



— Γεωμετρῆς Αγωνιστῆς —

PROCEEDINGS
OF THE
ASSOCIATION OF
Provincial Land Surveyors
OF ONTARIO,

AT ITS FIRST ANNUAL MEETING HELD AT TORONTO,
FEBRUARY 23RD, 24TH, AND 25TH.

1886.

*The Second Annual Meeting will be held at Toronto on Tuesday, 22nd February,
1887.*

PRINTED FOR THE ASSOCIATION
BY
C. BLACKETT ROBINSON, 5 JORDAN STREET,
TORONTO.



Association of Provincial Land Surveyors

— OF ONTARIO. —

ORGANIZED 23rd FEBRUARY, 1886.

OFFICERS FOR 1886-87.

President,

George B. Kirkpatrick, P.L.S., Crown Lands Dep't, Toronto.

Vice-President.

John Galbraith, M.A., A.M. Inst. C.E., School Practical Science, Toronto.

Secretary-Treasurer.

Willis Chipman, B.A.Sc., Brockville.

Councillors.

Matthew J. Butler, A.M. Inst. C.E., M. Am. Soc. C.E., Napanee.

Elihu Stewart, P.L.S., Collingwood.

Villiers Sankey, P.L.S., Toronto.

Auditors.

George Brockitt Abrey, P.L.S., Toronto.

Lewis Bolton, P.L.S., Listowel.

Bankers.

Bank of Montreal.

Standing Committees.

LAND SURVEYING.—P. S. Gibson (Chairman); T. O. Bolger, R. Coad, J. H. Jones, Alex. Niven, Wm. Ogilvie, V. Sankey, E. Stewart, T. B. Speight, Chas. Unwin, A. C. Webb.

DRAINAGE.—H. B. Proudfoot (Chairman); J. L. Bowman, W. R. Burke, R. H. Coleman, Joseph Kirk, J. S. Laird, W. G. McGeorge, I. Traynor.

ENGINEERING.—J. Galbraith (Chairman); H. J. Browne, M. J. Butler, J. D. Evans, Wm. H. Furlonge, E. Gardiner, T. H. Jones, T. C. Keefer, H. D. Lumsden, Chas. Sproatt.

INSTRUMENTS.—G. B. Abrey (Chairman); F. L. Blake, Edgar Bray, Thomas Fawcett, O. J. Klotz, J. McAree, Hugh Wilson.

LEGISLATION.—G. B. Kirkpatrick (Chairman); Thos. Byrne, E. Stewart, V. Sankey.

PUBLICATION.—W. Chipman (Chairman); J. McAree, A. J. VanNostrand, A. W. Campbell.



PREFACE.

THE Provisional Executive Committee have considered it proper that the Report of Proceedings of the first meeting of the Association of Provincial Land Surveyors of Ontario should be prefaced by a statement of the circumstances which led to its organization.

Early in December, 1885, a correspondence was carried on between Willis Chipman, of Brockville, and the conveners of the meeting held in Toronto on 23rd February, which correspondence resulted in the issuing of the following circular to the Land Surveyors of the Province:—

CIRCULAR.

We, the undersigned Provincial Land Surveyors, deem it advisable, for the purpose of improving ourselves and maintaining and elevating the standard of our profession, to organize an Association of Provincial Land Surveyors in Ontario.

We request your earnest co-operation. Associations of this kind are now in successful operation in many of the States, and are doing a great work, and we feel that if we do not wish to fall behind in the race we must follow their example.

A meeting for organization will be held at Toronto, on Tuesday, 23rd February, 1886, at 2 p.m. Arrangements have been made for meeting in the Crown Lands Department.

It is desirable that all P. L. Surveyors should attend this meeting, that a Constitution may be adopted that will meet with the approval of the majority of the profession. Those who may find it impossible to attend will oblige the conveners by communicating their views to Willis Chipman, Brockville, Secretary *pro tem*.

Conveners: Otto J. Klotz, G. B. Kirkpatrick, T. H. Jones, Jno. M. Moore, P. S. Gibson, G. B. Abrey, M. J. Butler, Lewis Bolton, Prof. Galbraith, Alex. Niven, Edgar Bray.

At this Convention a Constitution and By-laws were adopted, which are embodied in this Report of Proceedings.

The meeting was a very enthusiastic one, and thoroughly representative. Many letters of encouragement and hearty approval were received by the Secretary from members of the profession who were unable to be present.

All the papers published in this Report were prepared upon only two weeks' notice, and the Committee takes this opportunity of thanking the members who so kindly volunteered them.

To our exchanges we may state that our first Report of Proceedings is necessarily very imperfect, but we hope that next year we may be in a position to publish something of more interest.

Signed on behalf of the Provisional Executive Committee.

WILLIS CHIPMAN.

CONSTITUTION AND BY-LAWS
OF THE
Association of Provincial Land Surveyors
OF ONTARIO.

CONSTITUTION.

ARTICLE I.

NAME OF THE ASSOCIATION.

This Association shall be known as "The Association of Provincial Land Surveyors of Ontario."

ARTICLE II.

OBJECTS OF THE ASSOCIATION.

The objects of this Association shall be the promotion of the general interests, and elevation of the standard of the profession.

ARTICLE III.

MEMBERS.

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

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

3. Articled pupils may become Associate Members.

4. Honorary Members shall be those persons only who are distinguished by professional attainments. They shall be exempt from dues.

ARTICLE IV.

OFFICERS.

1. The Officers of the Association shall consist of a President, a Vice-President, a Secretary-Treasurer, and three Councillors, who shall constitute an Executive Committee, which shall have the direction and management of the affairs of the Association.

2. The meetings of the Executive Committee shall be held at the call of the President or Secretary-Treasurer.

3. The Executive Committee shall, as soon after its election as possible, strike the several Standing Committees.

4. Three members of Committee shall form a quorum.

ARTICLE V.

ELECTION OF MEMBERS.

1. Any Provincial Land Surveyor shall be eligible as a Member of this Association upon payment of the necessary fees.

HONORARY MEMBERS.

2. Candidates for election as Honorary Members must be recommended by at least two Members.

ASSOCIATE MEMBERS.

3. Candidates for election as Associate Members must be recommended by at least two Members.

VOTING FOR MEMBERS.

4. All voting for the election of Honorary and Associate Members shall be by ballot and at a General Meeting of the Association.

5. A majority of the ballots cast shall decide.

ARTICLE VI.

ELECTION OF OFFICERS.

1. The nomination of Officers shall be made at the General Annual Meeting.

2. The voting for Officers shall be by letter ballot, which ballot will be issued by the Secretary-Treasurer to all Members on or before 15th day of March in each year.

3. The ballots are to be returned to Secretary-Treasurer on or before 1st day of April in each year and opened by him.

4. Ballots are to be retained by Secretary-Treasurer, and submitted at the next General Meeting to Scrutineers.

5. Candidates and retiring Officers are to be notified by the Secretary-Treasurer of result of election.

6. The Secretary-Treasurer is to have vote only in case of a tie.

ARTICLE VII.

MEETINGS.

1. The General Annual Meeting shall commence on the Fourth Tuesday in February, in the City of Toronto.

2. Special Meetings of the Association may be called by the President, and shall be called by him at the request in writing of ten or more active Members.

3. The Secretary-Treasurer shall give at least one month's notice to all Members, of any Special Meeting to be held.

4. Fifteen active Members shall form a quorum at any meeting for the transaction of business.

ARTICLE VIII.

AMENDMENTS TO CONSTITUTION.

1. This Constitution may be amended by a two-thirds vote of the active Members of the Association, such vote to be taken by letter ballot.

2. Any amendment of the Constitution must first be proposed at the General Annual Meeting, and be favourably considered at such meeting before being voted upon.

3. The Secretary-Treasurer shall then prepare letter ballots, specifying the amendment proposed, and issue the same to the Members of the Association at the same time as the letter ballots for the election of Officers.

4. Sub-sections 3, 4, and 6, of Article VI. of this Constitution, are to be read as Sub-sections 4, 5, and 6 of Article VIII.

ARTICLE IX.

AUDITORS.

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

ARTICLE X.

SUBSCRIPTIONS.

1. The fee for Membership for Active Members and Associate Members shall be \$3, and an annual subscription of \$2 for each subsequent year; both payable in advance.

2. The Association Year shall begin on the 1st day of April in each year, and annual subscriptions must be paid to Secretary-Treasurer on or before that date.

3. Any Member twelve months in arrears shall be struck off the roll, and no Member in arrears shall be allowed to vote.

BY-LAWS.

I.—ORDER OF BUSINESS.

1. Reading of minutes of previous meeting.
2. Reading correspondence and accounts.
3. Reports.
4. Unfinished business.
5. Nomination of Officers (if at the General Annual Meeting).
6. New business.
7. Adjournment.

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

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

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

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

VI.—The Chairman shall appoint two Scrutineers when a ballot is taken.

VII.—Every Member while speaking shall address the Chair.

VIII.—Parliamentary rules to govern in all cases not provided for in preceding sections.

DUTIES OF OFFICERS.

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

2. The Presiding Officer shall only have the casting vote, but not a deliberative one.

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

MINUTES OF MEETING

HELD IN THE PARLIAMENT BUILDINGS, TORONTO, ONTARIO, FOR THE PURPOSE
OF ORGANIZING AN ASSOCIATION OF PROVINCIAL LAND SURVEYORS,
FEBRUARY 23RD, 1886.

In response to the circular issued in January, the following Provincial Land Surveyors met at 2 p.m., on 23rd February, 1886, in the Private Bills Committee Room of the Parliament Buildings:—

Abrey, G. B., Toronto.	Galbraith, John, Toronto.
Apsey, J. F., Toronto.	Gibson, P. S., Willowdale.
Barrow, E. G., Hamilton.	Hermon, E. B., Rednersville.
Blake, F. L., Toronto.	Jones, T. H., Brantford.
Bolton, Lewis, Listowel.	Kirkpatrick, G. B., Toronto.
Bowman, C. D., West Montrose.	Klotz, Otto J., Preston.
Bowman, J. L., Berlin.	Livingstone, T. C., Hamilton.
Bray, Edgar, Oakville.	McAree, John, Toronto.
Bray, H. F., Oakville.	Niven, Alexander, Haliburton.
Butler, M. J., Napanee.	Pope, R. T., Bracebridge.
Cavana, A. G., Orillia.	Proudfoot, H. B., Clinton.
Campbell, A. W., St. Thomas.	Sankey, Villiers, Toronto.
Chipman, Willis, Brockville.	Selby, H. W., Stayner.
Davidson, W. S., Arkona.	Speight, T. B., Toronto.
Davis, John, Guelph.	Spry, W., Toronto.
Ellis, H. D., Toronto.	Stewart, Elihu, Collingwood.
Evans, John D., Trenton.	Willson, Alfred, Toronto.
Fawcett, Thomas, Gravenhurst.	Wilson, Hugh, Mount Forest.

Motions were then passed appointing P. S. Gibson, of Willowdale, Chairman, and Willis Chipman, of Brockville, Secretary.

The Chairman then called upon the Secretary to read the circular calling the meeting, and extracts from replies received thereto.

The Chairman then spoke of the desirability of forming a P. L. S. Association, and the prospects of making such an association a success. In Law and Medicine they had such societies. He thought the objects of a P. L. S. Association should be to revise and improve the Survey, Municipal, Drainage, and Registration Acts, and other Acts of Parliament in which surveyors have an interest.

The Association might suggest amendments to the Board of Examiners of list of subjects upon which candidates are now examined. American associations of surveyors are now agitating for legal recognition.

He then called for a general expression of opinion from all Provincial Land Surveyors present.

OTTO J. KLOTZ was the first speaker, and heartily supported the movement. He alluded to the fact that various attempts had been made in former years to form an Association. Such attempts had always been directed in the wrong course, *i.e.*, seeking incorporation, and obtaining rights now vested in the Crown. In fact *incorporation* had up to the present time been looked upon as the sole panacea of the Provincial Land Surveyors. Organization and unity of purpose is the first step towards success. As an Association, as individuals, our success is dependent upon ourselves. There is the material among the Provincial Land Surveyors of Ontario to form an Association creditable to themselves and to the country, and which will ever bear "Progress," the watchword of the nineteenth century, on its banner.

He then read the following letter from Lindsay Russell, late Surveyor-General, being a reply to the circular of October 21st, 1878:—

"In answer to circular of 21st inst. sent me, I have to reply that while I sympathize in all efforts to raise the standard or status either, of our profession, I cannot see that it is practicable to do anything in the latter direction by legislation. The only object that legislation respecting any profession can legitimately have is to ensure to the public proper protection from the exercise of such profession by unqualified persons. There cannot be any legislation for the benefit of a special class, or, rather, there should not be.

"The only legitimate means of raising the status of the profession consists in the effort of each individual thereof, by the evidences of conduct, acquirements, and ability, to win for himself the good opinion of those of his fellow-citizens with whom he comes in contact. The more as individuals the members of any profession succeed in this, the higher as a class they will stand. If as a class they are held in slight esteem by the public, it is because they do not merit more. Public opinion is, on the whole, tolerably just, and no doubt rates the services of any class at their true value. I am afraid we will have to rest content with being of no more importance in the eyes of our fellow-creatures than the circumstances of our own merits, and the value of our services to them, have combined to prescribe. I would willingly join in any discussion of the interests of the profession, but shall be unable to attend the meeting proposed, as I have to go elsewhere at the date specified.

"I remain, dear Sir, yours truly,

"F. H. LYNCH-STAUNTON,
"Hamilton."

"LINDSAY RUSSELL.

