order to do this, the dredge had to be "stripped," which kept the contractors busy for nine days before work was resumed again on the north side of the bridge.

From the railway down to the north side of Lake Wawanosh, the surface was irregular and the cutting through long stretches of alternate black muck and hard clay. No particular difficulty, however, was encountered, with the exception of a portion about three-quarters of a mile in length, just below the mouth of the

Waddell Creek, where very soft, deep, black muck was met with and much trouble and delay occasioned by there being no holding ground for the anchors, and also the weight of the earth banks would crowd in the sides, notwithstanding that a good layer of brush had been laid on the sides before the earth was put out. When the dredge was backed up to take out what had squeezed in, the dipper would work the whole thing up into the consistency of porridge, that could not be dredged. The best job was made of this part of the work that could be done under the circumstances, and eventually the water from above washed the cutting clear.

For a mile above the London road, the banks were high, and the clay very hard, indeed, but fair progress was made, notwithstanding this. The 40 foot iron bridge at the London Road was removed by being raised with jackscrews, and pushed to one side on skids.

North of the London road, and across Lake Wawanosh, the surface was more uniform, and nothing was met with that deserves special observation, except, perhaps, that the bottom across the old lake bed was a genuine "hard-pan."

Notwithstanding this, and the before-mentioned obstructions, an average of 16 rods per 24 hours, and cutting about 90 cubic yards per rod, was made, including all unavoidable delay, from the railway to the north side of Wawanosh, a distance of 1,850 rods.

We met with a "calamity" on the section north of the London Road, in consequence of an open half-box of dynamite being left on the dump, some distance behind the dredge. A yearling calf came along and ate several sticks of the powder—the calf "departed."

After the London Road was crossed, July 22nd, dams were made across the stream at certain distances ahead of the dredge, in order to save all the water possible to complete the work with.

The section from Wawanosh to the outlet was where the most difficulty was encountered. The drain here, as constructed by the Government, was 22 feet wide in the bottom, and about 10 feet deep when new. The present drain is 30 feet wide at the bottom and 2 1-2 feet deeper than the Government work. This very considerable increase in size cut into the old earth banks, and made the vertical depth from the top of the old earth bank to the bottom of the new drain about 20 feet. This cutting was chiefly through a wet, sandy soil, that caved easily, especially as it was overlying a muddy clay bottom that was altogether too yielding to hold the dredge up stiff on her anchors; and, consequently, every time the crane swung with a load, she would settle down on that side, making it exceedingly difficult to put a dipper load to the full extent of the reach of the dipper arm. One side of the work was taken out at "a set," and as far as possible before anything was done

to the other side; and in order to overcome the settling of the anchors, before described, a bench was made in the bank, and the corner of the bow float was pushed in as far as possible, and made to rest upon it.

This very materially assisted the anchors to hold the dredge firmly up against the swing of the crane and loaded bucket, and in this way much better progress was made. The caving behind the dredge caused the most anxiety, as it was feared all the time that a considerable length of the new made earth bank would suddenly slip in and completely prevent the dredge from "backing up." Nothing serious, however, occurred in this way, although several bad slides did take place, but not before the dredge was put out of harm's way. All through the worst of this section, the cutting was very heavy, quite twice as much as would have been necessary under ordinary circumstances, on account of the soft, greasy nature of the soil required to be moved, the cut for a long distance being 80 to 90 feet wide at the top and 180 feet from the extreme of one earth bank to that of the other.

The average progress made through this part of the work was 8 1-3 rods every 24 hours, and the whole contract was finished by the 10th of November, 1896, having taken 192 days to complete, and an average made of 14 rods per day, including all delays, except the passage of the Grand Trunk Railway bridge in the 4th concession.

When the end was reached, it was with feelings of relief and satisfaction that we looked back upon what had been accomplished, because it was then quite clear that if any mistake had been made in the first instance as to the power or capacity of the machine necessary for the performance of the work, failure would have been inevitable. For example, if the contract had been commenced with a dredge similar to one that was being used on another drain close at hand, it would have been utterly useless when the deep cutting was arrived at, and it would have then been too late to rectify the error.

Before the contract was finally let, much was said about the probable impossibility of making the side slopes of the drain conform to the requirements of the specifications; but, as a fact, no trouble at all was experienced in this respect. The bottom width was increased slightly, and the side slopes were cut nearly 1 to 1, if not quite, and in one year after the work was finished the drain was in better condition, and more fully up to the mark, than if it had been done with a plough and scraper. Care was taken to make the cut rounding in the centre, and rather below what was required, and in order that he chief force of the current might be kept in the middle of the drain in the future. The earth banks, too, were well put back.

Before closing this narrative of the Perch dredging contract, it is only just to say that the contractors performed their work vigorously, and most satisfactorily throughout, doing more than strictly required, when occasion made it necessary, without hesitation or cavil.

Up to the present date, the new work has given every satisfaction, notwithstanding that there has been one or two freshets since completion.

The total available sectional area of the cut at the outlet is 480 square feet, or 1.84 feet for each one hundred acres of area, and the flow when nearly full is about 2 3-4 to 3 miles per hour. The total area of 26,000 acres is now pretty thoroughly surface drained, the upper third having a fall of about seven feet per mile, the middle third about three feet per mile, and the outlet third about 1 3-4 feet per mile.

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

PERMANENT WAY.

W. E. McMULLEN,
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That the tendency of civilization has always been towards permanency of structure is well evidenced by the existing engineering works of ancient Egypt, Greece, and Rome, and in the many mighty works of the present time. Railway building, while one of the most important branches of modern engineering, has, however, been beset with such peculiar conditions that to obtain anything more than a moderately durable construction has been found a somewhat difficult problem on account of the numerous variable and unknown quantities which enter into its solution. It will be acknowledged, though, that a permanent way, if it be possible, is the objective goal of all intelligent railway builders, both for its safety to travellers, goods, and equipment, and its economy of tractive power and cost of maintenance. Heretofore there probably have been very good reasons for a more or less temporary construction such as (a) the item of first cost until the success of the enterprise has been assured and until the earnings of the road give encouragement to expenditure upon a more durable construction; (b) economy of construction, necessitating a roadbed more or less temporary in the first place as a basis for permanent work; (c) the rapid evolution of rolling stock from the very small engines and coaches of fifty or sixty years ago to the hundred-ton moguls and heavy sleepers of the present day. Had some of our railway enterprises attempted permanent construction at their inception they would have lived but little past their birth, and had some others followed the plan of more gradual permanence of structure and roadbed their shareholders might have obtained at least a little interest on the capital invested in stock. Then, again, an absolutely smooth and durable road is not at first a necessity, but it is in most cases very necessary that a road commence to earn some money before entering upon an engineering construction more expensive than will in safety carry their trains. Besides this, permanent construction has generally been found more economical when carried on from a road already constructed, by means of which supplies can be transported, filling performed most easily, and masonry built without impeding traffic and with an economical force of men, since then the time for the completion

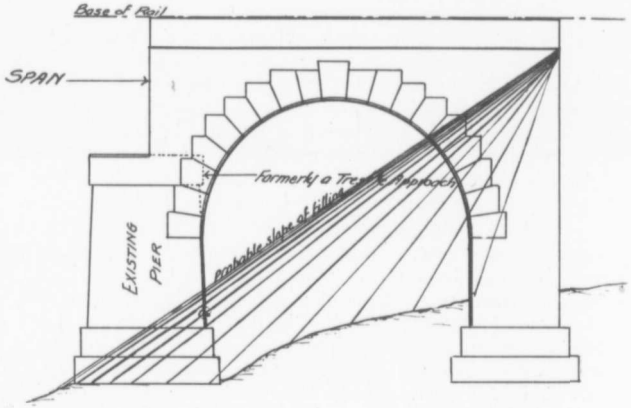
of the work is not now of prime importance, and, moreover, money may be expended upon the work as it becomes necessary.

The reasons, however, which held good for present construction no longer are sufficient for the retention of a system which requires a prodigal expenditure of labor and material, provided it can be substituted for one which gives a larger place to durability and economy.

In considering permanent way, undoubtedly the first care will be to fill all unnecessary openings in the line, such as trestles crossing the ravines of small creeks, the wooden approaches to steel bridges, open culverts which can be replaced with closed water-ways and pit cattle-guards. The first of these can usually be provided for with masonry culverts or iron pipes. Where the embankment will be high, but with little water passing under the track, cast-iron pipes have been found to work very well, and are much less expensive than arch culverts if the water-way required be a small one, say less than the area of a five-foot arch culvert. The lower side of the intake end should be placed well below the bed of the stream and have an apron of boulders or timbers at the outlet to prevent back-scouring, especially if there is much of a fall in the pipe. The pipe also should be laid on a firm foundation, so that an even grade may be maintained when the filling comes upon it. It is usual to make the joints with Portland cement, but since there is very rarely much internal pressure, they do not require the same care in laying that water service pipes would, and in fact rejected pressure pipes may often be used and found satisfactory for the purpose at a considerable saving on the cost of A1 pipe. Sometimes the pipe is built into masonry at the ends, giving the work a more finished appearance, protecting the ends from being broken, and preventing the filling from falling in front of the pipe. Of cattle guards little need be said, for whether they be pit or surface they are a necessary evil. The pit guards are gradually going out of use, as they are dangerous to trains should a beast become lodged in one, since in case of derailment before coming to the pit it would be liable to pile up the cars when they came to it. Pit guards are also receptacles for rubbish and snow, are expensive to maintain, and generally give the track a bad surface when the frost gets into the roadbed. Surface guards are free from most of the objectionable features of pit guards. They are not expensive to maintain, do not necessitate an opening in the road, and are not a menace to derailed trains. The principal objection to the surface guard is that it does not turn stock (or perhaps it will be better to qualify that by saying that cattle often seem to delight in walking over or jumping the surface guard). There is little question, however, that the surface guard with its imperfections is to be preferred to the pit, and, as considerable inventive

energy is constantly being spent upon cattle-guards, something more effective in this way may be expected.

Before leaving the subject of the elimination of openings in the line, mention might be made of a method in use upon the Canadian Pacific Railway in connection with steel bridges upon stone piers with trestle approaches, where the approaches have to be filled and some provision made for the slope at its junction with the pier, when, as is generally the case, the pier is without wings and is not designed to act as a retaining wall. The accompanying sketch illustrates the method followed, viz., that of springing an arch of sufficient span from the existing pier and filling over it so that the toe of the slope will extend to the stream side of the pier or as far



as the nature of the location will permit. The advantages of this principle over the use of wing, T or U walls, are in elegance of design and economy of masonry.

But having provided all openings in the road with permanent or durable structures, there now remains still the greater part of the line supported upon a sub-foundation varying with the temperature and weather, upon wooden ties which require frequent renewal, necessitating a continual breaking up of the roadbed and with a running surface which while good in itself is so dependent upon its foundation that it is also frequently requiring renewal at considerable cost and inconvenience to traffic. The first thing necessary for a permanent track is a road-bed which shall be dry at all times, at least above the frost line. So long as a track foun-

dation can be reached by rain and snow water a perfect surface will never be obtained. The method adopted thus far in railroad construction has been to provide a porous or approximately porous covering for the surface at sub-grade, such as gravel, broken stone, cinders, burnt clay, crushed slag, etc., and to construct side ditches to carry off the water. Where there is a good thickness of this covering or ballast, and where the ground at sub-grade is so sloped as to assist in carrying the water to the ditches and the ditches themselves of sufficient depth and cross-section to take the water a fairly good foundation for the track may be expected, but in cold and wet climates there will be even with a well-ballasted road a certain amount of heaving. This may not be very noticeabble where the material at sub-grade is of a uniform quality, for then the heave will also be uniform, but where there are bridges upon masonry foundations and alternate cuts and fills the difference in the heave at these places will be quite appreciable, causing rough track.

Even were a frost-proof roadbed obtained there would still be a perishable track support to provide for before permanency of way has been attained. For a number of years the almost universal system of track support in America and Great Britain has been the wooden cross sleeper, and although in many respects a most primitive and unsatisfactory method of supporting a rail, for want of a cheaper first cost substitute, or one which could be more expeditiously put into the road it has received general adoption. Ordinarily ties are from 8 ft. to 9 ft. in length, 6 to 8 inches thick, and 6 to 10 inches on the face, the specification varying with different roads and localities, that of the Atlantic Division C. P. R. being 8 ft. long, 6 in. thick, and 6 in. face. Some ties are sawn, some hewn, some put in with the bark on (which, by the way, is very bad practice), and some peeled. There is much variety also in the class of wood. In the northern roads cedar, spruce, tamarac, hemlock, white pine, white oak, and in the southern roads white oak, yellow pine, chestnut, cypress, etc., are all brought into service for track ties, and are serviceable anywhere from five to fifteen years, depending largely on the class of timber used, the amount and weight of the traffic, whether upon curve or tangent, the condition of the roadbed, the climate, and whether they have been treated with a preservative process or not. There are usually from 2,640 to 3,000 to the mile, and the cost before putting under the track will vary from 15 cents to 50 cents each, according to the locality, the class of timber used, etc. Sooner or later, though, these ties will have to come out. After a few years of service in a well ballasted road the tie will be well packed and firm in position, but the weather has so rotted the tie that it will not hold a track spike, or perhaps on account of shimming in the winter the tie is spike-killed or perhaps cut very

badly by the outside of the base flange, and so the road-bed is torn up, a new tie put in and packed, and the old one thrown to the fire. So has the process been and so it will be until something better is provided. To avoid some of the objectionable features of the wooden tie, tie-plates and steel ties have been introduced, the former quite extensively in the United States and the latter principally in Europe and India, but to a very limited extent on this continent. The tie-plate is usually a piece of steel plate from 4 to 6 inches in width, 8 or 9 inches long, and from three-sixteenths to thirteen-sixteenths inches thick (there are so many different patterns of tie-plates that it is difficult to describe them in general terms). Flanges are on the underside which press into the fibres of the tie and keep it secuerly in its place. It has been of excellent service on southern roads in preventing the cutting of soft ties, thus ececting considerable economy in tie renewals and cost of maintenance labor. Where there is frost enough, however, to heave the track, necessitating shims, its use is not general, since the shims cannot satisfactorily be used on top of the plate. The metal tie is usually a pressed steel channel, with closed ends, like an inverted trough, the object of its use being permanency of road-bed and economy in tie renewals. When properly coated with tar it is very durable, it does not cut, and when well settled into the road-bed has very materially reduced the cost of maintenance. It is highly improbable, though, that it will ever be used in cold countries, with the present style of road-bed, even should timber become much more expensive than it is, on account of the difficulty in using shims with it, for a metal tie would heave quite as badly as a wooden one, and as a rail support has many of the objections which pertain to the wooden tie. But granted that there is a stable road-bed upon which staunch and durable cross-ties are placed, there is still a jointed track to take care of. How to keep up the joint and prevent rails from flattening at the ends has been the source of much thought, many devices, and the expenditure of considerable money, and the problem is to-day far from being satisfactorily solved. There have been two general classes of joints, supported and suspended. Each has its advocates, but there has not yet been constructed a joint either supported or suspended, lying within the limits of economy in first cost and application, which is as rigid or nearly so as the rail itself. Those who favor supported joints claim that a tie placed immediately under the contiguous ends of the rails is the best means of holding up the joint , while those who believe in the suspended joint assert that one tie is quite insufficient to maintain a joint properly, and so put in two ties, one on either side of the joint, as close together as they can be to pack well, and depend upon the joint being upheld by the strength of the fibres of the projecting rail ends, assisted by the angle-plate or splice-bar. As a com-

promise between the suspended and supported joint a three-tie joint has been introduced and used to a considerable extent upon the roads of this continent, the endeavor being to include in it the advantages of both suspended and supported joints by using angle-bars from 30 to 44 inches in length instead of the ordinary length of 24 to 30 inches and having under them a joint tie and two shoulder ties.