THOMAS FAWCETT, of Gravenhurst, President of the Dominion Land Surveyors' Association, spoke as follows :—

Although he has not been engaged for a number of years in making surveys in the Province to any extent, yet any movement which had for its object the elevation of the standard of the profession met with his entire approval. All classes, professional and otherwise, have found it advantageous to form themselves into societies for the means of self-protection, and for the purpose of better securing their rights. There is no reason, so far as he could discern, why the Provincial Land Surveyors of this Province should be an exception to that rule. He could easily see how meetings of the Association, if properly conducted, may be a great means of education. In a profession covering so wide a field as that of land surveying, it is next to impossible for any one person to become an expert in all its branches ; but through the medium of papers prepared by different persons on the branches to which they had devoted the most study, and through experience acquired knowledge, facilities would be offered for gaining information which do not now exist, and all members of the profession would be benefited by attending the meetings. For those reasons he was ready to support the movement.

LEWIS BOLTON, of Listowel, thought an organization of the kind proposed would be beneficial to the profession. At our meetings we could discuss the Survey Act and matters connected with our practice. He thought it would result in a great amount of good for Surveyors to meet and see each other. He would assist as far as possible in forming an Association.

ALEXANDER NIVEN, of Haliburton, said he was very glad indeed to see such a good representation of the Surveyors of Ontario as was here to-day, and he thought it looked well for the future.

He thought it very desirable to form an Association ; it would bring the Members of the profession together once a year, and an interchange of views and discussion of matters in which they were all interested would certainly be beneficial.

The Surveyors' Act required amendments, as there were often cases turning up in the practice of surveying to which the Act did not apply.

He would recommend the organization of a society at once, and although they could not now tell exactly what was required, they would after a few meetings know better what was wanted.

WILLIAM SPRY, of Toronto, was not very sanguine as to the success of an Association unless it was a very inexpensive one. Unlike the legal and medical professions, which were constantly increasing and becoming more lucrative, our profession was dying out. In surveying there were no prizes to be looked forward to, as in law or medicine. He considered that there were more surveyors than there was necessity for. He thought he could attend to all the local surveying in one or two counties himself if he had a horse. He approved of the sentiments expressed in the letter read by Mr. Klotz. He also stated that he had not practised as a Provincial Land Surveyor for twenty years, having been engaged on railroad work.

ELIHU STEWART, of Collingwood, then made the following remarks:—

The fact of our meeting here to-day is evidence that we are favourable to the idea of forming an Association for Ontario. There are many ways in which an organization such as proposed would be useful to the profession. Every surveyor knows that there are several sections of the Surveyors' Act which need amending, and, without going into detail, he would strongly urge that candidates for final examination should be examined in certain branches of engineering, especially levelling. Also in the Act are several other sections which should receive the attention of the Legislature; but before going that far they should be examined, and proposed amendments advised by those best acquainted with the subject, viz., the surveyors themselves, and this can only be done by a committee appointed by an Association embracing a fair representation of the profession throughout the Province.

He thought we need not further discuss the subject as to the advisability of forming a Provincial Association, and would make the following motion, as there was nothing else before the Chair:—

Moved by Elihu Stewart, seconded by Lewis Bolton, "That we proceed at once to organize."

The motion was then read from the Chair.

G. B. KIRKPATRICK, in speaking to the motion, was very glad to see the movement started for the formation of an Association of Provincial Land Surveyors for Ontario. At present the surveyors were strangers to each other, but meeting together as was proposed, yearly or oftener, for the discussion of matters of interest to the profession, and for the reading of papers of practical utility to them in their work, they would improve themselves, and an interest would be stirred among them to advance the best interests of the profession as was hardly possible in any other way.

He hoped some of the older members would give the younger men the benefit of their experience in some of the disputed cases that have come up before our courts from time to time. He would always be happy to do what he could to help the Association in every way.

From a social point of view he thought that if arrangements could be made so that they could dine together on the evening of their annual meeting, as was usual in similar associations, the interchange of thought and the feeling of union that would be evoked could not fail to have a most happy effect.

H. W. CAMPBELL, of St. Thomas, expressed himself highly in favour of forming an Association, or of co-operating in any measure which would tend to the improving of ourselves and the furthering and elevating of our profession. The legal, medical, and dental professions have each their Association, and in no particular are they considered other than beneficial to their members. He did not see why we in this Province should not organize a similar institution, whereby we might meet and discuss questions of interest and importance. At meetings of such an Association we could propose and advocate changes in the Surveyors' Act, and consider amendments offered thereto which are being constantly introduced by inexperienced men. And as the Ditches and Watercourses Act of 1883 has opened

up to us a new field of labour and a new class of work under its provisions, the great necessity of certain amendments is evident, in justice to the surveyor and in order that the work may be satisfactorily carried out which it was intended to perform. He wished the movement every success.

Mr. Stewart's motion was then put and carried.

The following were then appointed a Committee to draft a Constitution and By-laws :—

P. S. Gibson, G. B. Kirkpatrick, Alexander Niven, M. J. Butler, Elihu Stewart, Prof. Galbraith, Otto J. Klotz, and Willis Chipman.

This Committee then withdrew and prepared a Constitution and By-laws, each article of which was submitted to the meeting.

After some further amendments the Constitution and By-laws were adopted as a whole.

The meeting then appointed the following an Executive Committee to conduct the business of the Association until the election of officers, as provided for in the Constitution :—

Prof. Galbraith, School of Practical Science, Toronto ; John McAree, Toronto ; Willis Chipman, Brockville.

On motion, this Committee was empowered with the privilege of adding to its number if found necessary.

The Chairman then called for nominations for officers.

(See Articles IV., VI., IX. of Constitution.)

The following candidates were then nominated :—

For President—

Peter Silas Gibson Willowdale.
George B. Kirkpatrick Toronto.
F. F. Passmore Toronto.

For Vice-President—

Alexander Niven Haliburton.
Prof. J. Galbraith Toronto.
George Brockitt Abrey Toronto.

For Secretary-Treasurer—

Willis Chipman Brockville.
(No other nominations.)

For Councillors—

Matthew J. Butler Napanee.
Prof. J. Galbraith Toronto.
Elihu Stewart Collingwood.
Villiers Sankey Toronto.
T. B. Speight Toronto.
T. Harry Jones Brantford.
J. H. Davis Guelph.
Isaac Traynor Dundalk.

For Auditors—

George Brockitt Abrey Toronto.
 Lewis Bolton Listowel.
 H. W. Selby Stayner.

A motion was then carried empowering the Provisional Executive Committee to publish in the first Report such papers on professional subjects as they might deem advisable, and to solicit advertisements.

Upon motion, the meeting then adjourned.

The following is the form of ballot adopted for the election of officers for 1886-87 :—

RETURN THIS IN THE ADDRESSED ENVELOPE.

NOTE.—Ballots without endorsement on outside and back of Envelope are not opened.

ASSOCIATION OF PROVINCIAL LAND SURVEYORS
 OF ONTARIO.

BALLOT FOR OFFICERS FOR 1886-1887.

FOR PRESIDENT (one vote)—

PETER SILAS GIBSON, C.E., Willowdale.

GEO. B. KIRKPATRICK, Department of Crown Lands, Toronto.

FOR VICE-PRESIDENT (one vote)—

ALEXANDER NIVEN, Haliburton.

PROF. GALBRAITH, Toronto.

GEORGE BROCKITT ABREY, Toronto.

FOR SECRETARY-TREASURER—

WILLIS CHIPMAN, Brockville. (No other nomination for Sec.-Treas.)

FOR COUNCILLORS (three votes)—

M. J. BUTLER, M. Inst. C. E., Napanee.

PROF. GALBRAITH, Toronto.

ELIHU STEWART, Collingwood.

VILLIERS SANKEY, Toronto.

T. B. SPEIGHT, Toronto.

T. HARRY JONES, B.A.Sc., Brantford.

J. H. DAVIS, Guelph.

ISAAC TRAYNOR, Dundalk.

FOR AUDITORS (two votes)—

GEORGE BROCKITT ABREY, Toronto.

LEWIS BOLTON, Listowel.

H. W. SELBY, Stayner.

EXTRACTS FROM CONSTITUTION.

ARTICLE IV.—The Officers of the Association shall consist of a President, a Vice-President, a Secretary-Treasurer, and Three Councillors, who shall constitute an Executive Committee, which shall have the direction and management of the affairs of the Association.

ARTICLE X.—Two Auditors to be elected by ballot, etc.

ARTICLE XI.—The fee for membership for Active Members and Associate Members shall be Three Dollars, and an annual subscription of Two Dollars for each subsequent year ; both payable in advance.

DIRECTIONS TO VOTERS.

1. Make a distinct Cross opposite the names of Candidates for whom you wish to vote. The cross to be on the right hand side of the name.
2. Write your name on the back of Envelope after enclosing your Ballot duly marked.
3. Enclose Ballot and Envelope with your **THREE DOLLARS**, if not already paid, and address the same to the Secretary-Treasurer, on or before 31st March, 1886.
4. Register your Letter.

The Secretary desires each member to give his name in full, with Post-office address, University degree, if any ; and if Engineer of any Public Work, or for any Corporation, please state the same.

WILLIS CHIPMAN, *Secretary-Treasurer.*

With this ballot paper was sent an addressed envelope on the back of which the following was printed :—

NAME IN FULL—	ADDRESS—	DEGREE OR DIPLOMA—	OCCUPATION—	DATE OF SENDING BALLOT—
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REPORT OF PROVISIONAL EXECUTIVE COMMITTEE.

Members of the Association of Provincial Land Surveyors of Ontario:

GENTLEMEN,—We congratulate you upon the successful formation and organization of our Association upon what we consider a proper basis.

While in the United States we find the American Society of Civil Engineers, Boston Society of Civil Engineers, Engineers' Club of Philadelphia, St. Louis Engineers' Club, Michigan Engineering Society, Connecticut Society of Civil Engineers and Surveyors, Illinois Engineers' Association, and kindred Associations in Ohio, Indiana, and Iowa, we, in Ontario, have remained idle witnesses of the advances made by our professional cousins. Some few of us may be members of the Institute of Civil Engineers of Great Britain or of the American Society of Civil Engineers, while a few others have the advantage of practising in the vicinity of the Dominion or Provincial capitals, thereby being able to exchange views and opinions on professional topics, although not joined together by the fetters of a written constitution.

Mention should be made of the Association of Dominion Land Surveyors, which was organized in 1883, the papers published in the proceedings being of great interest to the profession.

The vast majority, however, of our Provincial Land Surveyors are without the advantages arising from association with fellow-professional men, which state of things must cease to exist before they can expect to accomplish much towards their advancement.

Class legislation we do not think is at present deserved, however much we may desire it. We must first become a united body, and be able to present our request to our Legislature so intelligently, so justly, and so forcibly, that they cannot do otherwise than comply.

We anticipate many changes in our Statutes within the next few years, especially in reference to municipal matters, and if we choose we can offer such suggestions as will be certain to benefit ourselves as well as the public at large.

Professional work is now being done for our municipalities by persons who have no credentials but those of being good political canvassers.

We cannot expect the Lawyer, the Physician, the Dentist, the Veterinary Surgeon, or the Pharmaceutical Chemist, to interest himself in our behalf; each has sufficient to do in furthering his own particular professional interests.

The Lawyer and Physician are slowly but surely encroaching on our field, and we must unite and resist the invaders.

The fact is, while the other professions have been advancing and keeping up with the times, we have, in comparison, been in a state of lethargic indifference since the time when the recognized fee of a Surveyor was £1 per day.

By Sub-section 3 of Article IX. of the Constitution, the Executive shall, as soon after its election as possible, strike the several Standing Committees.

The object of these Committees is to facilitate the carrying-on of the business of the Association. All questions and problems arising in practice may be referred to its particular committee for consideration, and it is hoped the members of the Association will see that these Committees are not kept wholly idle. All communications should be sent to the chairman of the committee having in charge the consideration of the subject of the communication, who should bring the matter before his committee, and report to the Association at its next meeting, if he considers it of sufficient interest.

Each Committee should endeavour to advance the interests of that branch of the profession which has been placed in its charge.

We would suggest to our successors that the following Standing Committees be appointed :—

1. Committee on Land Surveys.
2. Committee on Land Drainage.
3. Committee on Municipal Engineering.
4. Committee on Instruments, etc.
5. Committee on Legislation.
6. Committee on Publication.

COMMITTEE ON LAND SURVEYS.

This Committee should be carefully selected, and be as thoroughly representative as possible.

Its duty should be to examine carefully the "Act respecting Land Surveyor's and the Survey of Lands," and the "Registry Act," and suggest to the Association any necessary changes or amendments.

They should also prepare, or have prepared, for the General Meeting one or more papers to be read thereat on this particular branch of the work of the Association.

This may include difficulties experienced in interpreting the "Lands Act" and "Registry Act"; field-work practice; means of attaining a uniformity in notes and plans; investigating decisions of Courts, etc., etc.

The Annual Report of this Committee will become, in a short time, a valuable document, and alone worth our annual subscription.

COMMITTEE ON LAND DRAINAGE.

Upon examination of Appeal Reports for the last few years, this Committee will realize the muddle into which our legislators and our judiciary have managed to get this matter.

Legislation is required at once in this important matter. The "Municipal Act" and "Ditches and Watercourses Act" should be carefully criticised.

This Committee should, besides making an Annual Report, prepare one or more papers on this subject for publication in the Proceedings of the Association.

COMMITTEE ON MUNICIPAL ENGINEERING.

The work of this Committee will be, probably, more interesting to a large part of our Association than that of any other Committee.

It will have for its consideration, Sewerage, Water Supply, Street Paving, Roads, Bridges, etc.—subjects enough for a separate Association.

This Committee should prepare one or more papers for publication, and make an Annual Report.

COMMITTEE ON INSTRUMENTS.

This Committee should strive to bring before the notice of the Members of the Association all information obtainable regarding improvements in field instruments and office appliances, the recording of field notes, perpetuating boundaries, etc.

This Committee should also make arrangements with manufacturers of instruments, etc., to exhibit their manufactures at our Annual Meetings, and also arrange for exhibition of instruments belonging to Members of the Association.

COMMITTEE ON LEGISLATION.

This is probably the most important of Committees suggested, as upon the work done by this Committee depends much of the usefulness of the Association.

Its duties should be to draft and present to our legislators any bills that this Association may wish to become law, and endeavour to secure the passing of the same with as little mutilation as possible. They should also guard the interest of the profession by discouraging legislation thought to be unwise, unjust, or impracticable.

This Committee should act upon the recommendations of the second, third, and fourth Standing Committees, after the matter has been discussed at a General Meeting of the Association.

COMMITTEE ON PUBLICATION.

The duty of this Committee shall be to arrange for the publication of our Proceedings, including printing, lithographing, engraving, etc.

They shall also solicit advertisements from instrument manufacturers, bridge companies, drain tile manufacturers, stationers, etc., and see that the advertisements appear properly and correctly in the Proceedings.

This Committee should report to the Executive Committee immediately upon completion of its work.

We will conclude our Report by giving some reasons why every Land Surveyor in the Province should become a Member of our Association.

1. By becoming a Member you will have through the Association and its Committees a channel by means of which you can convey to the profession your views on anything affecting said profession, and become acquainted with the opinions of other Members.

2. The volume of Proceedings published annually will alone be worth to you more than your yearly fee, which is placed at such a figure as merely to cover cost of publication of Report and necessary expenses of Association.

3. You will receive through our Association copies of Proceedings of several State societies of surveyors and civil engineers, making in all several hundred pages of the cream of professional literature.

4. To the very clever surveyor we would say that you will undoubtedly become a "crank" unless you occasionally rub up against your professional brethren and get the "corners" polished off. To the "rusty" brother, we think there is probably no better way of brightening you up than by joining what we are confident is the permanent organization of the "Association of Provincial Land Surveyors of Ontario."

Signed on behalf of the Provisional Executive Committee.

WILLIS CHIPMAN.

THE SURVEYOR'S ACT.

BY VILLIERS SANKEY, P.L.S.

At the late meeting of P. L. Surveyors, held in Toronto, nearly every one who spoke, made some allusion to "The Act," and referred to the satisfaction it would give to have the said Act thoroughly and intelligently discussed from a surveyor's point of view.

This is most natural. It is the authority by which we act; it is our charter, so to speak, defining generally who may be surveyors, how they may be surveyors, what they may be called upon to do, and how it shall be done, together with sundry other regulations governing and relating to the same.

This Act, however, cannot be said to be very clear or concise, though the operations, etc., etc., which it regulates admit of the greatest exactness and accuracy. Why then should the above imputation attach to our act? I think the great reason is that while the practice of surveying has gone on improving, and the means and methods, as well as the persons who put these means into practice, have advanced with the rapid strides of the last twenty-five or thirty years of this nineteenth century. The Act itself has not advanced, but will be found to be practically the same that it was in 1849, and many of its sections date back as far as 1818 and even 1798.

This brings us to the object of this Paper, "The thorough understanding and consequent improvement of the Act."

For the preparation of a paper which would have the effect of starting intelligent discussion the time available has been entirely too short. The collecting of the necessary amount of material in the shape of legal decisions, and of surveyors' experiences in all parts of the Province being a matter of months not weeks, for without such material any paper compiled even with the greatest care, would be but the opinions of an individual, leading only to criticism and not to discussion.

I have decided, therefore, to confine this paper to a chronological history of "The Act respecting Land Surveyors and the Survey of Lands," R.S.O. Chap. 146.

By way of preface, and in order to enable us to understand the subject more perfectly, it will be necessary to recall very briefly a few important points in Canadian History.

By *The Treaty of Paris*, 1763, Canada was ceded to the Crown of England, and in the same year General Murray was appointed first Governor General of the British Province of Quebec.

The Quebec Act, of 1774, provided among other things for the introduction of the Criminal Law of England, but declared "That in all matters of controversy relative to property and civil rights, resort should be had to the Laws of Canada, as the rule for the decision of the same." Thus the Civil Laws of French Canada were confirmed.

The Constitutional Act, of 1791, divided the Province of Quebec into Upper and Lower Canada, with separate Legislatures and Governors. *The Union Act*, of 1840, united the Provinces of Upper and Lower Canada into one Province under one Government.

The British North America Act, which came into force July 1st, 1867, provided that the Provinces of Canada, New Brunswick, and Nova Scotia should be one Dominion under the name of Canada and divided it into four Provinces—Ontario, Quebec, New Brunswick, and Nova Scotia, with separate Governors and Local Legislatures.

Starting then (1763) with the new British Province of Quebec, we see that if the Civil Laws of French Canada had any regulations or ordinances relating to the Survey of Land, by such were surveyors governed, of these I have been unable to find any records. No doubt there were such. In 1785, "An Ordinance concerning Land Surveyors and the Admeasurement of Lands" was passed by the Legislative Council of Quebec, 25 Geo. III., Chap. 3; but of this Act I have been unable to procure a copy, though I have searched in the Library at the Parliament Buildings and at Osgoode Hall.

The next Legislation we find is in the year 1798, when "An Act to ascertain and establish on a permanent footing the boundary lines of the different Townships of this Province," was passed by the Legislature of Upper Canada, 38 Geo. III., Chap. 1. From this act we gather that a Surveyor-General existed at the time, for it provides for the planting of stone monuments, or monuments of other durable materials, at the several corners, governing points etc., of Townships and concessions under his inspection and order, after application had been made to the Governor. These monuments, so planted, governed the courses and distances of the boundaries and lines in said Townships and concessions, any distances expressed in any patent of grant or other instrument, to the contrary thereof notwithstanding, Sections 34, 35, 36, and 37 of our present Act, are similar provisions slightly extended. Section 4, of this Act of 1798, is, I think, worth while giving in full, as, no doubt, it will be new to many members of the profession. "And be it further enacted, by the authority aforesaid, that if any person or persons shall, knowingly and wilfully, pull down, deface, alter, or remove any such monuments so erected, he, she or they shall be adjudged guilty of felony, and shall suffer death without benefit of Clergy."

The remaining sections of this Act lay down how application for the planting of the said monuments was to be made, and how the expense was to be levied. It will be noticed that no provision, up to this time, was made, at any rate in Upper Canada, as to the qualification or admission of surveyors, the Act even does not refer to them but only to the Surveyor-General, on whom all responsibility was thrown. How the Surveyor-General was appointed I have not been able as yet to discover, but I think it probable, however, that each Governor granted a new commission to the former Surveyor-General, or appointed a new one. It is certain, also, that some of the Surveyors-General were not surveyors by profession.

We now come to the year 1818, where we find that in the Third Session of the Seventh Provincial Parliament, which met at York, October 12th, of that year, an act (59 Geo. III., Chap. 14,) was passed intituled "An Act

to repeal an Ordinance of the Province of Quebec, passed in the twenty-fifth year of His Majesty's reign, intituled an Ordinance concerning Land Surveyors and the Admeasurement of Lands, and also to extend the provisions of an Act passed in the thirty-eighth year of His Majesty's reign, intituled an Act to ascertain and establish on a permanent footing the boundary lines of the different townships of this Province, and further to regulate the manner in which lands are hereafter to be surveyed." This Act extends the previous Act with regard to the front angles of lots, and declares that all lines run and all monuments planted in the first survey shall be the true and unalterable boundaries. It also declares that the governing lines of all division lines or side lines shall be the boundary line of each and every concession, on that side of the township from which the lots are numbered, when such lines "are required to go the same course," (Section 51 and following ones of present Act). Here provision is first made for examination of surveyors. The Act provided that every surveyor thenceforth was to be examined by the Surveyor General, or Deputy Surveyor-General, as to his fitness and capacity and competent knowledge of the theory and practice of surveying in all its branches.

An appointment to act and a licence had to be obtained from the Governor, also a bond with two sufficient sureties in the sum of £500 had to be entered into, and the surveyor had to subscribe to the following oath: "I, A. B., do solemnly swear that I will well and truly discharge the duty of a surveyor of lands agreeably to the law, without favour, affection, or partiality, when and as often as I may be required thereto by any person or persons, or by the rule or order of any Court of Justice, and which I will faithfully and without unnecessary delay submit to the party requiring the same, or the Court directing my duty; also a plan of survey if required. So help me God."

For the first time, also, provision is made for swearing chain-bearers, but no distinction is made as to who may act.

The front of each concession is declared to be that end or boundary which is nearest the boundary of the township from which the concessions are numbered, and that when several lots in different concessions have been granted in one patent they are to be surveyed separately. (Sec. 63 present Act.)

Here we first find the provision for dividing up between the nearest undisputed monuments into the same number of lots as the same contained in the original survey. (Sec. 65 present Act.) There is also a provision in the case of lands entered into and improved through unskilful survey.

The next legislation on surveying is in the year 1839, when the Legislature of Upper Canada passed an Act (2 Vic., Chap. 17) to extend the provisions of the previous Act. This was a very short one, dealing chiefly with the cases of ejection or compensation through unskilful survey. It is also the last as to surveyors passed before the Union Act of 1840; the preceding Acts, therefore, refer entirely to Upper Canada.

We will now pass on to (4 and 5 Vic., Chap. 9,) 1841-42, "An Act to grant authority to licensed surveyors in that part of this Province called Upper Canada, to administer oaths in certain cases and to protect them while in discharge of their duty in surveying lands."

By this Act, licensed surveyors had authority to administer oaths to persons giving information as to boundaries or monuments; further, that evidence on oath had to be reduced to writing and signed by the person giving same, and had to be filed in the registry office for the county, to be used afterwards in any court of law. Sections 77 and 78, present Act, embody these provisions. The Act also declared it to be a misdemeanor to interrupt, molest, or hinder any licensed surveyor while in the discharge of his duty; anyone so doing might be punished by fine or imprisonment; the amount of fine or length of imprisonment, however, is not stated.

This ends the fourth Act of what we might term the first period of the Land Surveyor's existence in this Province. There were, as we see, four Acts which guided his operations, and these continued in force till the year 1849, or, in all, for a period of some fifty-one years, during which time the Land Surveyor had been gradually developing from an assistant or deputy of the Surveyor-General to an independent responsible public officer, who owes his position to neither party nor government, but only to his own intelligence and capacity, and the ability with which he has been able to convince the Board of Examiners of that capacity and fitness.

In 1849, we find an Act (12 Vic., Cap. 35) entitled an Act to repeal certain Acts therein mentioned, and to make better provision respecting the admission of Land Surveyors and the Survey of Lands in this Province, *i. e.*, the united Provinces of Upper and Lower Canada.

This Act repeals all the previous ones, and then sets out various regulations and enactments which governed the profession in both Provinces. There were in all fifty-two Sections; of these twenty-two relate especially to Upper Canada, and ten to Lower, the rest being general regulations common to both.

This Act forms the ground work of our present one, though several of its sections have been repealed, some of them important ones too. Thus Section two, now repealed, enacts "That no person shall after the passing of this Act survey lands for hire or profit within Upper Canada or Lower Canada, or act in any way as a Land Surveyor within either portion of this Province, unless duly authorized to practise, under a penalty of £10.

The Board of Examiners was here first appointed, consisting of the Commissioner of Crown Lands, and six other competent persons appointed by the Governor, the subjects for examination being:—Geometry, six books of Euclid, Plane Trigonometry, Mensuration, Plotting and Map drawing, and a sufficient knowledge of Spherical Trigonometry and Astronomy to ascertain latitude and draw a meridian.

Persons applying had to have served under an instrument in writing for three consecutive years as an apprentice to a Land Surveyor for Upper or Lower Canada, duly admitted and practising as such, and had to be at least twenty-one years of age. The Board could appoint a Secretary and met as now on the first Monday in January, April, July and October.

The Secretary was to be paid certain fees for receiving notices of examination and for certificates when granted. These fees were his remuneration. Section eight enacted that each person, on receiving a certificate, should pay the sum of £2. 10s. out of which the expenses of the examination were to be paid, and the remainder divided equally among the mem-

bers of the Board present who were not salaried officers of the Government. As before a bond had to be entered into, and the oath of allegiance and duty subscribed to.

The Board had power to dismiss or suspend a surveyor for gross negligence or corruption. Chain-bearers were to be sworn, and were not to be related to the parties interested within the degree of cousin-german. The Commissioner of Crown Lands takes the place in this Act of the Surveyor-General, and under his order monuments were to be placed; he also kept the standards of length for surveyors to check their chains by.

This Act also declares the wilful pulling down of any stone monument placed in Upper Canada under the order of the Commissioner of Crown Lands to be a felony, and the pulling down of any other land mark, post etc. in either Province to be a misdemeanor. The other sections of this Act which treat of the determining of concessions and lots, and the running of the boundaries of the same, may be said to be the parents of the similar sections of our present Act, it will not therefore be necessary to refer to them particularly in this paper.

We now come to (14 and 15 Vict. Chap. 4) 1851-52, the chief features of which were to appoint two boards of examiners, one to meet in Toronto and one in Quebec, consisting of the Commissioner of Crown Lands and eight other persons, in each case. The fee on receiving a certificate was increased from £2.10s. to £5 which was divided as before. The Secretaries for each Board now kept the standards of lengths for comparison, and no instruments under which applicants claim to have served, were to avail unless deposited with the Secretary within two months after date.