To produce the results expected from this joint, the shoulder and joint ties must be well kept up and be on the same level, or the effect will be a long suspended joint, a weak supported one, or perhaps a bent angle-bar if one of the shoulder ties is low. Another class of joint, not so universally in use as the ordinary angle-plate connection, but which has proved to be very effective, is the bridge joint. These have been fashioned in a number of ways, but the principle has been to suspend the joints by an iron plate placed underneath the ends of the rails, turned up over the flanges, and bolted through the web. With some bridge joints extra stiffness is obtained by trussing them on the underside.

The object of all this is to effect as nearly as possible a continuous rail. A joint in the track is always objectionable, for at that point the track is always weaker than at any other, causing the ties under it to receive more directly the wheel impact and making it very difficult to keep the joint ties on a level with the others in the track. Being weaker there is more deflection in the track, so that as the wheels come within a foot or so of the joint in fast running they are apt to jump and deal the next rail a blow a little beyond the end, flattening the rails at the ends and so making a rough riding track. When once a joint is badly down with flattened or vertically bent rails it can never be made good again until the rails are cut or new ones are put in. It is well known by trackmen that as far as maintenance is concerned the joint requires more attention than all the rest of the track.

In speaking generally of the standard track of to-day, it may be described as laid upon a variable foundation, supported in a manner which is more or less safe and far from economical, and connected in a way both expensive and in a degree ineffective. The question, then, is, "What principle will be adopted in the design of permanent road-bed when the time comes, as it surely will, for the change?" It was partly with the object of suggesting thought in this direction that this brief summary of track parts with some of their weak points was brought before the Association. Two designs described in a recent number of Engineering News are worthy of mention. The first, by Mr. J. W. Schaub, recommends commencing at sub-grade with a 12-inch layer of Telford stone or broken boulders as large as a man can lift; after this a six-inch layer of broken stone concrete, strengthened by steel wires

running through it. Above this is a six-inch top layer of gravel concrete crowned up between the rails to the level of their top. Through this crown pass one inch diameter tie rods for the purpose of connecting the parallel rails. These tie rods are spaced eighteen inches centre to centre, and the threads or nuts and rods are machine cut.

The rails are to weigh one hundred pounds per yard, and are to be continuous in lengths of about three hundred feet. They are to be rolled in lengths of sixty feet and spliced with angle-bars and turned bolts in the field. Where expansion and contraction are to be provided for, the rail ends should be scarfed and one end provided with slotted holes. At the expansion points the concrete road-bed should be discontinuous, so as to allow the concrete and track rails to expand and contract with perfect freedom.

The rails are to rest directly on the concrete, and are held in place only by the tie-rods spaced eighteen inches apart. All adjustments as to guage are made by the nuts on the ends of the tie-rods.

The drainage below sub-grade is to be effected by side ditches lined with porous tile and underlaid with a tile pipe drain. He estimates the cost of the road-bed to be $14,000 per mile, exclusive of rails, as against $6,000 per mile for the present form of track, which would with money at 4 per cent. mean an extra charge of $320 per mile per year against capital account, but this he estimates would be off-setted at least by a saving of $390, the cost of one man's labor on maintenance for a year, and by $180 more in the charge for renewals of ties, making an annual saving of $250 per mile, exclusive of anything which might be saved by less wear and tear on rolling stock and reduction in fuel through less tractive power being required. (Note.—This estimate of $6,000 per mile would scarcely apply to Canadian gravel-ballasted roads, which, exclusive of the steel, might be estimated to cost a third of that sum. The larger estimate is based upon broken stone, $1 per yard, and ties, 60 cents, and is inclusive of tie-plate).

A suggested improvement upon this design so far as economy of material was concerned, was to commence at sub-grade by rolling the road-bed perfectly hard and firm, and upon this to spread a two-inch layer of sand or gravel, on which concrete blocks 10 ft. long, 15 inches deep, 10 inches at top and 26 inches at base were to be carefully laid as longitudinal supports for the rails. Elevation for curves would be made by extra thickness in this sand layer, except in the case of very sharp curves, when it would be made in the road-bed at sub-grade. The rails would be held down to the blocks by clips held in place by 1-inch bolts at 40-inch centres, moulded into the concrete blocks, and steel guage bars would maintain the alignment of the track. Between the parallel

concrete supports earth would be filled and covered with a layer of asphalt to turn the water. The concrete blocks would be held in position laterally by the guage bars, designed to sustain compression and vertically by a two-inch iron dowel moulded into the end of one block and fitted into an iron-cased hole in the other. Spaces three and a half inches wide would be left under the rail at each guage bar to carry the surface water from between the rails. The estimated cost of this road-bed was $6,000 per mile. Examining these propositions first from a financial standpoint: in the first case upon the assumption that the present form of road-bed is $2,000 per mile and cost of renewals, $110 and money worth three and one-half per cent. instead of the figures given, even with this expensive design there would be an apparent saving of $80 per mile per year, and in the second proposition, estimating in the same manner, a saving of $360.

There will no doubt be criticisms of the designs and many difficulties foreseen before any radical change could be made in construction of road-beds, yet the very fact that saving could probably be effected makes it a matter worthy of the consideration of engineers.

Among the objections to the principle of the designs above mentioned which might be offered are, as far as the first proposition is concerned, the large initial cost; against the second, the liability of there being vertical movement between the ten-foot longitudinal blocks of concrete, even with the assistance of dowels. The difficulty of setting heavy concrete blocks at an exact super-elevation for curves and maintaining them there under heavy traffic, the lack of facility with which broken bolts and tie-rods could be quickly replaced in case of derailment and against both designs by the hammering of drivers upon the rail, when the base, which has little resilence, would act as an anvil, by the great expense which would be incurred by single track roads in taking care of their traffic while the road was being torn up.

So great is this last objection that such a work could scarcely be recommended to a busy single track line, especially where there are narrow cuttings and high dumps. This objection, of course, would not be of so great moment to double track lines. It should always be borne in mind, too, that if repairs were required to the concrete or should there be, by any mischance a settlement or upheaval in the road-bed the cost of setting it right would be far greater than with the present form of track.

The advantages, however, make the difficulties worth the thought required for their overcoming, namely, reduction in the cost of maintenance, greater safety to rolling stock, termination of increasing weight of rail, no trouble with splice bars, and low

joints, a better riding road, and greater security against creeping track.

It is not expected that Canada will immediately see the introduction of a permanent roadway, for ties and labor still are cheap and experiments dear. Our double track mileage is yet small and trunk lines few, but no doubt our neighbors to the south will before very long require a substitute for the wooden tie which already is with them an expensive article and what that substitute will be and what excellence it shall possess will be the result of the "brawn of the brain" of the cosmopolitan engineer.

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

A SUGGESTED AMENDMENT TO THE DITCHES AND WATERCOURSES ACT.

GEORGE SMITH,
Woodville.

The ordinary observer of the agricultural development of this Province cannot fail to notice the urgent necessity for a drainage law, simple and prompt in application, which will enable the ordinary farmer to obtain an outlet for the tile drainage work, which is rapidly becoming an absolute necessity to him if he is going to keep abreast of the times in his calling.

The average thinker is under the impression that we have such a law in the Ditches and Watercourses Act, but, to the engineer, experienced in the working of this Act, it becomes apparent that it is a failure, if so intended, and it is clearly evident to him that its astute framers were persons familiar with the suspicious and quarrelsome side of human nature, and also well aware that it is from this human weakness that lawyers reap their harvest, and he (the engineer), although sworn to be disinterested and impartial, soon finds out that the honor of being a "Township Engineer" is much more likely to bring discredit on his profession and ill-will to himself than professional advancement.

In the writer's fifteen years' experience of the working of this Act, he has many times heard the interested farmers declare in favor of the principle of arbitration, in settling the inevitable disputes arising therefrom, and he has, as many times, been forced to the conclusion that they were right in this idea.

In his idea the present Act might do very well up to sec. 13, if the position of township engineer was abolished and that official relieved of the honorable position of being a mud-target for lawyers as well as the members of the Council by whom he is appointed, which is about what he gets if he does not succeed in pleasing every person interested. If the parties fail to agree at their meeting or within five days thereafter, the promoters and those who are opposed to the work might have a board of three arbitrators appointed in the usual way from among any of the number of County Commissioners within ten miles of the drain, and this arbitration, so appointed, to constitute a Board of Works to construct the drain or otherwise dispose of it, as they saw fit. They should employ any O.L.S. to prepare a plan of the swamp, shewing drain location

and areas, profile and sections of drain, etc., with reports and full information, in the same manner as is usually done in making an award, and with this to guide them they should make an award which should be without appeal, provided that due notices were served upon all parties affected. In the writer's opinion, no person other than an O.L.S. is competent to undertake such a survey, as, in his experience, it almost always happens, in making an award, that it is desirable to have part of the drain, at least, constructed along a boundary line, which boundary line has generally to be located, and another still more desirable feature in such a law, to our profession, would be, that we would be relieved from the humiliation of being appointed and controlled by the ordinary Township Council, which honorable body being composed, as it almost always is, of much more conceit than intelligence, is not at all improved in this respect by the adoption of the recent County Councils Act, and to please such a body the O.L.S. is often obliged to imperil the honor and integrity of that profession which he is pledged to uphold.

During the past season the writer made an award between nine interested parties, one of whom (a woman) appealed against it, and although the document is dated July 25th, 1898, nothing has since been heard of it, and the eight others were thus obliged to lose all the advantage of an unusually favorable season for the construction of a badly needed drain, and so far as he has been able to learn from the lawyers the appellant's solicitor is expected to call the appeal before the Judge when it pleases him to do so, as the word "forthwith" in the fifth line of s. s. 3 of sec. 22 does not mean anything in particular, and his sole object in making the foregoing suggestion is that it may be discussed and improved upon, and eventually result in some better legislation than we have yet been blessed with, and our profession, as well as the public which we are honestly striving to serve, be relieved from this huge humbug.

APPENDIX.

BIOGRAPHICAL SKETCH OF
ROBERT BALDWIN SULLIVAN
SURVEYOR GENERAL FOR UPPER CANADA 1838-1840.

Robert Baldwin Sullivan, the subject of this memoir, attained not only to the distinguished position of Surveyor-General, but was also a judge in the Province of Upper Canada, and an eminent member of the Legislative Assembly. He was born of Irish parents who lived at Bandon, near Cork, Ireland. His father, Daniel Sullivan, during the troubles of 1798, was engaged in trade, making money, if not a fortune, supplying the troops with necessaries during that remarkable period of Irish history.

Daniel Sullivan had been intended for the church, and while at Trinity College, Dublin, he was a proficient in classical literature, and carried off the Greek prize. However, when the time for his ordination arrived, as he could not conscientiously subscribe to the Thirty-nine Articles, he gave up theology and went into business. He was married to Miss Baldwin, sister of Dr. Baldwin, whose name is so familiar to all Canadians, and they had four sons, Daniel, Robert, Henry and Augustus. Robert the second son was born at Bandon, on the 24th May, in the year 1802. He was from childhood a bright, intelligent boy, quick to learn, and what was better, able to retain in a remarkable degree, any knowledge he acquired. His early education was obtained at the principal private school of Bandon, supplemented by his father, who instructed him in the classics. In 1819, when Robert was but seventeen years old, Dr. Baldwin induced his father to emigrate, and make Canada his future home. Dr. Baldwin was then living in York, and had acquired a reputation in this new town in Canada, both as a doctor of medicine and a lawyer. Dr. Baldwin was also at this time a member of the Legislature of the Province. Mr. Sullivan. in leaving Ireland to make a home in Canada, was not going among strangers, his brother-in-law, the doctor, having reached a high position in the new land.

When Daniel Sullivan arrived in Toronto, acting on the advice of friends, he embarked in trade, and opened a general store just east of where St. James's Church now stands, on King Street. The boys of the family assisted their father in his shop; but this occupation did not long suit Robert. Dr. Baldwin, his uncle, was engaged both in medical pursuits and in law. Robert Sullivan, in choosing for himself a profession, preferred the law. The education he had received in Ireland now served him in good stead. Applying himself to his books he prepared himself to become a law student, and was, as student, entered in the books of the Law Society in Michaelmas Term, 4 George IV., 1823. On passing his examination he entered the office of his uncle, Dr. Baldwin, where he passed his five years of probation, and was called to the Bar in Michaelmas Term, 9 George IV., 1828.

During his studies in Dr. Baldwin's office he was able to devote a portion of his time to another pursuit. Just then the library of Parliament was in want of a librarian. His knowledge of books and Dr. Baldwin's influence secured for him this office.

As soon as Robert Sullivan was called to the Bar, he determined to strike out for himself. Doctor Rolph, who had lived at Vittoria, in the County of Norfolk, had made up his mind to remove from that place. Mr. Sullivan thought that this offered an opening for him to enter upon the practice of his profession at Vittoria; true it was remote from the capital, but this did not signify to him, he was determined to exercise his talents at the beginning, in some place, where if success were to be his, it would be based on his own merits; he never was a man to shine with borrowed light. He had been in Vittoria but a few years when he was called upon by Dr. Morrison to act as his council before the Legislative Assembly in his contest with Mr. (afterwards Chief Justice Sir) John Beverley Robinson, for the Parliamentary seat of York. This was a spirited contest, not only out of but in Parliament, and resulted in Mr. Robinson retaining his seat.

Mr. Sullivan acquitted himself so well before the Legislature in this trial of strength, that friends at once took him by the hand, and insisted on his coming to York where he would receive their patronage and support. This was in the year 1830, when he was but twenty-nine years of age. Mr. Sullivan could not but accept this flattering offer, and about this time moved from Vittoria to the capital, where he became junior partner in the office of his uncle.

When he had made his home in York he soon rose into popular favor, as is evidenced by the fact that he had not been a resident of the place more than five years when he was elected Mayor of Toronto over William Lyon Mackenzie, who was his opponent for the mayoralty in 1835. Mr. Mackenzie was Mayor of Toronto the

year previous, but was not able to hold the position the second year against Mr. Sullivan, who had been elected member of the Council for St. David's Ward.

Mr. Sullivan, being elected mayor, applied himself vigorously in advancing the interests of old York, now Toronto city and the capital of the Province, in the matter of drainage and other works of necessary improvement.

The City Council has kept in remembrance the second mayor by a portrait of Mr. Sullivan, which hangs on the walls of the Mayor's office at the City Hall.

Mr. Sullivan's term of office as mayor having expired, he was not long in being sought after for further and higher employment. The early months of the year 1836 find Sir Francis Bond Head the Lieutenant-Governor of the Province.

Shortly afterwards the Governor's council, finding that His Excellency was making appointments on his own responsibility without consulting them, retired in a body.

Under these circumstances the Governor knowing, or having heard of the distinguished ability of Robert Sullivan, sent for him, and sought his advice.

In the general election of 1836 a House hostile to the existing state of things had been elected. Parliament was called to meet in November of that year. The Governor was certainly in a dilemma, and needed advice. Mr. Sullivan was a non-partizan man; he was just the kind of adviser the Governor required in such a crisis. He was selected as adviser more on account of his talents than his politics. He was not alone in entering the Council, others, viz., the Honorable William Allan, Captain (afterwards Admiral) Augustus Baldwin, uncle of Robert Baldwin, and John Elmsley, were called to the Council with Mr. Sullivan. Mr. Draper (afterwards Chief Justice Draper) was soon after added.

Mr. Sullivan has sometimes been called a Tory, or Conservative, sometimes a Radical; the fact is, he was Mr. Sullivan, and that was all. He was not a party man in the strict sense. His partyism, if he had any, consisted in his desire to advance the interest of the Province under the aegis of Great Britain—he was a Reformer, but not a Radical.

The Legislative Assembly, in the session of 1836, as I have said, was hostile to the Governor. It was equally true that the Governor was hostile to the Assembly. In the view of the Assembly, an Executive Council without Robert Baldwin or Marshall S. Bidwell, ought not to possess the confidence of the country. The Assembly, holding this view, passed a resolution of want of confidence in the new Councillors, and Mr. Sullivan had to go with the rest.

On 4th March, 1837 Sir Francis Bond Head thought proper to dissolve the House of Assembly. A most exciting election took

place, which resulted in the return of a House opposed to the introduction of Responsible Government.

When the rebellion broke out in December, 1837, Mr. Sullivan buckled on his armour in defence of the Province. Both by precept and example he shows his abhorrence of rebellion. With Dr. Baldwin and Robert Baldwin he felt reform was necessary in the government of the country, but did not believe that armed revolt was the proper remedy for existing grievances.

In the autumn of 1837 Sir Francis Bond Head resigned his office of Lieutenant-Governor, but held office till the close of the session, which took place on the 6th March, 1838.

Mr. Sullivan had the confidence of the Governor during his whole administration.

Sir George Arthur succeeded Sir Francis Head as Lieutenant-Governor on 23rd March, 1838, and Mr. Sullivan was his most trusted Councillor. Sir George Arthur's Lieutenant-Governorship was, however, overshadowed by the advent to the Province of Lord Durham as Governor-General, which took place in the autumn of 1839, and, on his return to England, by Mr. Poulett Thompson (afterwards Lord Sydenham), who was sent out specially to build up a union of the provinces, founded on the report which Lord Durham made to the Imperial Government. The lesser light of the Lieutenant-Governorship was dimmed by the greater light of the Governor-General.

Lord Durham was in Toronto for one day, in July, 1838, and received an ovation from the citizens.

When Lord Sydenham came to Toronto in November, 1839, he took upon himself the management of affairs with the sole view of promoting the union. He took up his residence at Beverley House, and from thence used all the means at his command to influence Parliament, which met in the early part of December, 1839. He found the Legislative Council composed of honorable members not likely to yield to his wishes, unless he could have the support of some trusted man of ability to advocate his views.

One of the first to coincide with the Governor-General's views was Mr. Hamilton H. Killaly, who was soon after selected to form a Board of Public Works, thus overthrowing the despotism that prevailed in that Department. At this time Lord Sydenham became impressed, not only with the oratorical powers of Mr. Sullivan, but with his aptitude to advance the work in hand. Mr. Sullivan was his principal adviser in all the negotiations entered into, and his spokesman when he wished his views conveyed through other channels than his own. In the Legislative Council he advocated the union with all the eloquence at his command. He dealt with all the arguments advanced against the union in a masterly manner. He assured the House that Her Majesty was

determined to maintain the connection between the colonies and the mother country. This was the foundation on which he raised a noble superstructure.

In June, 1838, Mr. Sullivan occupied the position of Surveyor General, and continued in this office until September, 1840

In February, 1839, Mr. Sullivan was appointed a Legislative Councillor.

The Act of Union between the Provinces of Upper and Lower Canada passed in 1840, was announced by proclamation to come into effect on 10th February, 1841. The first Council after the Act of Union had been proclaimed, was formed on 13th February, 1841, and Mr. Sullivan was a member of that Council. Mr. Sullivan continued to hold office after the formation of the first Baldwin-Lafontaine Administration, which took place on September 16th, 1842. From the period of the union, up to the time of his resignation in 1843, he was the senior member of the Council and leader of the Government in the Legislative Council; while in the Assembly, although Mr. Harrison (the Honorable S. B. Harrison) conducted the business, Mr. Draper was in effect the leader. During the period from the union in 1841 to the resignation of the Baldwin-Lafontaine Administration, both Lord Sydenham and Sir Charles Bagot were in their turn Governors of the United Provinces. Lord Sydenham met with an untimely death, the result of an accident, in September, 1841. He was succeeded by Sir Charles Bagot, who survived his appointment only about nineteen months, and died at Kingston on the 19th May, 1843. Sir Charles Metcalfe succeeded Sir Charles Bagot, and held office until November, 1845, when he was obliged to resign his position on account of ill-health.

The Baldwin-Lafontaine Administration, of which Mr. Sullivan was a member, had the entire confidence of Sir Charles Bagot. When, however, Sir Charles Metcalfe came out as Governor, he was not so ready to yield to the advice of his Ministers as Sir Charles Bagot had been.

A rupture soon occurred between Sir Charles Metcalfe and the Baldwin-Lafontaine Cabinet. The Governor demanded to have the patronage of the Crown in appointments to office, while the Council held that the patronage was theirs to exercise so long as they had a parliamentary majority. On this question the Ministry resigned. Mr. Sullivan was no sooner out of office than he took up the pen to defend the Administration and its principles.

Sir Charles Metcalfe had a doughty champion in Doctor Egerton Ryerson.

Mr. Sullivan wrote a series of letters in "The Examiner" newspaper, under the "non de plume" of "Legion." Never before in Canada had more scathing letters on a political subject been written by any man. These letters are full of interest as to the principles of Responsible Government, enforced with logic and syllogism which had never been surpassed. Both the Reverend Doctor Ryerson and Mr. Sullivan are in their graves, and it will not be well, therefore, to exhume the controversy which was held by these two combatants, in which sarcasm as well as reasoning so much abounded.

When Mr. Sullivan left the Government he resumed the practice of the law in Toronto. He and Mr. Shuter Smith, of Port Hope, entered into partnership, and carried on their practice under the firm name of Sullivan & Smith, in Wellington street, Toronto.

Mr. Sullivan took great interest in all public matters. In 1847 he delivered a most excellent address in the Mechanics' Music Hall, Toronto, on the subject of "Emigration and Colonization." His address was productive of much good in stimulating emigration, and showing the capabilities and resources of Canada, as a field for the husbandmen of England and Ireland. Little was then known of the country to the west of Lake Superior. Mr. Sullivan related what he had heard from Mr. Angus Bethune and Mr. Ermatinger, then very lately from that country. Mr. Sullivan stated that the Saskatchewan River ran from west to east fifteen hundred miles without obstruction! A truth we all know now, but which was then thought to be almost fabulous. Mr. Sullivan's whole address showed the unbounded confidence he had in the possibilities of the future of Canada, so remarkably realized since his death.

Mr. Sullivan was not only a lecturer, but also a lover of poetry, and often indulged his fancy in versification.

He was a most agreeable conversationalist, and was a scholar in every sense of the word, well acquainted with the prose and poetical writings of the past centuries as well as the present. He could read and translate French fluently, and frequently found this useful in a Government composed of both English and French members.

Mr. Sullivan was twice married: first to a daughter of Captain Matthews, who was a distinguished officer of artillery, and was with Sir John Moore in his retreat to Corunna. By his first marriage Mr. Sullivan had but one child, a daughter, who died in her infancy. His second wife was a daughter of Colonel DeLaitre, by whom he had several children.

Judge Falconbridge, of the Queen's Bench Division of the High Court of Justice, married one of his daughters, the late Chief Justice Thomas Moss also married one of his daughters and Judge Charles Moss, another.

Surveyor-General Sullivan, will be remembered by all who knew him with affection and regard. He died at Toronto on 14th of April, 1853, at the early age of 51 years.

An obituary notice of him truly recorded that he was "Distinguished as a lawyer, statesman and orator; that he won admiration and esteem by his splendid talents and the eminent services which he rendered to his adopted country in the Legislature and the Executive, during an eventful period of Canadian history, while in private he gained the affections of his associates and friends by the gentleness of his disposition and the generosity of his heart."

PAPERS USED AT THE FEBRUARY SESSION OF THE BOARD OF EXAMINERS, 1899.

PRELIMINARY EXAMINATION.

Subjects Nos. 1 and 2.

PENMANSHIP, GRAMMAR AND ORTHOGRAPHY.

1. Write from dictation . . . . .

2. Give the plural form or forms of staff, die, pea, canto, cargo penny 8, brother, basis, index, miasma.

3. Give the principal parts of rend, lay, rise, lie, bid, wring, dare (to venture), chide, fly, awake.

4. Correct or justify the following:

"Toronto is the largest of any city in Ontario."
"Try and meet me to-morrow."
"I will buy a fifty feet chain."
"It is seven days since I have arrived."
"Less than fifty soldiers were killed."
"One of the best of his men were wounded."
"Seeing you and I coming he hid himself."
"Some of the best of we candidates may fail."
"From one bank of the river to another he swam easily."
"He was killed with a trenchant blow."

"Near yonder copse where once the garden smiled,
And still where many a garden flower grows wild,
There, where a few torn shrubs the place disclose,
The village preacher's modest mansion rose.
A man he was to all the country dear,
And passing rich with forty pounds a year."

(a) Transpose the above extract.
(b) Parse the words underlined, giving the relation of each.

Subject No. 3.

ARITHMETIC.

1. Reduce $\frac{11}{3}$ of $1\frac{999}{1000}$ to a simple fraction.

2. Reduce the following fractions to equivalent ones with the least common denominator $\frac{7}{13}$ of $\frac{4}{5}$, $11\frac{1}{13}$, $\frac{1}{2}$ of $\frac{18}{7}$ of $3\frac{8}{9}$.

3. Divide $\frac{15}{16}$ of $\frac{64}{100}$ by $\frac{17}{18}$ of $1\frac{2}{3}$.

4. Find the square roots of 687241, 151321, 45369, 87025.

5. Extract the cube roots of 13261, 13269, 830585, 830597, and give the remainder in each case.

6. It is required to build a sidewalk a quarter of a mile in length, 8 ft. wide and 2 inches thick, supported by 3 continuous lines of scantling 4 inches square; what will the lumber cost at $17 per thousand feet?

7. Fill in the blanks in the following Tax Bill. Amount of Assessment $900:

County rate, $3\frac{8}{10}$ mills on the dollar -	$.....
Model School rate, $1\frac{1}{4}$ mills on the dollar -	.....
Railway Debenture rate, $2\frac{6}{10}$ mills on the dollar	.....
Township rate, $1\frac{4}{10}$ mills on the dollar -	.....
General School rate, $5\frac{1}{10}$ mills on the dollar -	.....
High School rate, $1\frac{3}{4}$ mills on the dollar -	.....
Total Taxes - - -	$.....

8. Find the export duty on a stick of timber 20 ft. long, 3 ft. wide, and 2 ft. thick at $2 per 1,000 ft., board measure.

9. My salary is $1,200. If I pay 30 per cent. of it for board, 20 per cent. of the remainder for rent, 15 per cent. of the residue for clothes, $71.20 for books, and loan 40 per cent. of the remainder, what per cent. of my salary is unexpended?

10. A hare is 75 of her own leaps ahead of a hound, and she takes 5 leaps for every 3 the hound takes, but he covers as much in 1 leap as she does in 2. How many leaps will the hound take before he catches the hare?

SUBJECT NO. 4.

LOGARITHMS AND ALGEBRA.

1. Simplify:

$$2a-(2b-d)-\{a-b-(2c-2d)\}$$

$$6a-[4b-\{4a-(6a-4b)\}]$$

$$2a-[7a-\{2a-(2a-\overline{7a-a})\}]$$

2. $$\frac{x+3}{2}-\frac{x-2}{3}=\frac{3x-5}{12}+\frac{1}{4}$$

$$\frac{4x+17}{x+3}+\frac{3x-10}{x+3}=7$$

3. (*a*) Divide 75 into 2 parts so that 3 times the greater may exceed 7 times the less by 15.

(*b*) A watch gains as much as a clock loses, and 1799 hours by clock = 1801 hours by watch. How much does watch gain and clock lose per hour?

4. Define a Logarithm. What is the characteristic?

How are log. sines, tans, etc., calculated as used in the tables?

Find the log. sin of 35° 24′ 36″.

Find the angle whose log. tan = 10.9205559.

Find the logs. of .00764, 76432.

5. Show that every quadratic equation can be put in the form $x^2 + px + q = 0$.

Solve:

$$3x^2 - 4x = 39$$

$$x^2 - 3 = \frac{x - 3}{6}$$

$$\frac{x - 1}{x - 3} + 2x = 12$$

Subject No. 5.

EUCLID.

Book I., Prop. 16. If one side of a triangle be produced, the exterior angle is greater than either of the interior opposite angles.

Book I., Prop. 29. If a straight line fall upon two parallel straight lines, it makes the alternate angles equal to one another, and the exterior angle equal to the interior and opposite upon the same side, and also the two interior angles upon the same side together equal to two right angles.

Book I., Prop. 32, Cor. 1. All the interior angles of any rectilineal figure, together with four right angles, are together equal to twice as many right angles as the figure has sides.

Trisect a right angle.

If in the sides of a square, at equal distances from the four angles, four points be taken, one in each side, the figure formed by joining them will also be a square.

Book II., Prop. 111. If a straight line be divided into any two parts, the rectangle contained by the whole and one of the parts is equal to the rectangle contained by the two parts, together with the square of the aforesaid part.

Book II., Prop. 11. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square of the other part.