The next Act we find is 18 Vic. Chap. 83, 1855, the principal provisions of which were: First, that the Commissioner of Crown Lands should receive all fees for examination, and pay out to each examiner, not an officer of the Government, £1.5s for each day's attendance. Second, The Primary Examination is here first established, the subjects being vulgar and decimal fractions, square and cube root, geometry, plane trigonometry, mensuration and logarithms. Third, Every Surveyor attending court as a professional witness was entitled to 20s. a day, and also had the power of compelling persons to give evidence. This Act also extended the previous one with regard to corners of certain lots and concessions.

In 1857, 20 Vic. Chaps. 37 and 73 were passed, the first of which made provision for the admission of applicants who had undergone training at Universities, without full period of service. Chap. 73 amends parts of the previous Acts as to the mode of running side lines in those Townships in which the concession lines were not run, but the side lines only. In all these cases the original surveys were to be adhered to and followed.

Here ends the scattered Legislation, for in Chap. 77 Consolidated Statutes of Canada, 1859, we find the various provisions embodied in one Act, being the same, so far as to Upper Canada in the Consolidated Statutes of U. C, Chap. 93; and which we now have in Chap. 146 of the Revised Statutes of Ontario. This is the Act with which we are all familiar, and which I might almost say we could willingly see committed to the flames, with all reverence and respect however, for out of its venerable ashes it should be the aim and determination of every surveyor in the Province, to assist in the production of such an Act, as would at the same time be concise simple and effective.

In the foregoing paper I have endeavoured to place before you the chief points of our Act. I must apologize for the crudeness of its form, as I before stated shortness of time was the great drawback.

In conclusion, I would suggest that the Standing Committee on Land Surveying should formulate a series of questions to all surveyors in the Province, giving plenty of time for their consideration and answers before our annual meeting. This would give us material to discuss, and would have the effect of bringing the whole matter to a focus. The back picket, as it were, would stand out clearly, and the cross-hairs being readily adjusted, the front picket would be placed true and plumb. So that our young Association may have no fear of planting a post, with even the brass nail in the head, so true that, in the future, surveyors may range from it with accuracy and precision to the satisfaction of themselves and the public at large, whose servants we are.

LAND DRAINAGE.

SUGGESTIONS CONCERNING THE WORKING OF THE DRAINAGE ACTS OF ONTARIO,
WITH A FEW HINTS ON THE CONSTRUCTION OF OPEN DITCHES—BY H. B.
PROUDFOOT, P.L.S. AND C.E., CLINTON, ONT.

Having been requested by the Executive Committee to prepare a paper on "Drainage," and having accepted their request before I knew in what a short space of time the paper had to be handed in, I consider I owe some apology to the Association for the crude manner in which the subject will be handled.

There are, in Ontario, two separate and distinct drainage acts: the first is that portion of what is now called the "Consolidated Municipal Act," relating to the "powers of Municipal Councils as to drainage and other improvements paid for by local rates"; and the second is what is known as the "Ditches and Watercourses Act of 1883." The Municipal Drainage Act and the Ditches and Watercourses Act, although arriving at the same object in the end, viz.: the rendering of land fit for cultivation, or the improvement of land partially or disadvantageously cultivated, attain that object by altogether different methods. In the first, the *majority in number of the persons as shown by the last revised assessment roll* petition the Municipal Council for the improvements in their drainage facilities, and the Council may procure an examination to be made by an engineer or Provincial Land Surveyor, whose duties it will be to make an estimate of the cost and the amount in dollars and cents of the cost to be borne by each lot or portion of lot improved. A Court of Revision is then held, and the engineer's assessment can be altered by it if shown to be wrong. If no appeals are then made from the assessment so altered to the County Judge (if the Council did not alter the assessment an appeal could still be made to the County Judge), who has power to alter such assessment if needs be, then the Municipal Council may pass a by-law empowering them to issue debentures to defray the cost of such work, advertise for tenders and let the work; the parties interested having no further trouble with the exception of paying so much extra taxes once a year for the next ten years. The Municipal Act is by far the best under which to construct a ditch of such magnitude that it would be impossible for the several parties interested to construct their several portions in a short space of time during the summer with only the ordinary farm help. Also, there are only certain short periods of time, and they are not consecutive, during which an owner of a farm lot can find time to work at a ditch, and as it is generally absolutely necessary that the lower sections should be completed before the upper sections, and if each party had his time allotted for completing his portion of the work to suit the intervals in harvesting, etc., it is quite apparent for these reasons that the work that could be done by a contractor in a few months would be extended over a space of time ranging from one to four years if

the ditch were long enough. Farmers, though, as a rule, have a great dislike to have anything done about their places by other parties. Being very conservative as a class they generally are of the idea that a piece of ditching would be cheaper to them if they did it themselves, although it should take up all their spare time for a summer, than if the whole job was let by contract and thrown out in a couple of weeks. Engineers will find that to be their greatest trouble in advocating the Municipal Act in preference to the 1883 Act, although the fact that the cost of such drainage will extend over ten years, with interest at the low rate of five per cent., is a great incentive to have drainage done under the Municipal Act. The Municipal Act does not provide for the appointment of an engineer, it says: "An engineer or Provincial Land Surveyor," whereas, the Ditches and Watercourses Act of 1883 (Sec. 4.) states that every Municipal Council *shall* appoint an engineer to carry out the provisions of this Act, and in Section 21 it defines the word engineer as meaning "civil engineer, land surveyor, or such person any municipality by by-law may deem competent to perform the duties required under this Act." I am informed that movements have at several times been made to have the word engineer struck out of Section 4, and the words Provincial Land Surveyor inserted in place of it. Such a proceeding is altogether unnecessary as the *engineers* (?) appointed by several municipalities are, by their awards, etc., working gradually their own extinction.

The Ditches and Watercourses Act (Sec. 5) provides that *any owner* may force an outlet for the drainage of his lands, which is a distinction from the Municipal Act, which makes it necessary for the majority in number, etc. To sum up the Ditches and Watercourses Act, any owner can call a meeting of the several other owners who would be affected or benefited by a ditch or drain to agree, if possible, on the portions of such ditch or drain to be dug by each. Failing to agree, the first-mentioned owner may request the engineer appointed by the municipality to be called on to examine the premises and make his award, from which award any party interested can appeal to the County Judge. Under this Act the award is made in respect to the *quantity of the ditch to be made and completed by each party*. The quantity is to be expressed in the award as from stake marked — to stake marked —, describing the position of each stake. It is always best, however, to determine the position of the stakes by the calculation of the number of cubic yards or feet, and find from the result, by a direct proportion, the amount of dirt each party has to remove, which will generally bear the same ratio to the whole number of cubic yards or feet that the amount of his land to be drained bears to the area of the whole tract to be drained. Any award made under this Act, which allots money payments to one or more parties, instead of portions of the ditch, would not be worth the paper that it was written on, and would be immediately set aside by the County Judge, should the award be appealed. The last sentence is a distinction from the Municipal Act, in which the report specifies a certain value of the improvement to each lot, which value the party owning said lot is to pay, or, as it is given in some reports, the value of improvement is given at a certain sum per acre, and the cost of the ditch or the increase of the rate of taxation is placed at a certain per cent. of that value. For instance, the value of the improvement is placed

at \$20 per acre, and the cost of the ditch, say, at \$2 per acre (calculated in the same manner as the lengths of ditch under the Ditches and Watercourses Act), then the special rate of taxation would be ten per cent. of the improved value of the land.

Section 8 of this Act is slightly ambiguous. It provides that the award must be made within thirty days, but it does not state when it is to be filed. It will be observed in reading over the Ditches and Watercourses Act that in Section 8 the following occurs: "*Specifying clearly the locality, description, and course of said ditch or drain, point of commencement and termination of same.*" I have heard of one case decided against the defendant by one of the County Judges of Huron in which one of the principal objections raised against the award of the engineer was that he described the ditch commencing in the front of a lot and terminating in the rear thereof, or words to that effect. I would strongly advise all township engineers to make a regular description of their ditches in the same way as they would make a description of a piece of land.

The Act provides that the *engineer shall examine the premises, etc., and make his award in writing.* The word "examine" should be understood to include *survey*, as without a survey it would be impossible to make a just award. In making a survey I would advise engineers to use a compass instead of a transit, especially in swamps, a 100 foot chain, and a good level. Before proceeding with the survey, make a small plan of the lots on which the tract to be drained is situated, drawn to scale, and walk all around the said tract and sketch on the plan the approximate intersections of the lot lines with the swamp to be drained; and having taken a few levels, and ascertained the lowest point in the said tract of land, and plotted them on his plan, by having which constantly before him, he can lay out the ditches at once to the best possible advantage when there is no defined watercourse through the swamp, as is very often the case in those of black-ash, cedar, etc., especially near the head of a watershed. In running lines through a bush or swamp for drainage survey, never cut any more trees than actually necessary in order to do the levelling, as the more trees cut the more grubbing to be done when making the ditch, it being far easier to grub out a standing tree than a stump, the weight of the top pulling out a large number of the roots which would otherwise have to be cut. The line of levels should always be run, not in the centre of where the ditch is to be, but at one side thereof, and a chainage stake, marked in consecutive numbers, should be placed at every 100 ft. space, with another small level plug driven firmly and exactly at the foot of the chainage stake, with its top flush with the level of the ground, which admits easy verification of the elevation of the bottom of the ditch. Some engineers stake out the centre of the ditch also, which is a good plan, provided you have some idea of how deep the ditch is to be; and place the centre stake far enough from your level plugs to insure that the latter will not be interfered with by the digging of the ditch on the one hand, and near enough to the level plugs so that the latter may be placed on the *berm*, and not under the spoil bank.

The area of the cross-section of the ditch will, of course, always depend on the amount of land to be drained, the amount of fall that can be utilized, and the kind of soil through which the ditch passes. Professor Schubler gives the amount of water 100 lbs. of dry earth will retain, so that none

would flow off, as follows:—Sand, 25 lbs.; loamy soil, 40 lbs.; clay loam, 50 lbs.; pure clay, 70 lbs. The following extract from a paper on “Drainage Engineering,” by Professor R. C. Carpenter, of Michigan, will be found very useful in calculating the size of ditches.

Table for capacity of open drain : width of bottom, one foot; inclination of sides, one to one; drain full of water.

INCLINATION EXPRESSED IN FEET.	CAPACITY IN ACRES.				REMARKS.
	Depth, 1 foot.	Depth, 2 feet.	Depth, 3 feet.	Depth, 4 feet.	
1 in 10.....	949	2,555	6,870	14,268	One acre is considered the equivalent of 3,630 cubic feet, each day of twenty-four hours.
1 in 25.....	447	1,204	3,239	6,726	
1 in 50.....	314	846	2,290	4,725	
1 in 100.....	224	603	1,622	3,365	
1 in 150.....	204	542	1,458	3,027	
1 in 200.....	157	424	1,134	2,356	
1 in 250.....	142	382	1,027	2,132	
1 in 300.....	129	347	932	1,935	
1 in 400.....	108	289	779	1,619	
1 in 500.....	99	266	740	1,487	
1 in 1,000.....	70	189	507	1,053	
1 in 1,500.....	66	158	424	882	
1 in 2,000.....	51	140	367	763	
1 in 3,000.....	39	104	279	579	
1 in 4,000.....	32	87	234	487	
1 in 5,000.....	27	73	197	408	

“The capacity of drains of the same depth, but having widths and cross-sections differing from the areas tabulated, will be given approximately by considering that the capacity increases in the same ratio as the area. Thus, to ascertain the capacity of a drain three feet wide on the bottom and four feet deep, with slope of sides forty-five degrees, the area of cross-section would be twenty-eight square feet; the area of the tabulated form four feet deep is twenty square feet; the capacity would be the corresponding tabulated number multiplied by 28-20. The result would be more accurate if it even increased somewhat more, as the effect of friction is less as the breadth is increased for a given depth. The following factors should be introduced in the above results if a closer approximation is required” :—

TABLE OF FACTORS.

DEPTH.	BOTTOM WIDTHS.							
	$\frac{1}{2}$ ft.	1 ft.	$1\frac{1}{2}$ ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.
1 .....	.91	1.00	1.09	1.15	1.21	1.25	1.26	1.28
2 .....	.86	1.00	1.07	1.12	1.18	1.21	1.22	1.23
3 .....	.83	1.00	1.05	1.09	1.13	1.15	1.15	1.16
4 .....	.81	1.00	1.03	1.06	1.08	1.09	1.09	1.09

Professor Carpenter has made his calculations for a ditch with side slopes one to one, which I would never use unless at the upper end of a ditch in a stiff soil, and very seldom even then, as there is a great liability of caves being washed out by the water, and the "shelling" off is always greater in a steep bank in the spring. One to one and one-quarter is sufficiently steep, and one and one-half to one I consider the best slope of the three for a ditch which is supposed to be permanent. It is apparent that unless there is a surplus fall in the outlet part of the ditch it would be impossible to use side slopes of one and one-half to one in the upper part of the ditch, and slopes of one to one, for the sake of economy, in the firmer land in the outlet.

The term *outlet*, as I use it, requires a little explanation. In an amendment to the Ditches and Watercourses Act it is provided that an engineer cannot leave the surplus water brought down by a ditch on a lot of land if it overflowed the natural channel so as to damage the said lot unless so authorized by the owner thereof. The outlet is then made a great deal shallower than the main ditch, but on account of the alteration in the depth it should be made proportionally wider, so as to confine the surplus water as much as possible in the natural watercourse. In making the outlet it is sometimes expedient to clean out the natural watercourse, at others to make the outlet as straight as possible; but in such matters the engineer has to use his own discretion, the amount of fall generally assisting him in the determination of which is the most advisable course to pursue.