Book III., Prop. 1, Cor. If in a circle one straight line bisect another at right angles, the centre of the circle is in the line which bisects the other.

Book III., Prop. 22. The opposite angles of any quadrilateral figure inscribed in a circle are together equal to two right angles.

Book III., Prop. 36. 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.

Book IV., Prop. 6. To inscribe a square in a given circle.

Book IV., Prop. 10. To describe an isosceles triangle, having each of the angles at the base double of the third angle.

Upon a given straight line describe a regular octagon.

Subject No. 6.

PLANE TRIGONOMETRY AND RULES FOR SPHERICAL.

1. Prove that $\sin (90^\circ + A) = \cos A$
and that $\cos (90^\circ + A) = -\sin A$.

2. Find all the angles between 0 and 900° which satisfy the relation $\tan \theta = 1$.

3. Find the number of degrees in the angle subtended at the centre of a circle whose radius is 10 feet by an arc 9 inches long.

4. If D be the number of degrees contained in an angle, C the number of grades in the same angle, prove that $D = C - \frac{1}{10} C$, and $C = D + \frac{1}{9} D$.

5. What form the sides and angles of a spherical triangle ?

6. Show that the three angles of a spherical triangle are together greater than two right angles and less than six right angles.

7. Give from Napier's Analogies the other form for
$\tan \frac{1}{2} (A + B)$ and $\tan \frac{1}{2} (A - B)$
$\tan \frac{1}{2} (a + b$ and $\tan \frac{1}{2} (a - b$.

Subject No. 7.

MENSURATION.

1. The base of the Great Pyramid of Egypt is a square of 764 ft. in each side; find the number of acres of ground covered by it.

2. The sides of a triangular field are 32.13, 33.96, 48.39 chains; find the area of the field in acres.

3. The diagonals of a quadrilateral enclosure are 17.21 and 24.32 chains, and the angle between them is 39° 14'; find the area of the enclosure, true to the hundredth part of an acre.

4. A room 40 ft. long, 22 ft. wide, and 15 ft. high has four windows on one side, each occupying a space 7 ft. wide and 13 ft. high; two doors, each 4 ft. 9 inches wide and 8 ft. high; and two fireplaces, each 5 ft. 8 inches wide, and 4 ft. 6 inches high; find the number of square yards of painting required for the walls, allowing 1 ft. for the height of the cornice and 15 inches for the skirting board.

5. The parallel sides of a trapezoid are 39 and 56 yards and the angles which the other two sides make with the longer side are 45° and 57°. Find the area.

Subject No. 8.

LINEAR DRAWING.

1. Draw a scale of $5\frac{1}{2}$ inches to a mile to read to 10 yards.

2. Construct a scale of miles and tenths having for its representative fraction $\frac{1}{63360}$.

3. Draw 4 parallel lines 4.5 inches long, 1-10 inch apart—first, Dark; second, Fine; third, Simple dotted; fourth, Chain dotted.

4. Construct an equilateral triangle 2.5 inches high.

5. Construct a square 1.5 inches in side and describe about it a circle in dots; describe two other circles concentric with first, one $\frac{1}{10}$ inch outside and the other $\frac{2}{10}$ inch inside.

6. Describe a circle 1.85 inches in diameter. Assume a point 1.5 inches without it and from it draw a tangent to circle.

Subject No. 9.

GEOGRAPHY.

1. Name the oceans of the world and the directions of the chief routes of travel.

2. Describe the chief mountain ranges and mention any special features you know about them.

3. Name the counties and districts of Ontario which border on the great lakes and the chief harbors in each.

4. Describe the motions of the sun, the moon, and the earth. How do they influence the length of day and the seasons in the several parts of the globe? Explain standard time and its advantages and disadvantages.

5. Define longitude and latitude: from what points are distances on them measured? Are they natural or artificial? Name and describe the zones.

SUBJECT NO. 10.

CANADIAN HISTORY.

1. Give the boundaries, the Provinces, and the area of the Dominion of Canada.

2. Give date of capture of Quebec, and names of opposing parties and commanders.

3. Who were the United Empire Loyalists, and where did they chiefly settle?

4. At what date and under what authority did Parliamentary Government begin in Canada, and give date and place of meeting of first Parliament of Upper Canada?

5. What caused the war of 1812? Give the names of some of the battles, and the respective commanders?

6. When were Upper and Lower Canada united, and give the terms of the Union?

7. When were postage stamps introduced in Canada, and when did Canada get the control of the post-offices?

8. Describe some of the steps towards Confederation, naming some of the leaders of both parties and date of and name of Act passed.

9. Name first Governor-General of the Dominion and first Prime Minister.

10. Name some of the principal events since Confederation.

11. Give the boundaries of the Province of Ontario.

12. Name the Prime Ministers of Canada since Confederation.

FINAL EXAMINATION.

SUBJECT NO. 1.

GEOMETRY.

Book I., Prop. 47. In any right angled triangle, the square which is described upon the side subtending the right angle is equal to the squares described upon the sides which contain the right angle.

The diameters of a parallelogram bisect each other.

Trisect a right angle.

If in the sides of a square, at equal distances from the four angles, four points be taken, one in each side, the figure formed by joining them will also be a square.

Book II., Prop. 11. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square of the other part.

Book III., Prop. 1, Cor. If in a circle one straight line bisect another at right angles, the centre of the circle is in the line which bisects the other.

Book III., Prop. 22. The opposite angles of any quadrilateral figure inscribed in a circle are together equal to two right angles.

If this be so, show that a circle may be described about it, and find its centre and radius.

Book IV., Prop. 6. To inscribe a square in a given circle.

Book IV., Prop. 10. To describe an isosceles triangle, having each of the angles at the base double of the third angle.

Upon a given straight line describe a regular octagon.

Book VI. Define "Similar rectilineal figures," "Reciprocal figures," "Extreme and Mean ratio."

Book VI., Prop. 6. If the two triangles have one angle of the one equal to one angle of the other, and the sides about the equal angles proportionals, the triangles shall be equiangular, and shall have those angles equal which are opposite to the homologous sides.

Prop. 19. Similar triangles are to one another in the duplicate ratio of their homologous sides.

SUBJECT NO. 2.

ALGEBRA.

1. Extract the square root of:

$$4x^4 - 4x^3 + 5x^2 - 2x + 1$$

and the cube root of 10980.645048.

2. Solve: $7x^2 - 3x = 160$ (a)

$(3x - 2)(x - 1) = 14$ (b)

3. The product of two numbers is 750 and the quotient when one is divided by the other is 3. Find the numbers.

4. When are quantities in

(a) Arithmetical progression.

(b) Geometrical progression.

Give examples.

5. Show how many terms of 3, 4, 5, etc., make 25.

Sum to infinity: $5 - \frac{1}{2} + \frac{1}{20} - \frac{1}{200} \ldots\ldots\ldots\ldots$

SUBJECT NO. 3.

TRIGONOMETRY (PLANE AND SPHERICAL).

1. Prove the truth of the following rule in surveying: Take $\frac{1}{800}$ of the square of the distance in chains and it will give the correction for curvature in inches.

2. The sun's distance from the earth being 24,000 times the earth's radius, find (in seconds) the earth's apparent diameter as seen from the sun.

3. The sine of a certain angle is $\frac{3}{5}$. Find the other trigonometrical ratios of the angle.

4. Give the definition of sphere, pole, great and small circle and spherical polygon.

5. Prove that $\tan \frac{A}{2} = \sqrt{\frac{\sin (s-b) \sin (s-c)}{\sin s \sin (s-a)}}$.

6. Prove that $\tan \frac{1}{2}(A+B) = \frac{\cos \frac{1}{2}(a-b)}{\cos \frac{1}{2}(a+b)} \cot \frac{C}{2}$.

7. In a right angled Spherical Triangle, given $a = 37^\circ\ 48'\ 12''$, $b = 59^\circ\ 44'\ 16''$, $C = 90^\circ$. Find c, A and B.

8. In an oblique angled spherical triangle, given $a = 68^\circ\ 20'\ 25''$, $b = 52^\circ\ 18'\ 15''$, $C = 117^\circ\ 12'\ 20''$. Find A and B.

Subject No. 4.

MENSURATION AND LAYING OUT LAND.

1. The sides of a quadrilateral, taken in order are 75, 55, 60, and 40 inches, and the angle between the first two sides is 74° 40' 15"; show that the figure may be inscribed in a circle, and find its area in square feet.

2. The sides of a triangular field are 32.13, 33.96, 48.39 chains; find the area of the field in acres.

3. Two sides of a parallelogram are 10.62 and 15.35 chains, and the angle between them is 30°. Find the area.

4. One side of a quadrilateral field is 11.1 chains and the perpendiculars from the opposite corners are 3.52 and 5.95 chains; the foot of one perpendicular is distant 1.1 chains from one end of the given side and the foot of the other 3.65 chains from the other end. Find the area.

5. Let DA bear S. $20\frac{1}{4}°$ W.; AB, N. $51\frac{1}{2}°$ W., 8.19 chain B.C. N. $73\frac{1}{2}°$ E., and let it be required to part off two acres by a line fence D.C. running N. 45° W.

6. What is a traverse table? Explain fully how you would use such a table to calculate the area of an irregular field. What means does such a table afford to enable you to check the accuracy of the work as you progress?

7. Let BA bear S. 30° E., BC N. 80° E., and a fence be required to run from some point in BA a due north course and to part off one acre. Required the distance from the point B to the point F, whence it must start.

8. A field is bounded thus N. 14° W., 15.20 chains, N. $70\frac{1}{2}°$ E., 20.43; S. 6° E., 22.76; N. $86\frac{1}{2}$ W., 18.00. A spring within it bears from the second corner S. 75° E. 7.90. It is required to cut off ten acres from the west side of the field by a straight fence through the spring. How far will it be from the first corner to the point at which the division fence meets the fourth side?

9. AB bears N. 13° W., 12.50 chains; BC N. 89°, E. 16.48 chains, CD, S. 13° E. 4.83. DA is a curved line having a radius of 1584 feet. You are required to divide the field into two equal parts by a line drawn parallel to AB and find area of field.

10. What is Simpson's rule for areas of irregular figures? Illustrate and prove the truth of it.

Subject No. 5.

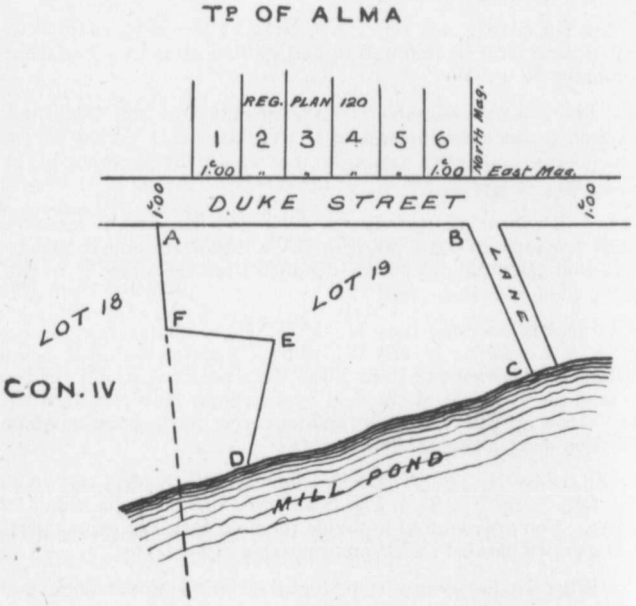
DESCRIPTIONS BY METES AND BOUNDS.

1. Correct the errors in this description:

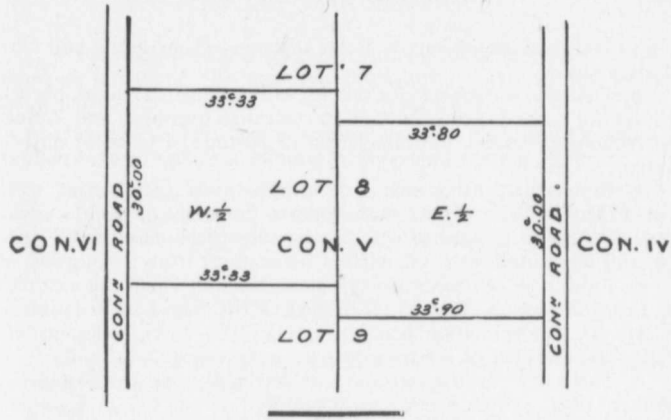
Description of five acres of land, being part of Township Lot 123. Commencing at the north-east angle of said half acre or north-west angle of John Smith's lot; thence south to the Portage Road, 10 chains; thence west along said road 5 chains; thence north along J. Roe's property, 10 chains to stone; thence N. 10° E. 5 chains, to the place of beginning.

2. Give some cases in which it would be best to omit magnetic bearings and the term more or less.

3. Give description by metes and bounds of the property A, B, C, D, E, F shown in diagram, assuming bearings and distances where not given.



Give description of the centre twenty-five acres of the double front lot in diagram, for tax title.



SUBJECT NO. 7.

CURVES.

1. Explain the following terms:

Angle of Intersection; Deflection Angles; Tangent Points; Simple Curve; Compound Curves; Reversed Curves; Radius of Curve.

What is meant by the expression, "A five degree curve"?

2. Given angle of intersection =31° 16' and tangent =950. Find the radius.

3. (a) How do you find the length of a curve, angles of intersection and deflection being given? (b) Given I=8° 32' and D=1°. Find the length of curve.

4. Given angle of intersection =80°; degree of curve =3° 20'; point of intersection at station 2048+30. Where are the B C and E C?

Plot the curve and tangents on a scale of 400 feet to one inch, showing chainage at B C, E C and length of curve.

What angle would you turn off the tangent at the B C to fix the first even station beyond the B C on the curve?

5. Given the perpendicular distance between two parallel tangents = 12 and the distance between two tangent points = 200, determine radius of reversing curves connecting them.

Subject No. 8.

PRACTICAL ASTRONOMY.

1. Define Azimuth circle, Polar distance, Hour angle and Co-declination.

2. Describe the process for taking, with a transit, at night, observation for altitude, of a star at its meridian passage, and define corrections necessary for calculation of latitude of place of observation.

3. Convert 1d. 11h. 40m. A. M. August, and October 9d. 10h. 1m. P.M. Civil Time into Astronomical Time.

4. When in latitude 48° 51' N. the sun's declination is 18° 30' N., and its altitude 52° 35s., what is its azimuth from the north ?

5. Find hour of observation in mean time at which the altitude of Procyon was 28° 10' 13" when east of the meridian in latitude 7° 45' N., its declination being 5° 41' 52" S., its right ascension 7° 29' 30" and that of the mean sun at mean noon 11° 4' 40".

6. The sun's right ascension and declination on the 8th September, 1854, 11 hrs. 6 min. 30.79 sec. and 5° 43' 52" 4 N., what will be its longitude and the obliquity of the ecliptic ?