When the outlet to a ditch or drain is a creek which would not carry all the water brought into it without overflowing its banks on account of the creek bed being choked with fallen timber, logs, roots, stones, etc., it has been my custom to award the cleaning out of the said creek bed to all the parties interested combined; that is, that they should make a *bee* and have it done. It seemed to work very well, as I never heard any grumbling about it until lately, when I was informed that it was almost impossible to get the parties to work together, especially if they were not satisfied with the other portions of the award. The next case I have of the kind, it is my intention to give it to all the parties combined and place the date of completion of said portion (Sec. 8) very close upon the date of the

expiration of the time of appeal, making the time altogether inadequate to the amount of the work to be done, and then proceed as provided for by Section 13 of the Ditches and Watercourses Act.

The grades or fall of a ditch will generally depend on the natural fall of the land to be drained. The engineer will find that he is very seldom called upon to lay out a ditch with less fall than 2.5 ft. to the mile. When it does occur so level, and the cases are by no means exceptional, the ditch will have to be made deeper at the lower end, and thereby create what is termed an *artificial* fall. Should there be a good fall above and a good fall below the level portion, I do not consider it necessary to make the *artificial fall* so great as would be required should the fall be all below the level portion, the water above adding a certain force to the water in the level portion and tending to drive it out. I consider three feet to the mile a fall sufficient for all ordinary purposes, although I have had cases in which the fall was as low as 1.75 ft. per mile, which, however, is altogether inadequate for a ditch which is supposed to keep itself clean.

When a Municipal Council employ an engineer to locate, and make a report, as provided for in the Municipal Act, the surveyor's or engineer's duties sometimes cease when the by-law has been passed, the council appointing either one of their own number or an outsider as inspector. In which case, if the engineer has any regard for his fair name, he will not furnish either the contractor or the inspector with a profile, for in ninety-nine cases out of a hundred, neither of them understands the least thing about a profile, and the contractor, if he is not honest, will be sure to get ahead of the inspector (?) and make a botch of the job, and if the ditch should not prove a success the engineer is of course blamed. The Municipal Act provides for a profile and the engineer has to return a profile with his returns; but there is nothing in the Act to prevent him from making it as unintelligible as possible, so as not only to prevent any mistakes, but also to make sure that they will not get any information from it. In place of the usefulness of the profile, however, under both of the Acts, I always return a *schedule*, which is, in fact, award, report, plan, profile and specifications all in one. The schedule is divided in the following manner, which, I think, is sufficiently clear without any explanation.

SCHEDULE OF DITCH.

SURVEY made on application of..... Stations 100 ft. apart.

STATION.	DEPTH.	BOTTOM WIDTH.	TOP WIDTH.	SIDE STOPES.	GRADER PER ST.	TO BE DUG BY	TO BE COMPLETED ON OR BEFORE	BEARING.	CUBIC YDS.	REMARKS.
75	ft. in. 3 06	ft. 3	ft. in. 11 09		ft. in. 0 12	John Brown.	1st Sept., 1885.	N. 25° 30' W.	Give cub. yds. between every five stations.	
76	4 02	3	13 05	1 1/4 to 1						74+90 angle.
77	3 09	3	12 04 1/2							76+30 - cross old creek bed.
78	3 10	3	12 07							

The last column, cubic yards, is not necessary for schedules for ditches done under the Ditches and Watercourses Act, as it is inserted only to enable the inspector to make a correct monthly estimate. Columns Nos. 7 and 8 are not necessary for ditches constructed under the Municipal Act; as was said before the whole job is generally done by contract.

Under the Ditches and Watercourses Act, it is always best to furnish each of the interested parties with a copy of the schedule of that portion of the ditch which said party has to execute, thereby doing away with the liability of mistakes in copying figures from the schedule filed with the Clerk.

The plan is very seldom referred to, and is, in fact, almost altogether useless, excepting where there is an appeal from an award, and then a copy has to be supplied to the Court from the Clerk's office, certified by him as a true copy, etc., etc., which makes it needful to have one. In addition to the lines of the ditch and the lot lines I generally show on the plan the bearing (mag.) of each course, the numbers of the angle stakes, the changes in the bottom widths of the ditch, and the numbers of the stakes where one party's portion ends and another begins. Sometimes the land to be drained is shown on the plan in dotted lines with the area of each lot, or portion of lot, that is to be drained. It is sometimes the custom to draw a series of parallel lines on the plan at stated distances from the ditch and parallel thereto, and make the assessment according to the areas included within said lines; but, as this system is most materially wrong, the less said about it the better.

The form of specification here given is the result of a great many years' experience in ditching, and was originally compiled by the officials of the Canada Company, with the exception of paragraph *b*, which I have added myself, and I think it an improvement, and I have also added, or rather given, different names for the papers the contractor is to get his information from.

SPECIFICATIONS.

(*a*) The dimensions and cross-sections of the ditch shall in all cases conform with the plan, profile, and schedule hereto attached.

(*b*) The depths given in the schedule are *supposed* to be correct; but the contractor will, in all cases, verify the grade of the finished ditch, and make it conform with the grades given on the profile and schedule, even by so doing making a difference in the depth of any station.

(*c*) At all suitable places not more than — rods apart, spaces or openings, not less than three feet wide at the bottom and having side, slopes inclined at the rate of one to one, shall be left in the spoil banks, on either side of said ditch, to admit of the ready inflow of surface water from the adjoining lands.

(*d*) The whole shall be brought to a regular inclination at the bottom so that no water shall stand stagnant therein. The slopes shall be brought to a uniform angle throughout, and shall be dressed to a straight line from the top to the bottom thereof. And a clear *berm*, or margin, of not less than — feet, shall be left between the top of the slope and the foot of the spoil bank throughout the entire length of said ditch. That side of the spoil bank next the ditch shall have a batter of not more than one and

one-half to one. Except where angles may occur the ditch shall be made in straight lines, and all such angles be turned with gentle curves, to facilitate the flow of water.

(e) All stumps, roots, logs, or other obstructions, shall be cut and removed from the body of the ditch to some point beyond the berm.

(f) In timbered lands the trees shall be felled to a distance of _____ feet each side of the centre of the ditch, and the logs and brushwood shall be removed a distance of _____ feet from each side of the centre of the ditch.

The blank spaces can be filled in to suit the circumstances of the case, as no positive rule can be laid down to suit all. I consider, however, that the clearing should extend a distance of not less than six feet from the outside of the berm, and I would never make the berm less than three feet wide, and would exceed that by another foot in clay soils.

Grave mistakes are sometimes made by taking water out of the natural watercourse in order to make the ditch shorter, and again by putting the ditch along the sides of two roads meeting at right angles to avoid the cutting of a field at an ugly angle. The engineer cannot be too careful of such deviations, as a great number of long and expensive lawsuits have been the result of such false ideas of economy, especially in the latter case. Another thing to be avoided is that an engineer should lay out a ditch in such a manner as to take the water that formerly flowed through a certain lot altogether away from it.

It is sometimes the case, when a contractor has a contract that is not finished when winter sets in, that he will continue work if there be nothing in his articles of agreement to prevent him, under which circumstances great vigilance has to be exerted by the inspector or engineer. All snow must be shovelled clear of the spoil-banks, and the spoil-bank made on the natural soil, and not on the snow. The berm should be made wider and always kept clean, and at his periodical visits the inspector should see that all ice, etc., is removed from the ditch, for in winter a sheet of ice bears the same relation to the bottom of a ditch that an old coat and charity bear to sin.

When commencing a survey of a ditch, especially should it run through a beaver-meadow, the engineer will often be informed by "ditchers" (?) that it will be impossible to drain that place, and that they (the ditchers and others) have often shoved a twenty-foot pole out of sight, etc. It is generally very true about the pole, but it is not so true about the drainage so long as the fall that can be obtained is sufficient to allow the water to run off. There are very few beaver-meadows in the country with more than three to four feet of black muck on the clay, although the presence of clay might never be discovered by the running of a pole through the muck, for in an undrained state the clay is just as soft as the muck. In the bottom of a ditch, however, the clay very soon becomes stiff and hard just from the water flowing continuously over it. I have heard it stated that clay below a beaver-meadow will rise on the same being drained; but I think it was more on account of the muck falling than the clay rising that that idea was induced.

Ditches, like everything else, vary greatly in cost, ranging from ten cents per cubic yard, in a light, sandy soil, to sixteen cents per cubic yard

for bush work, including grubbing and clearing, and for a hard, stiff soil. The total cost of ditches, compared with the number of acres drained, will depend greatly on the length of the outlet and the width of the area to be drained, a narrow swamp not requiring so deep a ditch as a wide one; but it generally ranges from \$2 per acre up to \$7 or \$9 per acre.

Since the Ditches and Watercourses Act was passed in 1883 the following amendments have been adopted :—

Section 3	amended by	47 V.,	c. 43.
“ 10	“	48 V.,	c. 47, s. 1.
“ 11	“	48 V.,	c. 47, s. 2.
“ 18	“	48 V.,	c. 43, s. 5.
“ 15	repealed by	47 V.,	c. 43, s. 2,
and another section substituted therefor.			

Since the portion of the Municipal Act we have been treating was consolidated in 1883, the following amendments have been adopted :—

Section 570	amended by	48 V.,	c. 39, s. 25.
“ 584 (1)	“	48 V.,	c. 39, s. 25.
“ 584 (2)	“	47 V.,	c. 32, s. 18.
“ 586	“	47 V.,	c. 32, s. 19.
“ 586	“	48 V.,	c. 39, s. 27.
“ 587	“	48 V.,	c. 39, s. 26.
“ 589	“	48 V.,	c. 39, s. 26.
“ 593	repealed by	48 V.,	c. 39, s. 28.

In conclusion, I would like to have the opinion of this Association on the exact meanings of the words *ditch* and *drain*, and whether there can be strictly such things as *closed ditches* or *open drains*.

In this paper I have attempted to throw out a few hints regarding the working of the two different Drainage Acts of Ontario, and the most economical methods and times for using the same. I have not attempted to touch upon the subject of *apportionments* and *assessments* under the different Acts, as those points will in all cases appeal to the engineer's judgment, being guided by the benefit received by the different parties.

Clinton, Ont., March 1, 1886.

MUNICIPAL ENGINEERING.

THE MANAGEMENT OF TOWNSHIP ROADS.

BY JAMES C. BURNS,

Student, School of Practical Science.

THE purpose of this paper is to discuss briefly, from a practical standpoint, the management of the ordinary township roads of the Province. To do this I have selected as a typical case the roads of Blanchard Township, situated at the southern extremity of Perth County, convinced that what is here said in regard to this township will be applicable with some little variations, from local circumstances, to most of the townships of the Province. Generally speaking, this township has a rolling clay loam surface presenting few difficulties in regard to drainage. It is traversed from north to south by the River Thames, whose banks rise to a height of sixty to eighty feet on either side, giving to road makers a little experience in hill cutting and embankment. Entirely within the limits of the township is the market town of St. Marys, which, being an excellent grain market, attracts considerable heavy traffic, rendering it necessary to keep in good repair its main entrance. All the main roads of the township lead in the direction of this town. The cross lines or side roads are little used, and consequently need little attention. The main roads are those on which nearly all the expense occurs, and it is of them I will speak principally. In order to arrive at a correct opinion as to the manner in which these roads should be dealt with it is necessary to know how they have been built and brought into their present condition.

They have been built and maintained under what is known as the Statute Labour System. Under its working all the roads of the township are divided into sections, or "beats," from one to two miles in length, depending on the position of some suitable boundary. Each beat is put under the supervision of some local ratepayer with the title of pathmaster, who is appointed annually and expected to direct all the work done on his beat during his official year. Each resident ratepayer is taxed to do a certain number of days' labour on the beat, his amount of assessed property adjoining being taken as basis of apportionment. When the work thus done is found insufficient, contracts for repairing or construction are let by the councillors who act as road commissioners. All bridges and culverts are built and repaired by contract.

Such has been the practice in this township since its early settlement, and such is the practice generally throughout the Province for the maintenance of the ordinary township roads. Although possessing some good features, this system is not the most suitable for the construction and maintenance of good roads and should give place to a better.

All the roads of this township were located by the original surveys which were made with reference to main roads, built by the Canada Company, who were the first holders of the land of this township, before this township was settled. None of these pioneer roads touch Blanchard.

The turnpike system was made use of in the construction of seventeen miles of roads, but has been long since discarded as cumbrous and unprofitable. With the exception of this portion, all the roads have been built by Statute Labour.

The first thing done was to cut off the timber growing on the road allowance. Where low ground was encountered the smaller trees of this timber, from ten inches to sixteen inches in diameter, were cut in lengths of twenty feet. These were laid side by side transversely, butts and tops alternately, to keep the intervals at a minimum, the surface being kept as level as possible by the eye. If the spaces were unavoidably large small triangular pieces were split and fitted into them. Over this was thrown the earth from the sides to a depth of eight to twelve inches and thus was formed a corduroy road, so called from its ribbed character. The remainder of the timber was piled in heaps and burned. The stumps being green were often immovable, and to avoid those that were situated in the middle of the road allowance, bends were made in the graded portion. The old lines were always followed in all subsequent work, and these sinuosities are common in all the concession lines except the turnpike. By the time the clearing process was through most of the stumps could be removed from the portions first cleared. A width of about twenty feet in the middle of the road allowance being left, the earth on each side was loosened with a plough to a depth of six to nine inches, and conveyed to the centre by horse-scraper and shovel to a depth of eight to twelve inches, and about eight feet wide. In places where the ground was high no grading was done at all, the longitudinal slope being depended on to keep the surface dry.