Subject No. 9.

SURVEY ACT.

1. Who may act as a Land Surveyor in Ontario ?

2. When may Municipal Councils have boundaries of lots ascertained and marked ?

3. What is meant by a "Governing Line ?"

4. What is a "proof-line ?" and when should it be used ?

5. What is understood by the "front" of a concession ? and what is a "single front" concession ?

6. What is meant by "double front" concessions ? When was the system introduced ? and how are lines to be run in these concessions ?

7. Describe the sectional system of survey, when was it introduced ? and how are lines to be run therein ?

8. How are lines to be run in Muskoka and Parry Sound Districts and country adjacent thereto ?

9. When post between lots is lost, how do you establish point ?

10. How are lines to be run in those townships where side lines of lots were run in original survey ?

11. Oral examination.

Group No. 10.

(A) THE MINES ACT.

1. What may the dimensions of a mining location be in: (a) unsurveyed territory; (b) surveyed townships. Give all the cases which may occur.

2. Distinguish between a mining location and mining claim. Explain how to secure a mining location and mining claim.

3. Make a plan on a scale of 10 chains to an inch of a mining location lying on the south-easterly shore of a lake, shore line bears north 7° 30' east, magnetic where the magnetic variation is 8° to the west.

(B) THE REGISTRY ACT.

1. Give form of surveyor's certificate to a plan of sub-division for registration purposes.

2. Where land is surveyed and sub-divided for the purpose of being sold in lots by reference to a plan, when must the plan be registered, who shall sign it, what scale must it be drawn to, and what information must the plan contain?

(C) THE DITCHES AND WATERCOURSES ACT.

1. "A" is the owner of Lot 1, Concession 2, in the Township of "Z." He is desirous of draining his land, and it is found necessary to continue the ditch through the following lands: Lots 2, 3, 4, 5, and 6, in Concession 2, owned by B, C, D, E, and F, respectively, across the road allowance between Concessions 2 and 1, in said township and through lots 6 and 7 in Concession 1, owned by G and H, respectively, to a natural outlet.

Explain, step by step, the procedure "A" will require to take in order to have an award made by the engineer. Cost of ditch, $980.

(D) THE DRAINAGE ACT.

1. Explain the following expressions and words: Initiating Municipality, Maintenance, Sufficient Outlet, Owner.

2. What persons are qualified under this Act to petition for the construction of drainage work. What number is required to begin proceedings. Give all the cases.

3. What do you understand by the terms: 'Benefit, Injuring Liability, Outlet Liability. How is the assessment for the last two determined.

4. What is the first duty of an engineer appointed under this Act ?

5. Prepare a report, sketch plan and assessment for the proposed improvement of Lots 1, 2, 3, 4, 5, in Concessions Numbers 1 and 2, Township of "A," by the deepening, etc., of Bear Creek, in which all classes of assessment occur.

Subject No. 11.

LEVELLING.

1. Define the following terms with sketch, if possible:

Apparent Level, True Level, Datum Line, Bench Mark, Height of Instrument, Back Sight, Fore Sight, Intermediates, Five Per Cent. Grade, One Hundred Per Cent. Grade, 1 in 16 Grade, Turning Point, Refraction.

2. State with diagram (a) how to adjust a level, (b) how a levelling staff is constructed, (c) how a field book is prepared and levels reduced when back sights, fore sights, intermediate sights, and turning point sights are taken.

3. Prove that the difference between true and apparent level is equal to the square of the distance between the points.

4. If you are preparing a profile for a case in court, would you have the horizontal and vertical scales the same or different, and if different what should the ratio of the one to the other be and why ?

5. What is the difference between true and apparent level at the distance of 3,100 feet ?

6. Required the difference between true and apparent level, for a distance of 140 chains.

7. How would you eliminate error in adjustment of level and corrections for refraction and curvature of the earth in running a line of levels in the field, without calculations ? Give reason for same.

Subject No. 12.

PRINCIPLES OF EVIDENCE.

1. What do you understand by the word "Evidence"?

2. What is the "best evidence"? "primary evidence"? "secondary evidence"? Explain under what conditions the latter is admissible.

3. Assuming you have good grounds to expect material evidence may be had from certain documents in the hands of the (a) adverse party, (b) a stranger. What steps would you take and by what means would you insure an examination of them?

4. What is hearsay evidence and when, if ever, is it allowable?

5. What is an affidavit? Give its essential parts, illustrating your reply by an affidavit to a post.

Subject No. 14.

GEOLOGY AND MINERALOGY.

1. Name the thirteen characteristic elements most important in rocks.

2. Name the three classes of minerals which are the principal constituents of rocks, and give two or more examples of each.

3. Name the two classes into which rocks may be conveniently divided and give three examples of each.

4. Distinguish between Calcite, Dolomite, and Hydraulic Limestone.

5. Define Tavertine and manner of formation.

6. Define Stratification, Layer, Stratum, Formation, Seam, Joint, Fault Folds, Dislocations, Dip, Strike, Anticlinal, Synclinal, Conformable, Fossils, Dike.

7. Name the six ages into which the formation of the earth's crust is divided.

8. Name in order, about eighteen, of the formations in Ontario.

9. Give a short account of the following formations: Huronian, Trenton, Utica, Hudson River, and Corniferous, giving economic products and fossils, etc., etc.

10. What is Gypsum? Where is it found in Ontario? Explain its origin and some of its uses.

11. Describe the Glacial Period, as to its Source, Geological Distribution, Materials, and Course of Travel.

12. Give a short Geological description of the surface of Ontario, north of Lakes Huron and Superior.

13. Name the valuable minerals and metals found in the part of Ontario mentioned in question 12.

14. Give a list of the principal economic minerals and metals mined in Ontario.

Subject No. 15.

BOTANY AND THE FOREST FLORA OF CANADA.

1. Describe the functions of leaves. How are they classified? Draw and describe any Canadian leaf you know.

2. What elementary substances should the soil contain for the nourishment of plants?

3. What is the difference between underground stems and roots?

4. Name six trees of Ontario. State their varieties and economic uses. Number them in order of value.

LIST OF MEMBERS.

21st September, 1899.

The names of those members granted exemption by By-laws ratified by the Association are marked*.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Abrey, George Brockitt, Sawbill, Dist. of Rainy River.....10th Jan., 1860
D.L.S.

Allan, John Richard, Renfrew.....6th Nov., 1894
Grad. S.P.S.

Aylsworth, Charles Fraser, Jr., Madoc.....8th Jan., 1886
D.L.S.

Aylsworth, John Sidney, Selby, P.O. Box 23...9th Jan., 1871
D.L.S.

Aylsworth, William Robert, Belleville, P.O. Box 2.....8th Nov., 1861
D.L.S.

Baird, Alexander, Leamington.....7th July, 1877
D.L.S., C.E.

Barrow, Ernest George, Hamilton.....4th Oct., 1877
D.L.S., Mem. Can. Soc. C.E., City Engineer.

Bazett, Edward, Burk's Falls.....8th July, 1881
D.L.S.

Beatty, David, Parry Sound.....12th July, 1869
D.L.S.

Beatty, Herbert John, Eganville.....8th Nov., 1893
Grad. S.P.S.

Beatty, Walter, Delta.....19th July, 1858
D.L.S., M.P.P.

Bell, James Anthony, St. Thomas.....11th Oct., 1875
D.L.S., Co. Engineer, Elgin; City Engineer, St. Thomas.

Bigger, Charles Albert, Ottawa, 68 Daly Ave..6th Jan., 1882

Bolger, Thomas Oliver, Kingston.....6th July, 1865
D.L.S., City Engineer.

Bolton, Ellsworth Doan, Listowel ..... 7th Nov., 1895
B.A.Sc. (McGill)

Bolton, Lewis, Listowel.....9th July, 1864
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Boswell, Elias John, Peterborough.....7th Nov., 1896
Grad. S.P.S.

Bowman, Clemens Dersteine, West Montrose.10th July, 1879

Bowman, Herbert Joseph, Berlin.....7th Jan., 1887
D.L.S., Grad. S.P.S., Treasurer County Waterloo. Assoc. Mem. Can. Soc. C.E.

Bray, Edgar, Oakville.....6th Oct., 1866
D.L.S.

Bray, Harry Freeman, Oakville.....10th July, 1882

Bray, Samuel, Ottawa, Dept. of Indian Affairs..6th Jan., 1877
C.E., D.L.S.

Brown, David Rose, Cornwall.....10th Oct., 1850
D.L.S.

Brown, George Laing, Morrisburg.....19th Feb., 1898
Grad. S.P.S.

*Brown, John Smith Kemptville.....8th July, 1852
D.L.S.

Browne, Harry John, Toronto, 18 Toronto st..6th July, 1872
C.E.

Browne, William Albert, Toronto,
18 Toronto st.....10th April, 1876

Burt, Frederick Percy, New York, N.Y.....8th July, 1885
Manager and Treasurer Engineering News Pub. Co., 220 Broadway.

Butler, Matthew Joseph, Napanee,
P.O. Box 359.....11th Jan., 1878
M.I.C.E., Mem. Am. Soc. C.E., Mem. Can. Soc. C.E., C.E.

Byrne, Thomas, Sault Ste. Marie.....15th July, 1862
D.L.S.

Caddy, Cyprian Francis, Campbellford.....10th July, 1860
D.L.S.

Caddy, John St. Vincent, Ottawa, 559 King st..6th Oct., 1866
D.L.S.

Cameron, Alfred John, Peterborough.....9th April, 1889

Campbell, Archibald William, Toronto,
Parliament Building 10th April,1885
C.E. Provincial Instructor in Road Making.

Carpenter, Henry Stanley, B.A., Sc.
(Toronto Univ.), Collingwood ..... 25th Feb., 1899

Carre, Henry, Belleville, P.O. Box 203.....8th Nov., 1861
City Engineer, B.A. and C.E. (Trin. Coll., Dublin), D.L.S.

Carroll, Cyrus, Rat Portage.....10th Jan., 1860
Mem. Can. Soc. C.E., D.S. .L

Casgrain, Joseph Philippe Baby, Morrisburg...5th Jan., 1887
D.L.S., P.L.S., (Que.) C.E., Assoc. Mem. Can. Soc., C.E., Chief Eng. M. & P

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Cavana, Allan George, Orillia.....8th July, 1876
D.L.S.

Chalmers, John, Rat Portage.....14th April, 1896
Grad. S.P.S.

Charlesworth, Lionel Clare,
Port Arthur O. & R. R. Co.....14th April, 1896
Grad. S.P.S.

*Cheesman, Thomas, Mitchell.....11th July, 1856
D.L.S.

Chipman, Willis, Toronto, 103 Bay st.....4th Oct., 1881
B.A. Sc. (McGill), Mem. Am. Soc., Mem. Can. Soc. C.E.

Code, Abraham Silas, Alvinston.....14th April, 1896

Cozens, Joseph, Sault Ste. Marie.....7th July, 1875
D.L.S.

*Davidson, Alexander, Arkona.....11th Oct., 1858
D.L.S.

Davidson, Walter Stanley, Sarnia.....9th April, 1884

Davis, Allan Ross, Napanee .....8th Jan., 1886
B.A.Sc. (McGill.)

Davis, John, Alton.....5th April, 1878

Davis, William Mahlon, Berlin .....11th April, 1885
Grad. R. M. Coll., (Kingston), Town Engineer.

Deacon, Thomas Russ, Rat Portage.....12th Nov., 1892
Grad. S.P.S., Town Engineer.

Deans, William James, Oshawa.....11th July, 1884

DeMorest, Richard Watson, Sudbury.....9th April, 1889
M.E.

Dickson, James, Fenelon Falls.....6th April, 1867
D.L.S.

Dobbie, Thomas William, Tilsonburg.....11th July, 1856
D.L.S.

Dobie, James Samuel, Port Arthur.....21st Feb., 1898
B.A.Sc. (Toronto).

Doupe, Joseph, Winnipeg, Man.,
169 Edmonton st.....13th Jan., 1863
D.L.S., P.L.S. (Man.), C.E. (McGill).

Ducker, William A., Winnipeg, Man.,
334 Pacific ave.....6th April, 1882
D.L.S., P.L.S. (Man.)

Esten, Henry Lionel, Toronto, 157 Bay st....7th Jan., 1887

Evans, John Dunlop, Trenton.....8th July, 1864
D.L.S., C.E., Chief Eng. Cent. Ont. Ry., Eng. for Weddell Bridge & Engine Works.

Fair, John, Brantford.....13th April, 1875.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Fairbairn, Richard Purdom, Toronto, 127 Major st.....7th Oct., 1876
Surveyor for Dept. of Pub. Works.

Fairchild, Charles Court, Simcoe.....9th April, 1894
Grad. S.P.S.

Farncomb, Alfred Ernest, Fort William.....9th April, 1895

Farncomb, Frederick William, London, 213 Dundas st.....6th Nov., 1889

Fawcett, Thomas, Ottawa, Dept. of Interior...6th Jan., 1881
Dom. Topographical Surveyor.

Fitton, Charles Edward, Orillia, Box 142....10th April, 1879
D.L.S.

FitzGerald, James William, Peterborough, Box 333.....13th July, 1857
D.L.S.

Flater, Frederick William, Petrolea.....9th April, 1888

Ford, William Butterton, Hamilton, 42 James St. N. .....21st Feb., 1898

Francis, John James, Sarnia P.O., Box 304...16th Oct., 1861
D.L.S.

*Fraser, Charles, Wallaceburg.....5th Aug., 1847
D.L.S

Galbraith, William, Bracebridge.....4th April, 1883
D.L.S.

Gamble, Killaly, Toronto, 88 Charles st.....6th April, 1888
D.L.S., P.L.S. (Man.), Captain R.A. (Ret'd).

Gardiner, Edward, St. Catharines.....6th Jan., 1866
D.L.S.

Gaviller, Maurice, Collingwood, Box 164.....6th Jan., 1866
C.E. (McGill), D.L.S.

Gibbons, James, Renfrew.....15th April, 1890
Grad. S.P.S.

Gibson, Harold Holmes, Willowdale.....8th Sept., 1891

*Gibson, James Alexander, Oshawa.....7th April, 1855
D.L.S.

Gibson, Peter Silas, Willowdale.....19th July, 1858
C.E. M.S. (Mich. Univ.) D.L.S., Mem. Can. Soc. C.E., Engineer Tp. of York.

Gibson, Wilbert Silas, Willowdale.....21st Feb., 1898

Gillon, Douglas John, Fort Frances.....9th Nov., 1895
Grad. R.I.E. Coll.

Graydon, Aquila Ormsby, London.....8th July, 1880
City Engineer.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Griffin, Albert Dyke, Woodstock,
P.O. Box 612.....11th Nov., 1890

Hanning, Clement George, Preston,
Lock Box 130.....19th July, 1858
D.L.S., C.E, (Trin. Coll., Dublin).

Hart, Milner, Toronto, 103 Bay st.....11th July, 1863
D.L.S.

Harvey, Thomas Alexander, Steelton, Penn...13th Nov., 1893
C.E. (R.P.I., Troy, N.Y.)

Heaman, John Andrew, London,
Albion Building.....16th Nov., 1896

Henry, Frederick, London, Albion Building..7th April, 1887

*Hermon, Royal Wilkinson, Rednersville....13th July, 1857
D.L.S.

Hobson, Joseph, Montreal, G. T. Ry. Office..3rd Oct., 1855
D.L.S., Chief Eng. Grand Trunk Railway System.

Hopkins, Marshall Willard, Rat Portage....13th Nov., 1893
B.A.Sc. (McGill), Assoc. Mem. Can. Soc. C.E., Chief Engineer I.R.R. Co.

Hutcheon, James, Guelph.....10th Nov., 1891
Grad. S.P.S., City Engineer.

Irwin, James Moore, Rat Portage..... 13th Jan., 1863
D.L.S.

James, Darrell Denman, Toronto,
77 Victoria St. .....3rd Nov., 1891
B.A., B.A.Sc. (Toronto University).

James, Silas, Toronto, 77 Victoria st.....19th July, 1858
D.L.S.

Jones, Charles Albert, Petrolea.....8th April, 1881
D.L.S.

Jones, John Henry, Sarnia, Box 194 .....10th Oct., 1863
D.L.S.

Jones, Thomas Henry, Brantford.....10th Oct., 1878
City Engineer, B.A.Sc. (McGill). D.L.S.,

*Keefer, Thomas Coltrin, Ottawa.....14th Aug., 1840
D.L.S., C.E.

Kennedy, James Henry, Penticton, B.C. .....7th April, 1887
C.E. (Toronto University), Mem. Can. Soc. C.E., Engineer of V.V. & E. Ry.

Kippax, Hargreaves, Huron, South Dakota...7th July, 1877
C.E. (Toronto University), Assistant to Surveyor-General.

*Kirk, Joseph, Stratford P.O., Box 373.....16th Feb., 1843
D.L.S.

Kirkpatrick, George Brownly, Toronto,
Dept. of Crown Lands.....13th April, 1863
D.L.S., Director of Surveys.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Laird, James Stewart, Essex.....6th April, 1867
D.L.S.

Laird, Robert, Rat Portage.....11th Nov., 1887
Grad. S.P.S.

Lewis, John Bower, Ottawa, Brunswick House .....4th Oct., 1883
D.L.S., P.L.S. (Quebec), C.E.

Lougheed, Aaron, Port Arthur,.....12th Nov., 1888
D.L.S.

*Low, Nathaniel Edward, Wiarton.....11th July, 1856
D.L.S.

Lumsden, Hugh David, Toronto, 63 Homewood ave.....4th Jan., 1866
C.E., D.L.S., M I.C.E., Mem. Can. Soc. C.E.

Macdougall, Allan Hay, Port Arthur.....11th April,1859
D.L.S., Town Engineer.

Mackay, James John, Woodstock .....25th Feb., 1899

MacKenzie, William, Sarnia.....11th April, 1896
Grad. R.M.C. (Kingston).

MacKenzie, William Lyon, Cranbrook, B.C.....7th April, 1887
C.E.

MacPherson, Duncan, Montreal, P.Q.....9th Jan., 1884
Grad. R.M.C., M.I.C.E., Mem. Can. Soc. C.E., Div. Eng. Eastern Div. C.P. Ry.

McAree, John, Rat Portage.....6th April, 1867
Dominion Topographical Surveyor, B.A.Sc., (Toronto University).

*McCallum, James, Fort Frances.....30th Mar., 1849
D.L.S.

McCubbin, George Albert, St. Thomas, Box 423.....9th Nov., 1895
Asst. City Engineer.

McCulloch, Andrew Lake, Nelson, B.C.....10th Nov., 1888
Grad. S.P.S., Assoc. Mem. Can. Soc. C.E.

McDonell, Augustine, Chatham, 4 & 5 Ebert's Block.....11th July, 1863
D.L.S.

McDowall, Robert, Owen Sound.....11th Nov., 1890
Town Engineer, Grad. S.P.S.

McEvoy, Henry Robinson, St. Marys.....10th July, 1875
D.L.S.

McFadden, Moses, Neepawa, Man.....13th April, 1858
D.L.S., P.L.S. (Man.)

McFarlen, George Walter, Toronto, Court House.....11th Nov.,1889
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

McGeorge, William Graham, Chatham, Box 225.....8th Jan., 1866
D.L.S.

McGrandle, Hugh, Huntsville.....5th Jan., 1883
D.L.S.

McKay, Owen, Windsor, P.O. Box 167.....7th Jan., 1887
Grad. S.P.S., Chief Eng. D. & L. E. Ry.

McKenna, John Joseph, Dublin.....9th July, 1860
D.L.S.

McLatchie, John, Nelson, B.C.....9th Jan., 1864
D.L.S., P.L.S. (Que., Man. and B.C.).

McLean, James Keachie, Elora.....8th April, 1876
D.L.S.

McLean, William Arthur, Toronto, Parliament Buildings .....21st Feb., 1898
Secretary of Roads.

McLennan, Murdoch John, Williamstown...13th Nov., 1893
B.A.Sc. (McGill), D.L.S.

McLennan, Roderick, Toronto, 115 Avenue Rd.....20th June, 1846
D.L.S.

McNab, John Duncan, Owen Sound.....9th Oct., 1879

McNaughton, Finlay Donald, Cornwall..... 25th Feb., 1899

McPherson, Archibald John, Brockville.....10th April, 1897
B.A.Sc. (Toronto).

McPherson, Charles Wilfrid, Toronto.....21st Feb., 1899

McPhillips, George, Winnipeg.....9th July, 1885
D.L.S., P.L.S. (Man.)

Manigault, William Mazyck, Strathroy, P.O. Box 300.....8th July, 1876
D.L.S.

Marshall, James, Holyrood.....6th Oct., 1866
D.L.S.

Meadows, William Walter, St. Thomas.....21st Feb., 1898
Grad. S.P.S.

Miles, Charles Falconer, Rat Portage, Hilliard House.....13th Jan., 1862
D.L.S.

Miller, Frederick Fraser, Napanee.....8th Jan., 1885

Moore, John MacKenzie, London, Albion Building.....9th Oct., 1879

Moore, John Harrison, Smith's Falls.....11th Nov., 1889
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Morris, Alfred Edmund, Perth.....10th April, 1879

Morris, James Lewis, Pembroke.....7th July, 1886
D.L.S., C.E. (Toronto University).

Mountain, George Alphonse, Ottawa.....9th Jan., 1884
Mem. Can. Soc. C.E., D.L.S., P.L.S. (Que.) Chief Eng. Can. Atlantic and O.A. & B. Rys.

Murdock, William, Toronto, 37 Bloor St. E.....10th Jan., 1860
D.L.S., C.E.

Murphy, Charles Joseph, Toronto, 157 Bay st..6th Oct., 1886

Newman, John James, Windsor.....21st Feb., 1898

Newman, William, Windsor,
57 Sandwich st. w.....12th Nov., 1892
Grad. S.P.S.

Niven, Alexander, Haliburton.....8th July, 1859
D.L.S.

Ogilvie, William, Dawson City, Yukon Dist..12th July, 1869
D.L.S., Commissioner for Yukon District.

O'Hara, Walter Francis, Chatham.....14th April, 1892
D.L.S.

Paterson, James Allison, Hamilton,
53 Erie Ave.....5th April, 1878
C.E., Mem. Can. Soc. C.E.

Patten, Thaddeus James, Little Current.....5th Jan., 1883

Peterson, Peter Alexander, Montreal, P.Q...16th July, 1863
D.L.S., C.E., Mem. Can. Soc. C.E., Chief Engineer Can. Pac. Ry.

Pinhey, Charles Herbert, Ottawa,
630 Wellington ave.....12th Nov., 1888
D.L.S., Grad. S.P.S., Assoc. Mem. Can. Soc. C.E.

Proudfoot, Hume Blake, Sawbill .....6th Jan., 1882
D.L.S., C.E. (Toronto University).

Rainboth, Edward Joseph, Ottawa.....11th Nov., 1887
D.L.S.

Rainboth, George Charles, Aylmer, Que....11th July, 1868
D.L.S., P.L.S. (Que.)

Reinhardt, Carl, Montreal, 340 Mountain St....25th Feb., 1899
B.A.Sc. (McGill.)

Ritchie, Nelson Thomas, Dryden.....9th Nov., 1888

Roberts, Vaughan Maurice, St. Catharines...5th April, 1887

Robertson, James, Glencoe.....11th July, 1885
Grad. S.P.S.

Robinson, Franklin Joseph, Barrie.....21st Feb., 1898
Grad. S.P.S.

Roger, John, Mitchell.....10th Nov., 1888
Grad. S.P.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

*Rombough, William R., Toronto,
61 Walton St.....14th Nov., 1848
D.L.S.

Rorke, Louis Valentine, Sudbury.....14th April, 1890
D.L.S.

Ross, George, Welland.....10th July, 1879
B.A.Sc. (McGill), D.L.S.

*Rubidge, Tom S., Cornwall.....9th Feb., 1849
D.L.S., Asst. Eng. Dept. Rys. and Canals.

Russell, Alexander Lord, Port Arthur.....16th April, 1873
D.L.S.

Sankey, Villiers, Toronto, City Hall.....11th Jan., 1878
Grad. R.I.E. Coll., D.L.S., City Surveyor.

Saunders, Bryce Johnston, Fort William.....7th Jan., 1885
B.A.Sc. (McGill), D.L.S.

Scane, Thomas, Ridgetown.....7th Jan., 1865
D.L.S.

*Schofield, Milton C., Guelph.....28th Sept., 1843
D.L.S.

Schwitzer, John Edward, Rat Portage.....16th Nov., 1896
B.A.Sc. (McGill.)

Seager, Edmund, Rat Portage.....8th July, 1861
D.L.S.

Selby, Henry Walter, Dinorwic, C. P. Ry.....8th Jan., 1876
D.L.S.

Sewell, Henry DeQuincy, Rat Portage.....9th July, 1885
D.L.S., A.M.I.C.E.

Silvester, George Ernest, Sudbury.....12th Nov., 1892
Grad. S.P.S.

Sing, Josiah Gershom, Meaford, P.O. Box 3.....9th Jan., 1879
D.L.S.

Smith, Angus, Ridgetown.....14th April, 1896
Grad. S.P.S.

Smith, George, Woodville, Box 77.....7th April, 1881
Engineer for Co. Victoria and four Townships.

Smith, Henry, Toronto, Crown Lands Dept...8th Nov., 1861
Supt. Colonization Roads, D.L.S., Mem. Can. Soc. C.E.

Speight, Thomas Bailey, Toronto,
Yonge St. Arcade.....6th Jan., 1882
D.L.S.

Squire, Richard Herbert, Brantford,
30 Arthur st.....14th April, 1896
B.A. Sc. (Toronto University.)

Steele, Edward Charles, Port Arthur.....9th April, 1889

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Stewart, Elihu, Collingwood.....8th April, 1872
D.L.S.

*Stewart, George Alexander, Calgary, Alta....8th July, 1852
D.L.S.

Stewart, John, Montreal.....11th Nov., 1887
D.L.S.

Stewart, Walter Edgar, Aylmer.....12th April, 1892

*Strange, Henry, Rockwood.....30th Nov., 1838
D.L.S., C.E

Tiernan, Joseph Martin, Tilbury Centre.....7th Jan., 1886

Traynor, Isaac, Dundalk.....16th April, 1873
D.L.S.

Turnbull, Thomas, Winnipeg, Man.,
C. P. R. Office.....6th July, 1878
D.L.S., C.E. (Toronto University).

Tyrrell, James Williams, Hamilton,
42 James st. n.....8th April, 1885
Co. Eng. for Wentworth, C.E. (Toronto University), D.L.S.

*Unwin, Charles, Toronto, 126 Seaton st....12th April, 1852
D.L.S.

Ure, Frederick John, Woodstock.....7th April, 1887
C.E.

Van Buskirk, William Fraser, Stratford.....7th April, 1888
Grad. R. M. Coll.

Van Nostrand, Arthur J., Toronto,
Yonge St. Arcade.....30th Oct., 1882
D.L.S.

Wadsworth, Vernon Bayley, Toronto,
103 Bay st.....9th April, 1864
D.L.S.

Wagner, William, Ossowo, Man.....13th April, 1858
D.L.S.

Walker, Alfred Paverley, Toronto, Room 508,
Union Station, C. P. Ry., Eng. Office.....6th Jan., 1882
D.L.S., Mem. Can. Soc. C.E.

Wallace, Charles Hugh,
36 Dame St., Dublin, Ireland.....9th Nov., 1889
D.T.S., C.E. (Trin. Coll., Dublin),

Wallace, James Nevin, Hamilton,
119 Hunter St. N. .....21st Feb., 1898
B.A., B.E. (Trin. College, Dublin).

Ward, Archeson Thomas, Toronto,
Yonge St. Arcade.....10th April, 1897

Warren, James, Walkerton, Box 190.....7th Oct., 1864

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Watson, John McCormack, Orillia,
P.O. Box 224.....13th April, 1892

*Weatherald, Thomas, Goderich,
P.O. Box 273.....12th Jan., 1856
D.L.S., C.E.

West, Robert Francis, Orangeville.....7th April, 1881

Wheelock, Charles Richard, Orangeville.....7th Jan., 1886
Treasurer County of Dufferin.

Whitson, James Francis, Toronto,
Crown Lands Dept.....9th Jan., 1886

Wicksteed, Henry King, Cobourg.....7th Jan., 1886
D.L.S., C.E.

Wiggins, Thomas Henry, Cornwall.....10th Nov., 1891
Grad. S.P.S., D.L.S., Town Engineer.

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Stewart, John, Montreal.....11th Nov., 1887
D.L.S.