The traffic soon compacted the clay and pressed it down, so that in the majority of cases it was only from two to five inches above the original level of land, and where no grading was done the track became a depression, passable only in dry weather. On the other hand, the narrow roadway was raised, when the ground was low and wet, to a height of fifteen to twenty inches, making a dangerous place to teams turning off, when meeting.

This was what was known as the clay, or, more commonly and appropriately, the *mud* road, for many years in use.

On this as a road-bed, pit gravel was hauled and spread loosely to a depth of eight to twelve inches, according to the fancy of the man doing the work. It soon became necessary to repeat this operation on account of the ruts which formed rapidly in this loose gravel, and this was done until, in some places, where the road is wet and springy, there is a depth of twenty to twenty-five inches.

Where the formation of the road-bed interfered with the natural course of the surface water, culverts were put in. These were at first made of logs. The logs were cut twenty feet long, about sixteen inches in diameter, and laid vertically above each other. Two of these were sufficiently high for the smaller culverts. The lower log on each side was held in place by being partially imbedded in the clay; the upper pair were held apart by

cross pieces mortised into them. On these cross pieces were placed poles four to six inches in diameter. In the larger culverts the logs were squared and held in position by end logs dovetailed into them at the ends, making a small angle with the longitudinal section of the road. Stringers were laid across and covered with planking. The planking generally used was rock elm three inches thick, twelve inches wide, and sixteen feet long. Some of these wooden structures have since been replaced by stone. The proper width for the waterway plus the thickness of the two side walls was taken out of the road. A wall of boulder stone, or, in some cases, rubble, eighteen inches thick, was then built, in nearly all cases without mortar, on a foundation usually level with the bottom of the waterway. This wall was built up within three inches of the level of the road surface, spaces being left for the insertion of three cross girders of wood flattened on the upper surface, on which was laid the plank, as tight as possible.

The defects of this condition of things are obvious. The superintendence of the work is placed in the hands of parties who have had no training or experience in the best methods of work, who have given the matter no attention or consideration, and who are consequently unskilled and incompetent to make the best use of the time and money spent.

No good road of any kind can be made and kept without a proper system of drainage, and this fundamental fact is almost entirely neglected by pathmasters. In many places no side drains exist at all, and where they do exist they are always too shallow. In the wet weather of spring and autumn, the seasons in which the traffic is greatest, the road-bed becomes saturated and softened, and unable to support the covering. Heavy vehicles cut through the gravel, bringing up the primeval muck, and mixing it with the covering, permanently ruining the road where it occurs, and rendering reconstruction necessary in the following summer. In other places, where the covering is not broken, but sinks, deep ruts are formed, which are allowed to develop till road-work time comes round. The gravel on the road soon becomes beaten down in three parallel lines, two where the wheels run and one in the middle where single horses travel. These constitute three shallow trenches which retain the water, and allow it to saturate the road covering, rendering it soft and easily cut by wheels. The original road-bed is too narrow, the highest portion in the centre being only ten feet wide and between side drains twenty feet. The high ridge of clay and gravel is dangerous to turn off, and in some places it is impossible to do so. Too great depth of gravel is put on at one time, and it is a long time before it is possible to go over it with a heavy load. In this condition the traffic seeks the side of the road when possible, cutting it and bringing the clay on the gravel.

The gravel is taken from the nearest pit, with no regard to its quality, and always contains too much clay or large stone to make a good road. All kinds, from coarse sand to stones three inches in diameter, are thrown on, and left for the traffic to compact. The large stones are the worst, as they cause ruts on either side from the concussion of the wheel as it drops over them. It usually takes about three months of light traffic to put the roads in condition for the heavier traffic.

Wooden culverts are a constant source of danger, being generally in a state of ill-repair. The foundations are not put deep enough, and the

water very soon undermines them, allowing the walls to fall in, in which condition they are usually allowed to remain, until complained of by some one who suffers by their condition. Then some one, who generally knows little about them, is entrusted with their reconstruction, and no improvement is effected. They are usually much shorter than the width of the road, leaving dangerous holes at the ends. Moreover, they are not economical, decaying, as they do, so rapidly from the alternate wetting and drying to which they are subjected. The cost in this township of culverts in repairs alone for the year 1884 amounted to \$358, a sum which does not include any new ones built.

Of the bridges—five in number—maintained by the township I need say nothing, as they have been well and properly built by competent engineers, and are models of their kind, except that I think it poor economy to build wooden structures when stone is as convenient as it is in this township.

To effect an improvement in the condition of these roads, thorough drainage of the road-bed is a prime necessity. This can be provided by an open drain on each side of the road, with side slopes of one to one and a width of one foot in the bottom. The slopes should be sodded or sown with grass seed to keep the clay from washing down. The earth from these drains should be used to level up the sides of the road. These drains will carry off all the surface-water of the adjacent soil, and prevent it from percolating through the road-bed.

Where the road-bed is spongy or inclined to be springy, cross-drains should be put in. Where there is no longitudinal slope to the road-bed these may be put in at right angles to the side drains; but if they are put in on a slope, they should be of the form of a broad letter V, with the angle pointing up the slope.

They should have a fall of one in thirty to one in one hundred, and should empty two inches above the bottom of the side-drains.

Another suitable style of underdraining is to put in longitudinal drains, with cross-drains leading to the side-drains. Two of these will be sufficient, and should be equidistant from the side-drains and from each other.

They may be made of tile, brick, or stone. The ordinary one and a half inch or two inch draining tile will be sufficient, and where they can be obtained conveniently will be found to be the most economical, and give good satisfaction. A covering of straw or leaves on them before the clay is put on will act as a filter, and prevent the clay from washing into the tile. With a fall of one in one hundred, a one and a half inch tile will discharge 12,000 gallons of water, and a two inch tile 22,890 gallons per day of twenty-four hours, which is considerably more than will ever be required of them in the sub-drainage of roads. H. F. French, in his standard work on farm drainage, after a careful estimate and comparison of stone, brick and tile, concludes that "drainage with tiles will generally cost less than one half the expense of drainage with stone, and will be incomparably more satisfactory in the end."

As tiles are easily damaged by the action of frost, their ends should not be left exposed, but the last two or three feet of these cross mitre drains should be finished with a blind drain of stone, made by throwing the stone in loosely. Surface drainage of the road is provided for by the slope given to the road, as will be described further on.

To allow the water collected by the side drains to flow in the natural watercourses from the upper side of the road to the lower, culverts are needed. The size of the culvert should be proportional to the greatest amount of water it will ever be required to give passage to, and should always be large enough to admit a boy to clean it out. If square, eighteen inches each way, and, if circular, twenty inches in diameter, is sufficient for this purpose. Wood should not be used in the construction of culverts, as the alternate wetting and drying to which it is subject is peculiarly conducive to rapid decay, and the weakness cannot be noticed until it makes itself felt by some disaster to life or property; besides, it is a source of much annoyance to traffic to have to take the side of a road while a culvert is being built.

Culverts should be made so as to last as long as possible, and for this reason, if not as a matter of economy, they should be built of stone, concrete, or brick. Where stone can be obtained conveniently, it will be found to amply repay the extra cost of construction by its solidity, permanence and consequent safety. The floor should be made of concrete, or of small stone grouted with cement, to provide a bed that the water will not wash out, and to render the cleaning-out easier.

The walls should be built on a solid foundation, got by digging down to the solid clay, and should always go below the flooring. The mortar used should be made of cement, as it best resists the action of water. The floor should be concave, and have an inclination, towards the outlet, of one in one hundred and twenty to one in thirty.

To prevent the flooring from being undermined, the stones should be sunk on edge across the upper end of the waterway. To protect the sides, end walls are built a few inches higher than the road to prevent the water from washing over them. They are inclined at a suitable angle to the longitudinal section of the road.

The length of the culvert should be the same as the distance through the road on a line with the crown of the arch, which should always be low enough to allow a thickness of six to ten inches of road-covering on top, preserving the proper height of road.

A culvert properly built will never need repairing, will be always perfectly safe, and of no expense, save for cleaning out once or twice per year.

In excavations it is not advisable to leave open drains at the sides, as they would quickly fill up with the clay washed down from the banks. Covered side drains are much to be preferred. A sufficient cross-section of waterway should be constructed of rubble stone, and the drain then filled up on top with broken stone. This will allow the entrance of the water and prevent that of dirt.

The upper end of this side-drain should not be left open, as sticks, leaves and dirt will enter with the water and soon choke up the drain. A blind drain, three to five feet long, should complete this end, unless it be a case of cutting a short hill, when there will be a fall both ways, and, of course, such a precaution would be unnecessary.

To prevent the sides from washing down, they should not have a grade of more than two to one, or in extreme cases one to one. The banks of hill-cuttings, when the work is under the direction of non-professionals, are always left too steep, the object being to save the expense of making the cutting wide enough at the top.

When the cutting is on a hillside the upper edge should be protected by an underdrain to carry off the rainfall of the ground above, and prevent it from percolating through the bank. When the bank is spongy, or infested with springs, it should be drained in the same way as has been described for the sub-drainage of a similar road-bed. A light covering of fertile earth applied on the bank, and seeded with some suitable hardy grass, as June or Blue Grass, will produce in a few months a tough sod which will prevent the washing down of dirt, and hinder any tendency to the formation of water-ruts on the sides. This seeding or other sodding should be applied to all embankments or approaches to bridges, to prevent the growth of weeds or the washing away of the clay.

The width of a road is an important consideration in its construction. As a general rule, narrow roads are more economical than wide ones, and consequently roads should be made only wide enough to suit the convenience of the traffic over them. For an entrance to a town, where there is considerable traffic both ways, the road-covering should be wide enough to allow two vehicles to meet and pass without leaving the metalled portion, and if the traffic is very great, still wider. For this purpose sixteen feet to seventeen feet will be sufficient. On the ordinary concession roads of a township, where the bulk of the traffic is in one direction, provision for the width of one vehicle is sufficient, the unloaded ones conceding the right of way to the loaded ones. As the metalled portion is put in the centre of the road allowance, the sides should be wide enough to allow the easy passage of those turning off. Eight feet of metal and ten feet of side will give sufficient room for these purposes, so that we will have a total width between side-drains of $10 + 8 + 10 = 28$ feet. A common width prescribed is thirty feet, and this may be taken as the best for all common roads. The transverse form best for roads has given rise to a good deal of discussion among engineers. The arc of a circle or of an ellipse is recommended by some, while others prefer two inclined planes sloping towards the side-drains, and connected in the centre by a short convex curve. Objections are raised to the former that the centre will be nearly level, and will hold the water, unless it is carried off by a longitudinal slope; that carriages will keep on the centre in order to run on the level, thereby causing excessive wear along one line; and that the wear of the sides is great when traffic is forced on them, on account of the tendency to slide on the part of the wheels. For these reasons the second form is more generally adopted.

The highest point of the middle arc should be in the centre of the road, and it should be drawn to a radius of eighty-five or ninety feet. The degree of inclination of the flat slopes should be from one in twenty to one in thirty for township roads. Drainage is assisted by giving the surface a longitudinal slope of at least one in one hundred and twenty-five, which can always be done, even where the surface of the ground is level, at little extra expense.

Where sidewalks are constructed on the side of the road, the water from the gutter, between the sidewalk and road, is conveyed into the side drains by small covered drains running under the sidewalk.

They may be near the surface, but not rising higher than the surface of the sidewalk, and should have a fall of one in ten to one in twenty, so

that they may promptly discharge all water from the gutter, and do not need cleaning often. They should be of sufficient cross section to admit the easy working of a long handled hoe, which may be used for the removal of whatever the water does not carry through.

Sidewalks are not necessary on roads of so little foot travelling as those of most of our rural districts, except in the vicinity of towns, and in these places, their construction is a much needed improvement. Under present management, when the muddy seasons of the year come round, it is impossible to travel on foot, except on the road sides. The sides are not prepared for travel, and, in many places, they are impassable. Besides the advantage for foot travel, a sidewalk is a safeguard from getting off the road on dark nights, a consideration by no means insignificant.

In order to construct a sidewalk, the roadway should be widened to the extent of five or six feet, graded to about the height of the centre of the road, and sloped gently outwards towards the side drain. The new grading should be well compacted as it is filled in, and then given some time to settle. A light coating of broken stone, topped off with two inches of screened gravel, should then be added and rolled with a light roller, or, if broken stone be too expensive, a coating of rough gravel three inches thick should be put on the clay and rolled. After this has become compact, the fine, sifted gravel, which has passed through a sieve with meshes half an inch in diameter, is then added and rolled.

If there is much clay in the gravel, it should be screened through a fine sand sieve, and what will go through, be rejected.

Pit gravel usually contains too much earthy matter for road-making and should be screened: first, to remove the large stones, through a sieve with meshes one and a half to one and three-quarters inches square, or, if less troublesome, these stones may be picked out, as the gravel is being loaded; secondly, to remove the clay and fine sand, through a sieve with one-half to one-quarter inch meshes. What is retained on the sieve at the second screening is the most suitable gravel for the top layer of road-covering. As the majority of township roads have already a thick coating of gravel, this gravel would be the most suitable for application to them. The second screening must not be pushed too far, as it will be well to have sufficient earthy matter remain to act as a matrix for the gravel when it is rolled.

When it is necessary to secure a sufficient depth of road-covering, or where the proper cross section requires a coating of gravel, the present road surface should be prepared for its reception by cutting off the edges, which are generally higher than the tracks, and removing any stone that would interfere with the proper shape of the road.