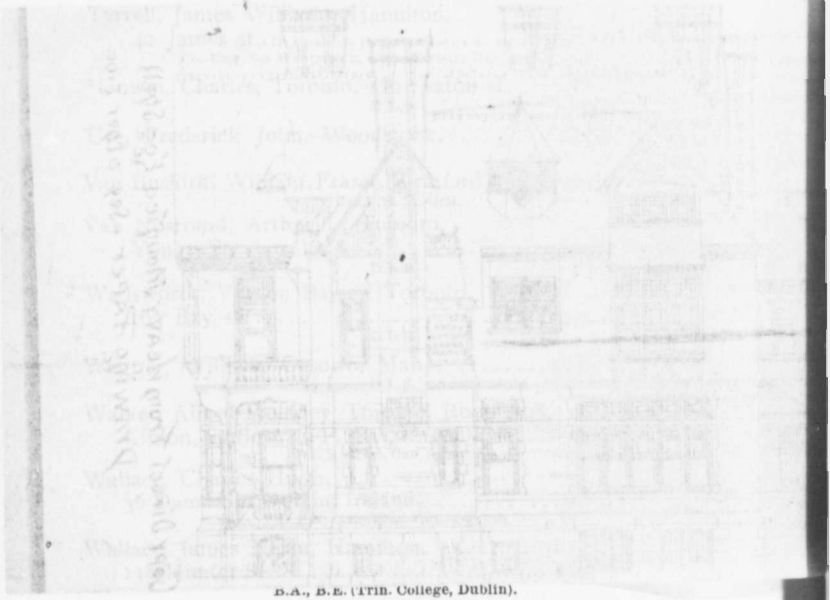
Stewart, Walter Edgar, Aylmer.....12th April, 1892

*Strange, Henry, Rockwood.....30th Nov., 1838
D.L.S., C.E

Tiernan, Joseph Martin, Tilbury Centre.....7th Jan., 1886

Traynor, Isaac, Dundalk.....16th April, 1873
D.L.S.

Turnbull, Thomas, Winnipeg, Man.,
C. P. R. Office.....6th July, 1878
D.L.S., C.E. (Toronto University).



B.A., B.E. (Trin. College, Dublin).

Ward, Archeson Thomas, Toronto,
Yonge St. Arcade.....10th April, 1897

Warren, James, Walkerton, Box 190.....7th Oct., 1864

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Watson, John McCormack, Orillia,
P.O. Box 224.....13th April, 1892

*Weatherald, Thomas, Goderich,
P.O. Box 273.....12th Jan., 1856
D.L.S., C.E.

West, Robert Francis, Orangeville.....7th April, 1881

Wheelock, Charles Richard, Orangeville.....7th Jan., 1885
Treasurer County of Dufferin.

Whitson, James Francis, Toronto,
Crown Lands Dept.....9th Jan., 1886

Wicksteed, Henry King, Cobourg.....7th Jan., 1886
D.L.S., C.E.

Wiggins, Thomas Henry, Cornwall.....10th Nov., 1891
Grad. S.P.S., D.L.S., Town Engineer.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

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*Stewart, George Alexander, Calgary, Alta....8th July, 1852
D.L.S.

Stewart, John, Montreal.....11th Nov., 1887
D.L.S.

Stewart, Walter Edgar, Aylmer.....12th April, 1892

*Strange, Henry, Rockwood.....30th Nov., 1838
D.L.S., C.E

Tiernan, Joseph Martin, Tilbury Centre.....7th Jan., 1886

Traynor, Isaac, Dundalk.....16th April, 1873
D.L.S.

Turnbull, Thomas, Winnipeg, Man.,
C. P. R. Office.....6th July, 1878

119 Hunter St. W. .....
B.A., B.E. (Trin. College, Dublin).

Ward, Archeson Thomas, Toronto,
Yonge St. Arcade.....10th April, 1897

Warren, James, Walkerton, Box 190.....7th Oct., 1864

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Watson, John McCormack, Orillia,
P.O. Box 224.....13th April, 1892

*Weatherald, Thomas, Goderich,
P.O. Box 273.....12th Jan., 1856
D.L.S., C.E.

West, Robert Francis, Orangeville.....7th April, 1881

Wheelock, Charles Richard, Orangeville.....7th Jan., 1885
Treasurer County of Dufferin.

Whitson, James Francis, Toronto,
Crown Lands Dept.....9th Jan., 1886

Wicksteed, Henry King, Cobourg.....7th Jan., 1886
D.L.S., C.E.

Wiggins, Thomas Henry, Cornwall.....10th Nov., 1891
Grad. S.F.S., D.L.S., Town Engineer.

Wilde, John Absalom, Sault Ste. Marie.....9th April, 1889

Wilkie, Edward Thomson, Carleton Place...11th April, 1891
D.L.S.

Williams, David, Kingston, 220 Queen St.....9 April, 1864
D.L.S.

*Winter, Henry, Thornyhurst.....11th July, 1853
D.L.S., C.E.

*Wood, Henry O., Billings' Bridge.....10th Oct., 1855
D.L.S.

*Yarnold, William Edward, Port Perry,
P.O. Box 44.....7th April, 1854
D.L.S.

REGISTERED AND WITHDRAWN.

The names of those who have become "Associates" under By-law No. 39 are marked*.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

Anderson, John Drummond, Trail, B.C.....13th April, 1892

Apsey, John Fletcher, Cumberland, Queen City Hotel, Md.....6th Jan., 1886
Grad. S.P.S.

Aylsworth, Charles Fraser, sr., Madoc .....2nd April, 1861
D.L.S.

Blake, Frank Lever, Toronto, Meteorological Office .....13th April, 1875
D.L.S.

Bell, Andrew, Almonte.....6th Oct., 1866
D.L.S.

*Bolton, Jesse Nunn, 264 Major St., Toronto.....6th April, 1867
D.L.S.

Booth, Charles Edward Stewart, Westmount, P.Q.....6th April, 1882

Bowman, Arthur Meyer, Mahan, Beaver Co., Pa.....11th Nov., 1887
Grad. S.P.S., Staff of U.S. Engineers.

Bowman, Franklin Meyer, Bellevue, Allegheny Co., Pa.....11th April, 1892
Grad. S.P.S., Engineer Structural Iron Works.

Brady, James, Victoria, B.C., Box 815.....15th July, 1862
M.E.

Burnet, Hugh, Victoria, B.C.....5th April, 1887
P.L.S. (B.C.).

Cambie, Henry John, Vancouver, B.C.....8th July, 1861
P.L.S. (B.C.).

Coleman, Richard Herbert, Toronto, Canada Co. Offices, Imperial Bank Chambers....6th Oct., 1877

Drewry, William Stewart, Ottawa, Dept. of the Interior .....5th April, 1883
D.L.S.

Edwards, George, Thurso, Que.....6th Jan., 1866
D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

*Ellis, Henry Disney, Kuching, Sarawak, Borneo ..... 7th April, 1877
D.L.S., Commr. of Pub. Works and Surveys.

Galbraith, John, Toronto, School of Prac. Science..... 13th April, 1875
M.A., D.L.S., Prof. Engineering, S.P.S.

Gibson, George, St. Catharines..... 10th April, 1860
D.L.S.

*Gilmore, Robert, Toronto, 294 Huron st.... 11th April, 1856
D.L.S., C.E

Green, Thomas Daniel, Ottawa, Dept. of Indian Affairs..... 7th Jan., 1885
D.L.S.

*Harris, John Walter, Winnipeg, Assm't Com. Dept..... 6th Oct., 1866
P.L.S. (Man.), D.L.S.

Henderson, Eder Eli, Henderson P.O., Maine ..... 7th April, 1887
Grad. S.P.S.

Hermon, Ernest Bolton, Vancouver, B.C..... 7th Oct., 1885
P.L.S. (B.C.), D.L.S.

Innes, William Livingstone, Simcoe,..... 14th April, 1892
C.E. (Toronto Univ.)

Jephson, Richard Jermy, Calgary, Alta..... 7th April, 1877
P.L.S. (B.C.), D.L.S.

Johnson, Sydney Munnings, Greenwood, B.C..9th Nov., 1895

Johnston, Robert Thornton, 944 Amsterdam ave., New York, N.Y..... 9th April, 1899

Kains, Tom, Victoria, B.C..... 11th July, 1873
D.L.S., P.L.S. (B.C.).

*Klotz, Otto Julius, Ottawa, 437 Albert st..... 6th Jan., 1876
C.E. (Mich. Univ.), Dominion Topographical Surveyor.

Lane, Andrew, Sparrow's Point, Md..... 4th April, 1895
Grad. S.P.S., Draftsman Maryland Steel Co.

Lendrum, Robert Watt, South Edmonton, Alta..... 8th Jan., 1874
D.L.S.

Livingstone, Thomas Chisholm, Winnipeg, Man..... 10th Jan., 1859
D.L.S.

MacLeod, Henry Augustus F., Ottawa, 340 Cooper st..... 11th Oct., 1856
C.E., D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

*McMullen, William Ernest,, St. John, N.B..11th Nov., 1892
Asst. Eng. C. P. Ry.

Magrath, Charles Alexander, Lethbridge, Alta..1st Nov., 1881
B.A.Sc. (McGill), D.L.S., P.L.S. (B.C.).

Moore, Thos. Alexander, London South....12th Nov., 1892

Munro, John Vicar, New York, N.Y.,
359 West 31st st.....9th April, 1895

Pearce, William, Calgary, Alta.....12th Oct., 1872
D.L.S., P.L.S. (B.C.).

Ponton, Archibald William, Ottawa,
Dept. of Interior.....9th April, 1880
D.L.S.

Pope, Robert Tyndall,——— Ireland.....13th April, 1875
C.E., D.L.S.

Purvis, Frank, Mesa City, Arizona.....7th April, 1875

Reid, James Hales, Bowmanville, Box 35.....6th Oct., 1860
C.E., F.G.S.

Reid, John Lestock, Prince Albert, Sask.....8th April, 1870
D.L.S.

Reiffenstein, James Henry, Ottawa,
Dept. of the Interior .....16th April, 1873
D.L.S.

Reilly, William Robinson, London,
361 Simcoe st.....7th April, 1881
D.L.S., P.L.S. (Man.)

Rogers, Richard Birdsall, Peterborough.....9th Jan., 1879
B.A.Sc. (McGill), D.L.S.

Ross, Joseph Edmund, New Westminster,
B.C. .....11th Nov., 1890
P.L.S. (B.C.).

Sanderson, Daniel Leavens, Coral, Mich.....4th Oct., 1882

Shaw, Charles Æneas, Greenwood, B.C.....6th Oct., 1877
P.L.S. (B.C.).

Sherman, Ruyter Stinson, Vancouver, B.C..12th April, 1890
P.L.S. (B.C.).

Simpson, George Albert, Winnipeg Man.....7th Oct., 1864
C.E., D.L.S., M.P.

Spry, William, Toronto.....19th July, 1858
C.E., D.L.S.

*Stewart, Louis Beaufort, Toronto,
School of Prac. Science.....6th April, 1882
Dominion Topographical Surveyor, Lect. in Surveying.

Strathern, John, Vancouver, B.C.....5th Oct., 1876
P.L.S. (B.C.), D.L.S.

NAME AND P.O. ADDRESS. DATE OF ADMISSION BY BOARD.

*Taylor, William Verner, Anaconda, B.C.....7th Nov., 1896
Grad. S.P.S

Tracey, Thomas Henry, Vancouver, B.C.....8th April, 1870
P.L.S. (B.C.), C.E., D.L.S.

Vicars, John Richard Odlum, Kamloops, B.C..5th Jan., 1887
D.L.S., P.L.S. (B.C.).

Weekes, Abel Seneca, Westaskiwin, Alta....12th April, 1890
D.L.S.

Wheeler, Arthur Oliver, New Westminster, B.C. .....8th July, 1881
P.L.S. (B.C.), D.L.S.

Willson, Alfred, Toronto, Can. Co. Offices, Imperial Bank Chambers.....6th Oct., 1866
D.L.S., Commissioner Canada Company.

Wilkins, Frederick William, Ottawa, Dept. of the Interior.....6th Jan., 1877
Dominion Topographical Surveyor.

SUMMARY.

Active members subject to dues.....	202
Active members exempted from dues	20
Withdrawn from practice (including 8 Associates)	61
Dead	26
Total number enrolled since incorporation.....	309

Deceased Members.

NAME.	LATE RESIDENCE.	DATE OF P.L.S. CERTIFICATE.	DATE OF O.L.S. REGISTRATION.	DIED.
Bolger, Francis	Lindsay	10th October, 1863	1892	3rd November, 1895.
Bowman, Leander Meyer	Toronto	14th April, 1892	1892	20th September, 1895.
Burke, William Robert	Ingersoll	5th April, 1878	1892	10th June, 1897.
Caddy, Edward C.	Cobourg	18th December, 1846	1892	26th September, 1897.
Coad, Richard	Glencoe	8th October, 1879	1892	17th May, 1897.
Creswicke, Henry	Barrie	8th July, 1864	1892	22nd January, 1898.
Cromwell, Joseph M. O.	Perth	1st October, 1846	1892	19th October, 1897.
Deane, Michael	Windsor	26th May, 1848	19th December, 1892.	3rd April, 1897.
DeGurse, Joseph	Windsor	5th April, 1883	1892	22nd March, 1898.
Foster, Frederick Lucas	Toronto	9th April, 1863	1892	27th July, 1899,
Fowlie, Albert	Orillia	13th January, 1863	1892	——April, 1898.
Gibbs, Thomas Fraser	Adolphustown	31st May, 1841	1892	17th April, 1893.
Gilliland, Thomas Brown	Eugenia	11th July, 1868	25th January, 1896	14th December, 1898.
Haskins, William	Hamilton	5th July, 1855	1892	5th July, 1896.
Hewson, Thomas Ringwood	Hamilton	6th July, 1877	1892	21st October, 1898.
Howitt, Alfred	Gourock	12th January, 1856	1892	6th May, 1896.
Lynch-Staunton, Francis H.	Hamilton	11th October, 1856	1892	11th June, 1899.
MacMillan, James Alexander	Calgary	6th January, 1877	24th December, 1894	——— ———, 1898.
MacNab, John Chisholm	Hamilton	8th January, 1880	1892	16th October, 1897.
Malcolm, Sherman Morgan	Blenheim	11th October 1858	1892	13th January, 1899.
Ogilvie, John Henry	Rat Portage	8th April, 1876	24th April, 1894	21st September, 1898.
Pedder, James Robert	Doon	10th November, 1891.	23rd December, 1892.	17th January, 1897.
Robinson, William	London	——May, 1846	1892	11th October, 1894.
Thomson, Augustus Clifford	Chicago	14th January 1861	1892	—— December, 1896.
Walsh, Thomas William	Simcoe	25th April, 1842	1892	14th March, 1895.
Wheelock, Charles John	Orangeville	——— ———, 1856	1892	4th July, 1897.

OBITUARY.

FREDERICK LUCAS FOSTER.

Our Vice-President Frederick Lucas Foster, whose decease we record with deep regret, was the son of Mr. Colley Foster, Barrister, and grandson of Colonel Foster, sometime Commander of Her Majesty's forces in Upper Canada. He was born in Toronto, on February 21st, 1842. After receiving his early education at Upper Canada College, he was for some time attached to the Military School in Toronto, and was a member of the Trinity College Rifle Corps. Having decided to embrace the profession of Land Surveyor, he was apprenticed to Mr. Charles Unwin, his cousin, on October 11th, 1858, and during his apprenticeship he was frequently occupied on government work with his eminent master. After completing his course with Mr. Unwin, and passing the requisite examination, he was sworn in as a Provincial Land Surveyor on April 9th, 1863. He commenced his professional career at Windsor, Ontario, in 1865. A good deal of Township work was entrusted to him, and the Government also employed him on the survey for defining the boundary between Canada and the United States along the St. Clair River. He was a member of the Council of Ontario Land Surveyors from 1895 to 1899. Mr. Foster was distinguished as a draughtsman, and made a plan of North America for the Ontario Government in 1884.