The gravel should then be applied, and adjusted to the proper form with rakes or shovels. The work of compacting the gravel is best done by the use of a roller, five to six feet long, and weighing one and a half to two tons. This is as heavy as can be used at first on loose gravel, but, as it consolidates, a heavier one may be used. It is convenient to have a roller that may be loaded, as the work proceeds, to any desired weight up to six tons, which will be sufficient for any gravel road.

A good form of roller is made of two hollow cylinders of cast iron, set abreast on a strong wrought iron axle, making, together, a length of five

feet, with a diameter of five to six feet. These cylinders are set in a wooden frame, and have apertures in the ends, through which they may be loaded up to the desired weight. A roller of this kind, weighing one and a half tons and capable of being loaded up to six tons, would be the most suitable for township use. Another form of roller is so designed that when an increase in weight is wanted it may be filled with water which may be emptied out when moving from place to place. Road rollers propelled by steam are also used, but are more expensive and require more care.

Not more than three to four inches of gravel should be applied at once without rolling; layer after layer being formed until a sufficient height and proper cross section is attained. The rolling should be done when the gravel is damp, but not so wet that the earthy matter will collect on the surface in a semi-fluid state. If the gravel have not sufficient binding material to make it pack firmly, a little stiff, sandy clay or stone dust must be added.

The sides of the road should be rolled first, until they are compact enough to resist the tendency of the gravel to spread sideways when the roller is placed on the middle. While the rolling process is going on men should be in attendance to fill up depressions, and keep the surface at the required form of cross section. The rolling should be continued until the covering is forced down into a solid, firm surface which will be nearly watertight.

There are two methods in use on the best roads of keeping them in an efficient state, the choice of which depends on the amount of traffic to be provided for. (1) The method of minute and daily repairs by which the road-covering is constantly maintained at the proper thickness. (2) The method of partial repairs accompanied by the addition of material at stated intervals; the former applicable to roads of moderate traffic, the latter to roads of great traffic. As our roads come under the first heading it is the method we should adopt.

In order that the road-covering be maintained, so that extensive repairs will never be needed, minute repairs to the surface should be made systematically in small patches as soon as ruts or depressions appear. The road should be constantly undergoing repairs.

To have this done the road should be divided into lengths, on each of which an intelligent labourer should be placed, who thoroughly understands his business, to attend constantly and at all times to the condition of the road, and for which he should be held accountable. He should keep the ditches in good order, and fill in the ruts and depressions as soon as they appear.

To enable him to do this, gravel, or broken stone, should be deposited in suitable places on the side of the road, one heap in each quarter of a mile. He should be furnished with a wheelbarrow, a shovel, a pickaxe, and a rammer. In spring and autumn, when the road is wet, and more work needed, other men should be placed under their charge without, however, easing them of their responsibility.

The new material should be added, little by little, from time to time, in depressions and deficient places, and it should be broken fine in comparison with that used in the original construction. This patching should

be done so constantly that it will never be necessary to add more than one to two inches in thickness at a time. If done when the road is firm and dry the surface of the depression to be filled should be loosened with a pick to a depth of half an inch, and taken out to put over the new material. This will promote a close union of the two materials. The patching should be firmly rammed with a rammer of twelve to twenty pounds, or it may be rolled. Ruts should not be filled with material harder than the original substance of the road ; but the filling should be as much like it as possible. The deeper the ruts to be filled the coarser the material used may be.

It is one of the greatest mistakes in roadmaking that can be committed to lay on thick coats of material. If the thickness of the road covering is to be properly kept up it should never be necessary to put on more than a stone's thickness at a time. A cubic yard nicely prepared and broken to a rod superficies will be quite enough for a coat, and if accurately noticed will be found to last as long as double the quantity put on unprepared and in thick layers.

This is what a high authority (Penfold) says of broken stone, and the same observation applies with equal force to gravel roads :—

In long continued drought the binding becomes baked and hard allowing the small stones to become loose and wear each other. This may be remedied by sprinkling the surface and rolling with a light roller. The sprinkling should be as much like a light shower as possible so as not to make the surface too wet.

In speaking of the system of keeping up the roads by constant patching, Gillmore says :—

“ This system of maintenance for roads of moderate traffic seems open to the objection of being unnecessarily expensive, but observation and experience have fully demonstrated that such is not the case, and that the ‘ stitch in time ’ policy applies here with peculiar and significant force. It is not only vastly cheaper to maintain such a highway in good condition for a given traffic adapted to it than to pay the extra expense of conducting the same traffic on a bad road, but is also vastly cheaper to keep the road in excellent order than it is to restore it to that state after a period of injurious neglect, during which it has become filled with deep ruts and thickly covered with dust and mud.”

“ The French engineers of the Corps des Ponts et Chaussées were the first to give anything approaching to an exhaustive practical study to this question. It was found that in proportion as the intervals between the periods of repairs were shortened upon roads of small traffic two important and valuable results invariably followed, viz., that the annual expense was lessened ; and that the roads were always in better condition ; and, finally, that the roads were never so good, nor the expense of maintenance so small as when the system of unremitting and minute attention was in full operation.”

That the cost of putting the township roads in a state of proper repair, and of so maintaining them, would be repaid many times over by the saving effected in the expense of conducting the traffic over them alone could be easily and completely demonstrated did the limits of this paper permit. The discussion of this phase of the question, however, must be omitted as also that of the many side advantages upon which it is difficult to place a

money value, but which are inevitable consequences of a good system of road maintenance, such as, economy of time due to greater speed, a longer endurance of animals and vehicles, the advantage of lighter and cheaper vehicles, freedom from excessive dust and mud, the increase of population attracted by the better facilities for commercial intercourse and consequent increase in the value of real estate.

These considerations alone would furnish sufficient argument in favour of putting our roads in a state of efficiency such as has been described—a thing which is manifestly impossible under the present system of administration.

The Statute Labour System was devised to meet the requirements of early settlements, when a simultaneous opening of all the roads in a township was the thing most desirable. Its chief advantages were that under its working each ratepayer was permitted to do his share of the road build-in his own immediate neighbourhood, and that he was able to pay his road tax in labour rather than in specie; but these considerations, however important at first, have since lost all their force.

The portions of road in which all are most interested are those in the neighbourhood of the town, which are used in common by all, and the second consideration has come to be considered a doubtful privilege, as time is quite as valuable to the farmer on his property as on the road. Owing to the laxity of pathmasters, the time spent on the roads is flagrantly misapplied. The day required is eight hours long, and any pretence of work is accepted. The impression is prevalent that in road-work the time is to be put in with as little exertion as possible. The real amount of gravel hauled is never so great as the amount reported, on account of smallness of waggon boxes and the desire of teamsters to save their horses. Anyone who has observed statute labour will agree with me that over one third the prescribed time is wasted through the trickery of workmen and the carelessness or ignorance of directors. As an example I present the following:—

The Township Council pays thirty-five cents per cord for gravel, and counts five loads to the cord. By actual measurements I find the average gravel-box used is eight feet long, three feet one inch wide, and ten inches deep, five of which, if filled, would hold $4\frac{5}{8}$ of a cord, showing a loss of $\frac{1}{8}\frac{7}{8}$ of a cord on each cord paid for, or a total loss of $\frac{1}{8}\frac{7}{8}$ of the money paid out, which in 1884 would be $\frac{1}{8}\frac{7}{8}$ of \$524=\$110 nearly; and, besides, the boxes are seldom filled.

Subjoined is a statement of the expenditures on the Blanchard Township public roads for the year 1884, as taken from the Auditors' Report, together with a statement showing how a better result at a smaller cost is possible under a proper system of management, the standard wages in each case being that fixed by the Council:—

ASSOCIATION OF PROVINCIAL LAND SURVEYORS.

PRESENT SYSTEM.

2,757 days statute labour	\$2,757 00
Contracts for gravelling	805 00
Contracts for grading	238 00
Repairing culverts	358 00
Contracts for ditching	95 00
Other work on roads	6 00
	<hr/>
Total	\$4,259 00

PROPER SYSTEM.

Six men for eight months @ \$208	\$1,248 00
Seven teams and drivers for five months @ \$260.	1,820 00
Engineering	800 00
	<hr/>
Total	\$3,868 00

SURVEYOR'S INSTRUMENTS.

BY MATTHEW J. BUTLER,

P.L.S., Assoc. M. Inst. C.E., M.Am.S.C.E., Napanee.

By way of preface the writer would remark that in the use of instruments a great deal more depends on the eye that looks through the small end of the telescope than on any perfection of mechanical construction. A good man will do better work with an inferior instrument than a poor one with all the latest improvements.

For various reasons, the writer thinks it advisable in discussing this question, to divide the subject into two groups, viz.: those of English and those of American manufacture, then to select instruments of different manufacturers as typical of their class and give notes on the particular instrument.

ENGLISH INSTRUMENTS.

Only two eminent manufacturers are known to the writer, viz., W. F. Stanley, 4 and 5 Great Turnstile, Holborn, London, and Troughton & Simms, of London, England; and, as the writer has had some ten years' practical experience with Stanley's instruments, they will be first described.

Stanley manufactures every variety of instrument that can possibly be required in the various duties of a surveyor. His drawing instruments are undoubtedly the best known to the writer, and when quality is taken into consideration, the cheapest.

Transits.—Two varieties are manufactured, one known as Stanley's Improved, with illuminated axis, diagonal eyepiece, extra fittings, striding levels, etc., his best workmanship; sold at, for six inch instrument, graduated so as to read to twenty seconds of arc, £34; when delivered in any part of Canada, duty and all other charges paid, will cost \$225.

The other instrument lacks the illuminated axis and the diagonal eyepiece, but is, in every respect, a very high-class instrument.

The writer has had one in constant use for the past ten years, during which time it has been used on all classes of work, viz.: Government surveys, farm and town surveys, railroad construction and location, hydraulic work, etc. It has been drowned once, been in a runaway accident, been through several railway accidents, and, in a word, have been subjected to pretty rough usage.

Notwithstanding all this, it has only been found necessary to adjust it four times, and, to-day, the writer can sight it on a fine picket and turn an angle of one hundred and eighty degrees, reverse the telescope, and strike the picket every time; or, even a more difficult test, plant five pickets in a direct line running from the instrument at distances of one, two, three, etc., chains, remove the instrument to the last one and sight back, and strike every picket on the line. But few instruments will stand this test. The objections to these instruments are their weight, lack of power in the telescope, and in their graduations. They only read from zero to three

hundred and sixty degrees around to the right ; in turning an angle to the left, subtractions from three hundred and sixty degrees have to be made—a great inconvenience in railroad work.

It is also somewhat difficult to set them exactly over a point, particularly on side-hills, as it has to be done entirely by the manipulation of the tripod ; the addition of a shifting centre would be a great improvement. This instrument costs, laid down in any part of Canada all charges paid, \$186. The five-inch Transit Theodolite, reading to thirty seconds of arc, similar in every respect, costs, laid down, \$145.44.

Levels.—A more marked difference is found in levelling instruments than in any other class, when we come to compare English and American instruments. The Dumpy Level is the usual form manufactured in England, whereas, in America, the Wye Level is the favourite. Equally good work can be done with either class of instrument. When we come to examine into a reason for this marked difference in the choice of a levelling instrument, we can only see a peculiarity in each nation. The Englishman wants his instruments handed to him in such a way that every part is of the most substantial character, and that everything that by good workmanship can be made permanent shall be so done. He requires that the instrument maker shall do his portion so well that but few parts can become disarranged ; therefore, his adjustments are few and difficult to make—but then they will not require to be so often attended to.

Whereas, in the case of the American, he wants everything left in such a way that if anything should go wrong the user can fix it himself, and it is natural that such should be the case, from the fact that in the early days on this continent, when the present types of instruments were selected, instrument makers were few and far between, the engineer or surveyor would find himself thousands of miles from an instrument maker, when, owing to a fall or other accident, some of the so-called permanent adjustments would become disarranged, and as only a maker could repair them, it would cost nearly the price of the instrument to have it done. In this way, improvements were brought about intending to obviate the necessity of sending the instrument to the factory ; but as there are instrument makers now to be found in nearly every city on the continent, it is a comparatively easy matter to reach them. Hence it seems to the writer that the fewer parts there are to an instrument the better ; that if provision is made in the manufacture of the instrument for adjusting parts that should be made perfect in the manufacture ; the necessity for the adjustment will frequently arise. Simplicity and not complexity should be the desideratum. Have as few adjustments as possible, but have the instrument perfect before leaving the factory.

Stanley, of London.

Stanley's Improved Level is of the Dumpy pattern with a few modifications ; the base or tripod-head is composed of three radiating arms, making a wide, firm base to level up from ; only three screws are used in this instrument in levelling it up. The collimation is put in differently from any the writer has seen elsewhere. It is formed by means of a dagger point which goes to the optical centre of the telescope, thus leaving one-half of the field of view wholly unobstructed. It permits of easy

adjustment by means of a jam nut and screw, which permit the moving in and out of the pointer so as to just exactly reach the optical centre of the telescope. The writer, however, does not consider it equal to the ordinary spider web, and has had it taken out and the latter substituted.

The telescope on this instrument is of extra good power; large, flat field, free from aberration. The writer has read an ordinary Sopwith self-reading rod, graduated to $\frac{1}{100}$ of a foot, at a distance of 2,000 feet in favourable weather. Although this instrument has been in pretty constant use for about four years on railroad work, it has not yet been found necessary to adjust it.

The cost of this twenty-inch instrument, laid down in any part of Ontario, all charges paid, is \$115. Stanley also manufactures Dumpy Levels of the well-known Grovatt pattern. A sixteen-inch instrument of this class can be laid down in any part of Ontario for \$103.