He was admitted as a member of the Ontario Society of Artists in 1888, and was for several years one of their Executive Council. Evidence of his ability as an artist have frequently appeared in the Annual Reports of the Land Surveyor's Proceedings.

In 1872 he married a daughter of Colonel D. D. Broadhead, of Boston, Mass., and two daughters, who survive him, were born of this union. His wife died in 1887.

Mr. Foster's simplicity of character, honesty of purpose and dignified gentlemanly bearing, are borne witness to by all who knew him; and in private life his gentleness and unselfish kindliness, endeared him to all with whom he has associated.

He died at Toronto, on July 27th, 1899.

FREDERICK LUCAS FOSTER.

FRANCIS HARDWICK LYNCH-STAUNTON.

Francis Hardwick Lynch - Staunton, the second son of George S. Lynch-Staunton, D.L., of Clydagh was born at his father's residence in Galway, Ireland, on August 15th, 1828. He was educated at the famous seminary of St. Mary's, Oscott, England.

He came to Canada in 1854, and received his commission as P.L. S. in October 1856. He practised as a Land Surveyor and Civil Engineer in the County of Bruce for ten years. He was also a Dominion Land Surveyor and was frequently employed in the North-West on Government work, between 1871 and 1883. He resided in West Flamboro', from 1865 to 1876, and in the latter year he went to Hamilton, where he continued to reside and practice his profession until his decease on June 11th, 1899. While in Hamilton, he was engineer in charge of the building of the old high level bridge, and of the H. and D. Railway. In 1860 he was appointed Lt.-Colonel of the 1st Battalion of the Co. of Bruce Militia. He was married to a daughter of the late George Corbett, of Kingston, and left nine children.

BY-LAWS OF THE

Association of Ontario Land Surveyors

AS REVISED 1899

(To take the place of all previous By-laws passed by the Association.)

Definitions in the following By-laws as defined by the "Ontario Land Surveyors' Act." Definitions

The word	"Association"	means	The Association of Ontario Land Surveyors.
"	"Council"	"	The Council of Management.
"	"Board"	"	The Board of Examiners.
"	"Chairman"	"	The Chairman of Council.
"	"Secretary"	"	The Secretary-Treasurer.

PREAMBLE.

The following By-laws are enacted under the powers granted by the Act respecting Land Surveyors"—Cap. 180, R. S. O., 1897. Authority for By-Laws.

THE ASSOCIATION.

1. The Annual General Meeting of the Association shall be held (as provided by the said Act) in the City of Toronto, on the fourth Tuesday in February in each year, at such place as may be selected by the Council. Annual Meeting of Association.

2. Special meetings of the Association may be called by the President, or shall be called by him at the written request of ten or more members. Special Meetings.

3. Due notice of such meetings shall be given by the Secretary to each member of the Association by circular letter posted to his registered address at least 10 days before any such meeting. Notice to be given by Secretary.

4. Fifteen members shall form a quorum at any meeting of the Association for the transaction of business. Constitution of quorum.

THE COUNCIL.

5. In addition to the duties assigned to the Council by the said Act, it shall have the direction and management of all the affairs of the Association, and shall appoint the several Standing Committees and name the Chairman of each. Duties of Council

Regular Meetings of Council.

6. There shall be two regular meetings of the Council in each year, one to be held during the annual meeting of the Association, and one on the third Tuesday in April.

Special Meetings of Council.

7. Special meetings may be called by the President or Chairman.

Notice to be given by Secretary.

8. Due notice of every such meeting shall be given by the Secretary to each member of the Council.

Constitution of quorum.

9. At any meeting of the Council when business relating to the property or to the financial affairs of the Association is transacted, five members shall form a quorum; for the transaction of any other business three shall form a quorum.

Annual Report of Council.

10. The Council shall make a report of the affairs of the Association at the Annual Meeting, which report shall include the report of the Secretary and also of the Board of Examiners.

Board of Examiners to report to Council.

11. The Board of Examiners shall make a report to the Council at the Annual Meeting of the Association in each year.

STANDING COMMITTEES.

Standing Committees.

12. The Standing Committees shall be as follows: Each shall be composed of not less than 5 and not more than 9 members.

Committee on Land Surveying.
" Drainage.
" Engineering.
" Topographical Survey.
" Entertainment.
" Publication.

Duty of Standing Committees.

13. Each Standing Committee appointed by the Council shall endeavor to advance the interests of the Association in that branch allotted to it.

Provision for Meetings.

Meetings of any Standing Committee shall be held at the call of the Chairman, three members to form a quorum.

Standing Committees to report to Association.

Each Standing Committee shall present to the Association, or to the Council, an Annual Report on the work done by said Committee.

ORDER OF BUSINESS AT MEETINGS OF ASSOCIATION.

Order of Business.

14. The following shall be the order of business at the meetings of the Association:—

1. Reading of minutes of previous meeting.
2. Reading of correspondence.
3. Reports and papers.
4. Unfinished business.
5. New business.
6. Nomination of officers (if at the General Annual Meeting).
7. Adjournment.

RULES.

Procedure.

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

Reports of Committees.

16. Reports of Committees must be in writing and signed by the Chairman thereof.

Rules of speech.

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

Discussion Closed.

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

Majority vote may re-open any motion.

19. Any motion may be re-opened by a majority vote of those present.

Appointment of Scrutineers.

20. The Chairman of the meeting shall appoint two scrutineers when a ballot is taken, as defined in sec. 22 hereof.

Speakers to Address the Chair.

21. Every member while speaking shall address the Chairman.

Voting at General or Annual Meetings.

22. All voting at any General or Annual Meeting shall be by standing vote, unless a ballot be demanded by at least two members.

Parliamentary rules to govern.

23. Parliamentary rules to govern in all cases not provided for in preceding sections.

DUTIES OF OFFICERS.

Presiding officer at Association meetings.

24. The President, or in his absence the Vice-President, shall preside at all meetings of the Association; in the absence of both, the meeting shall appoint a Chairman.

Presiding officer at Council Meetings.

25. The Chairman shall preside at all meetings of the Council; in his absence the meeting shall appoint a presiding officer.

Duties of Secretary-Treasurer.

26. In addition to the duties assigned to him by the said Act, the Secretary-Treasurer shall keep an accurate record of the proceedings at all meetings of both the Association and the Council in separate books, conduct all correspondence, announce all meetings, report the result of elections to the Commissioner of Crown Lands, the officers of the Association and the candidates for election, receive all fees and subscriptions and other moneys. He shall, under the direction of the Council, deposit all moneys in such bank or other financial institution as it may select. He shall pay no bills unless sanctioned by the Council and signed by the Chairman. All payments of $10.00 and upwards to be made by cheque, signed by the Secretary and countersigned by the President, or in his absence by the Chairman of the Council. He shall submit an account of all moneys received and paid by him under the said Act and these By-laws to the Council at the Annual General Meeting of the Association, and shall perform such other duties as may from time to time be assigned by the Council or the Association.

The Sec-Treas. to give bond. Where they shall be deposited.

27. The Secretary-Treasurer shall give a bond in the usual form to the amount of $1,000, such bond to be in the custody of the President, and deposited in the bank where the funds of the Association are kept.

EXAMINATIONS.

Examination of candidates for apprenticeship.

28. Candidates for admission to apprenticeship are to be examined as follows, in the subjects prescribed in Rev. Stat. Ont., c. 180, s. 22; and no candidate shall be admitted unless he obtains at least the minimum marks set opposite each subject, and at least a total of 550.

Subject.	Max. Marks.	Min. Marks.
1. Penmanship	50	30
2. (*a*) Orthography (including dictation)	50	40
(*b*) English Grammar	50	25
3. Arithmetic (Fractions, Decimals, Square Root)	100	60
4. Logarithms and Algebra (including Equations 1st degree)	100	60
5. Euclid (Books 1, 2, 3 and 4)	100	60
6. Plane Trigonometry and Rules for Spherical	100	50
7. Mensuration of Superficies	50	30
8. Linear Drawing (use of ruling pen and construction of scales)	50	25
9. Canadian and General Geography	50	25
10. Canadian History	50	25

Examination of candidates for admission to practice.

29. Candidates for admission to practice are to be examined as follows in the subjects prescribed in Rev. Stat. Ont., c. 180, s. 25; and no candidate will be admitted unless he obtains at least the minimum marks set opposite each subject, and at least a total of 1,000.

Subject.	Max. Marks.	Min. Marks.
1. Geometry, including the first 6 books of Euclid, excepting the last thirteen propositions of the fifth book	100	50
2. Algebra (simple and Quadratic Equations, Progressions and Exponents)	100	50
3. Trigonometry (Plane and Spherical)	100	60
4. Mensuration of superficies and laying out and dividing land	150	75
5. Descriptions by metes and bounds	100	75
6. Use and Adjustment of Instruments for surveying and levelling	100	70
7. Laying out of Curves	50	30
8. Practical Astronomy, including finding of Time, Latitude, Longitude, Azimuth, Variation of Compass, and drawing Meridian Lines	150	90
9. Survey Act	150	90
10. Mines Act, Registry Act, Municipal Act, (so far as they relate to surveys and drainage), Ditches and Water-courses Act	100	50
11. Levelling	50	35
12. Principles of Evidence and drawing up Affidavits.	80	40
13. Taking of Field notes and preparing of Plans	100	60
14. Geology and Mineralogy, (rudiments of)	75	40
15. Elementary Botany and the Forest Flora of Canada	50	25

30. If a candidate for admission to practice obtains at least the total of 1,000 marks, but fails to obtain the minimum marks in, at least, two of the subjects, such candidate may at a subsequent examination be examined only in the two subjects in which he has failed.

The Board to regulate examinations.

31. The Board may make, from time to time, such regulations as it considers necessary for the proper carrying out of these examinations.

Complaints against members or any unlicensed practitioner to be filed with Secretary.

32. Any complaint against a member of the Association or against any unlicensed practitioner shall be filed with the Secretary, who shall immediately forward the same to the Chairman.

The Chairman may call a special meeting.

If the matter complained of is of a serious and pressing nature, the Chairman may, at his discretion, call a special meeting of the Council for the purpose of hearing said complaint; if not so acted on, the complaint shall be heard at the next regular meeting of the Council.

Procedure where the delinquent is a member.

In the case of a member of the Association, the Council shall take action as defined in the said Act.

Procedure where the delinquent is an unlicensed practitioner.

In the case of any unlicensed practitioner, the Council, if satisfied as to the justice of the charge, shall name a prosecutor and direct him as to his action in the conduct of the case, and shall allot such portion of the penalties, or authorize the payment of such fees as it may deem expedient.

The Council has power to pass By-laws.

33. The Council shall have power to pass any By-law which it deems expedient for the good of the Association, and such By-law shall have the same force until the next Annual Meeting, as if it had been passed by the Association. Such By-law must be reported to the Association at the next Annual Meeting, and the action taken thereon. All members of the Association shall be notified by the Secretary of the passing of such By-law by the Council.

34. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Henry Strange, Milton C. Schofield, William Robinson, Joseph Kirk, Charles Fraser, Joseph M. O. Cromwell, H. O. Wood, F. H. Lynch-Staunton and E. C. Caddy.

35. The annual fees to this Association paid by candidates admitted to practice at the session of the Board in February in any year shall cover the annual dues for the remainder of the then current Association year, and for the Association year immediately following the same.

36. Grants exemption from dues under 55 V. c. 34, s. 10 (4), to Thomas Coltrin Keefer, Nathaniel Edward Low, Thomas Cheesman, James McCallum and Thomas W. Walsh.

37. Grants exemption from dues under 55 V. c. 34, s. 10 (4), to Royal Wilkinson Hermon.

38. Reduced the number of minimum marks in the subject of "Levelling." (Obsolute.)

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."

40. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Tom S. Rubidge and James A. Gibson.

41. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Charles J. Wheelock, Thomas Weatherald, Michael Deane, John Smith Brown, and William Edward Yarnold.

42. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Alexander Davidson.

43. Grants exemption from dues, under 55 V. c. 34, s. 10 (4), to Charles Unwin, Wm. R. Rombough and Henry Winter.

44. Changes the name of "Committee on Topographical Surveying" to "Committee on Topographical Survey."

45. Whereas any registered surveyor desiring to give up practice can have his name removed from the list of practitioners 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 Asociation, therefore it is hereby enacted that such surveyors shall have the aforesaid privileges upon the payment of an annual fee of one dollar, and their names shall be printed in the list of members in the annual report of the Association and properly marked.

46. Grants exemption from dues, under 55 V c. 34, s. 10 (4), to George Alexander Stewart.

RULES AND REGULATIONS

OF THE

Board of Examiners for Ontario Land Surveyors.

Adopted by the Board of Examiners.

1. The examination sittings shall commence each day at 9.30 a.m., continue until 12.30 p.m., recommence at 1.30 p.m., and continue until 4.30 p.m., day by day until completed, subject to the direction of the Board.

2. All the papers will be collected at the close of each sitting, and candidates will not be permitted to write on any question on such papers at any future sitting.

3. Any candidate obtaining assistance, during the hours of examination, by copying the papers of another candidate, or otherwise, will at once be dismissed, and any candidate who shall permit such copying or give such assistance, will be considered equally guilty and treated similarly.

4. The candidate shall sign each sheet and mark on the top the number thereof and of the subject or group of subjects. He shall mark in the margin the number opposite each question, and shall attach the several sheets, together with the examination paper, to the cover provided for that purpose.

5. The candidate shall not write on one line more than one step in geometrical or algebraic work. A single step may cover several lines, but two or more should in no instance be put on the same line. They should be written thus:

Because $A = B$
And $B = C$
Therefore $A = C$

6. No other person than the examiners, the secretary and the candidates shall be admitted into the examination room unless by permission of the Board.

7. No books or diagrams of any kind, except those allowed by the Board, shall be brought into the examination room.

8. Candidates are to present themselves punctually at the hours appointed for the commencement of the examinations, and no candidates will be allowed to enter the examination room later than fifteen minutes after that time, nor will any candidate be permitted to leave the room during a sitting, but so soon as he has finished his papers he may hand them to the secretary, after which he will not be allowed to re-enter until the next sitting.

9. A candidate rejected by the Board shall not be entitled to a new examination before the next regular meeting of the Board.

10. Each candidate for "Admission to Practice" shall bring with him an instrument suitable for taking the necessary observations required in sec. (8), By-law 29, which he shall submit to the Board for their examination and approval, and he shall also submit a plan and field notes of a survey, both made by himself, which may be filed with his papers.

11. Each candidate for Admission to Apprenticeship shall bring with him a ruling pen and scale.