Troughton & Simms.

The instruments manufactured by this firm have long held a deservedly high place in the estimation of Surveyors. The writer regrets that he has not in his possession a price list so as to be able to compare prices with Stanley and other manufacturers of good standing. The Reiterating Transit of this firm calls for special mention. It has three verniers, the upper limb carrying the verniers is the only one that moves, the lower limb is permanently attached to the tripod-head. The telescope is of very high power, and is particularly suitable for astronomical observations and work of that class; in fact the instrument is only applicable to work where great accuracy in laying down meridian is called for. The wants of our Dominion Lands Department have brought it into existence.

AMERICAN INSTRUMENTS.

The style of Transit Instrument manufactured by American instrument makers of good repute, while embodying the same general characteristics as those of English manufacturers, differs in detail very much. Transit Theodolites of American manufacturers are probably superior in many respects to any others in the world. They are very convenient in use, and as accurate as any made.

The improvements to be found on an American instrument may be enumerated as follows:—

The telescope has greater power, all screws are protected from rain and dust by caps, the object-glass and eyepiece slide are protected from rain and dust. By an arrangement the centre is made so as to shift, enabling the instrument to be easily and quickly placed over a given point, the tripod having first been set approximately. They are very much lighter, an instrument of the same size of English pattern will weigh from one-half to two-thirds more than an American one.

W. & L. E. Gurley, of Troy, New York,

Are large manufacturers of every kind of instruments; their Magnetic and Solar Compasses are to be particularly commended.

Heller & Brightly, and Young & Son, of Philadelphia.

Both of these firms manufacture a high-class Transit with all modern improvements. The cost of a six-inch Transit, laid down in Ontario, will be very approximately \$300.

They also manufacture Wye Levels of extra good quality. The cost, laid down in Ontario, for an eighteen-inch instrument is very approximately \$200.

Brandis, of New York,

Manufactures very high grade instruments, both Transits and Levels.

His seven-inch Transit Theodolite can be laid down for \$345.

His eighteen-inch Ordinary Level can be laid down for \$195.

His Level of Precision costs, laid down, \$350.

Buff & Berger, of Boston, Mass.

This firm also manufacture high grade instruments ; in many respects their instruments are very superior ; they also, in addition to Transits and Wye Levels, make a Dumpy Level.

Their Transit Theodolite, six-inch instrument, costs, laid down in Ontario, about \$350.

Their Wye Level, eighteen-inch instrument, costs, laid down in Ontario, \$200.

Their Dumpy Level, fifteen-inch instrument, costs, laid down in Ontario, \$150.

There are other makers who do good work, but, as a fair representation of American manufacturers has been given, it has not been thought necessary to enumerate them.

The prices of American and English instruments given are current as taken from the published catalogues and price lists. The duty and freight charges have been added to bring them to Ontario.

In Canada, Foster, of Toronto, and Hearn & Harrison, of Montreal, also manufacture Transits, Levels and Compasses.

James Foster, King Street, Toronto, is now manufacturing a Micrometer (Lugeol's) that is said to give entire satisfaction. It may be briefly described as follows :

An ordinary telescope, thirteen inches long, with an object glass two inches in diameter. The object glass is bisected ; by the aid of a screw the upper part is made to slide on the lower, in this way two images of an object are formed. The images of two vanes fixed on a target rod are brought into contact ; by the aid of a Micrometer screw the angle is read, and a constant for each instrument, varying with the base, is determined by experiment. This constant is multiplied by the Micrometer reading which gives the distance.

It differs from the Rochon Micrometer in that both images are of equal brightness, thus giving better definition of the base. Price, \$65.

Foster also manufactures a new and improved form of Planimeter, designed by Cortez Fessenden, Esq., M.A., and the writer. It may be briefly described as follows : By the combination of the sliding motion of a parabolic curve and the revolving one of a bar at right angles to the axis

of the parabola a pointer is made to follow the outlines of any irregular figure. A wheel is placed at the vertex of the parabola, and is a function of it; it is so related to the pointer that while the pointer describes a periphery the wheel describes an area, thus integrating by polar coördinates any required area. The only skill required in its use is that of being able to read a vernier.

The prices of Foster's other instruments are about as follows :

10 in. Drainage Level	\$40 00
12 in. Dumpy Level	70 00
14 in. Imp. " Level	95 00
18 in. Wye Level	130 00
5 in. Railroad Transit Theodolite	160 00
5 in. Transit Theodolite	195 00

From the prices given of Canadian manufacture it will be seen that they compare very favourably with those of any other manufacturers in either the United States or England. Surveyors who have had practical experience with all kinds of instruments say that they are of equally good quality.

QUIRKS.

BY THEO. DELIGHT.

ALTHOUGH now considered by most of my professional brethren as somewhat *antiquated* and *rusty*, I am still in the field, and can, I think, run a line as well as the best of them.

My line of life, however, may soon be run, and I oftentimes think I hear them shouting at the post ahead, which necessitates, generally, an obtuse angle in my line.

Well, well, I did not intend moralizing; but to offer to the profession a few "quirks" which may be of interest to some, and furnish recreation for others.

Quirk No. 1.—When I first became the proud possessor of a *Theodolite*, I found that, in taking observations of *Polaris*, the azimuth angle read when the telescope was in normal position $1' 30''$ different than when taken in reversed position, the upper plate being turned 180° in azimuth. I tested my instrument, and found that the line of collimation would cut a vertical line, and also that the graduations of horizontal plate were correct. Can some of our clever young surveyors suggest what was wrong?

Quirk No. 2.—A deed is placed in my hands which was drawn by a city lawyer (now a judge in the Superior Court), some twenty years ago.

The description reads as follows:—

"Being composed of the rear part of the west corner of the east half, of lot number three, in the sixth concession of——; containing by admeasurement five acres of land, being of the whole width of the said west corner of the east half of said lot, and of sufficient depth to comprise five acres."

The side lines in this concession are N. 24° W., concession lines N. 56° E.

This property, although wild lands, is now valuable, a mine having been discovered on the rear of the lot, and I am asked by the present owner to survey it, giving him his five acres.

Quirk No. 3.—In 1870 a Provincial Land Surveyor makes a plan of a suburban property, shewing it as subdivided into building lots, streets, lanes, etc., which plan is duly registered with all necessary certificates thereon.

It is afterwards found that the surveyor never staked out on the ground the lots or streets shewn on the plan. He merely took the property, which was a ten acre park lot, as shown on a previously registered plan, and subdivided it on paper. Should such a plan have been registered?

Quirk No. 4.—The sides of a township lot are as follows:—AB 30 chains east, BC 80 chains north, CD 20 chains west, DA 81 chains, more or less.

The bearing of side lines is north. What is the method of dividing this lot into east and west halves—each of 100 acres.

Quirk No. 5.—A man purchases the east half of a township lot which was fenced when he bought it. After holding it over ten years he sells west half of his half, retaining the east quarter of lot.

The last buyer wishes his land, as purchased, surveyed ; and it is then found that the east fence is correct, but the west fence, supposed to have been on the centre line of the lot, is too far east by one chain.

If from fence to fence is nine chains, and the farm has parallel ends and sides, how is the surveyor to proceed ?



*R. Hurwood
Depy Surveyors*

BIOGRAPHICAL SKETCH
OF
REUBEN SHERWOOD,
DEPUTY SURVEYOR.

THOMAS SHERWOOD, the first actual settler in the United Counties of Leeds and Grenville, located on lot No. 1, in the first concession of Elizabethtown, in June, 1784.

At the commencement of the Revolutionary War he remained loyal to the British Crown, and escaping to St. John's, Lower Canada, *via* Lake Champlain, was employed in the Secret Service, going into the States and enlisting men to serve His Majesty King George III. His two brothers entered the Continental Army.

Soon after his settling in Elizabethtown he was appointed a magistrate and a captain in the militia, and being a man of education was called upon to run the side lines of the lots for the first settlers, and to show them the location of their land. Though not a legalized Surveyor he had the instrument and understood its practical use.

His son Reuben was born in 1775. He studied with Ephraim Lay in the State of New York, then a British Province. There is no record of when he was appointed a Deputy Surveyor, but he was conducting surveys of townships in 1799.

From 1809 to 1820 he was employed in Government Surveys, subdividing into township lots (on the single front concession plan) the whole or part of each of the following townships, *viz.*:—Augusta, Bastard, Bathurst, Beckwith, Burgess, Crosby North, Crosby South, Drummond, Elizabethtown, Escott, Kitley, Lansdowne, Leeds, Marmora, Nelson, Pittsburgh, Sherbrooke, Storrington, Nassagaweya, and Yonge.

Until his death in 1851 he continued to practise his profession in this Province, and with him many served their apprenticeship who afterwards became prominent Surveyors. Among these were the following:—John McNaughton, Richard Birdsall, J. S. Dennis, and W. Harry Kilborn.

We will add to this brief sketch a few extracts from his Diary, which will give a fair idea of the hardships suffered by Surveyors seventy years ago.

EXTRACTS FROM THE DIARY OF REUBEN SHERWOOD, D.P.S., ON THE
SURVEY OF THE TOWNSHIPS OF NELSON AND NASSAGAWEYA.

SURVEY PARTY:

Alexander Robertson,	}	<i>Chairmen.</i>
Charles McLean,		
Alexander Hamilton,	}	<i>Axemen.</i>
Henry Glennon,		
Nathaniel Gilchrist,		
J. B. Pichette,		
Francis Pichette,		

Monday, 25th February, 1819.—A snowy morning, the party all employed in arranging for bread, axes, pease, etc. Mr. Hopkins not at home. Mr. Chisholm also away. Gave the men one quart of whiskey in the morn, and gave them one quart of spirits on the road up. Purchased from Ostrander, blacksmith, four axes, ready helved and ground, at eleven dollars. * * * * *

Thursday, 4th March.—It snowed mostly all night and I could not get the stars in my horoscope, in the morning opened and proved Wilmot's line. * * * * *

Saturday, 13th March.—Snowing again in the morning. I go out with the party and finish the 2nd concession line to 15 and road. Return again at 7 p.m.; find Hudson arrived. An exceeding cold night; about fifteen inches of snow on the ground. Broke my compass-glass in coming home.

Sunday, 14th March.—A cold day. The boys go out and bring three packs of biscuits in, and all get drunk. * * *

Sunday, 21st March.—Hamilton and Baptiste leave me. I go out to Hopkins. See Mr. Merritt in the evening with Capt. Chisholm. Go in search of snowshoes, and travel all night, and next day breakfast at Ancaster.

Monday, 22nd March.—Obtain four pairs, and return by the way of Dundas. Meet McLean and Gilchrist on Dundas Street with a keg of whiskey, and send out three pairs of the snowshoes. I sleep at Hopkins.

Tuesday, 23rd.—Go out and find all my party *squibby*, having drunk up my whiskey and their own, and they had not moved the camp. * *

Saturday, 27th March.—The snow having frozen last night, we mount the snowshoes and move to No. 6 in the 5th concession, and run said line to No. 11, all good land. A fine creek in No. 8 runs easterly. * *

Friday, 9th April.—A fine day. We move down to the east angle of the township again to commence the townline. Robinson being in rear of us, the ice left him on the other side of the creek, and he could not get to us till I sent an axeman to him. The low lands all splash, and all the flats afloat, so that I could not make any headway. I prepared for the meridian again and took it. * * * * *

Thursday, 22nd April, 1819.—Commence the new township. Mosquitoes bite some to-day. * * * * *

Sunday, 25th.—A fine day. I go out with McCollum. Find the men asleep in the road. * * * * *

Monday, 3rd May.—Start to York on old buck, and arrive at 7 in the evening. * * * * *

Tuesday, 4th May.—Meet the Surveyor-General in the morning, and draw my lands in Nelson and Nassagaweya. * * *

Friday, 14th May.—Come out, and all hands *squibby*, nearly. I settled my accounts thereabouts.

Memorandum of “camp furniture” used on the survey of Augusta in 1810, as given in Reuben Sherwood’s notes:—

4 axes.
 1 hatchet.
 6 tin cups.
 4 iron spoons.
 2 wooden spoons.
 1 tin pan.
 1 camp kettle.
 1 tin pail.
 3 bags.
 8 blankets.
 1 gun.
 Pouch, horn and shot-bag.
 1 compass and chains.
 1 marking-iron.
 Old case of protracting instruments.

LIST OF MEMBERS.

NAME.	OCCUPATION.	ADDRESS.
Abrey, George Brockitt.....	31 King Street East,	Toronto.
Aylesworth, Wm. Robert.....		Deseronto.
Beatty, David		Parry Sound.
Bell, James Anthony		St. Thomas.
	City Engineer.	
Blake, Frank Lever		Toronto.
	Astronomical Assistant at Observatory.	
Bolger, Thomas O.		Belleville.
Bolger, Francis		Penetanguishene.
Bolton, Lewis		Listowel.
Bowman, C. D.		West Montrose.
	Engineer for Townships of Woolwich, Pilkington and Nichol.	
Bowman, Isaac Lucius		Berlin.
	Engineer for Townships of Waterloo, Wilmot and Wellesley.	
Bray, Edgar		Oakville.
Browne, Harry John		Toronto.
Browne, Wm. Albert		Toronto.
Burke, William Robert		Ingersoll.
	Engineer for County of Oxford.	
Butler, Matthew J., Assoc. M. Inst. C.E. ; M. Am. Soc. C.E.	Chief Engineer N. T. and Q. Railway.	Napanee.
Byrne, Thomas.....		Sarnia.
Burt, Frederick Percy		Brockville.
Campbell, Archibald W.		St. Thomas.
Cavana, Allan George.....		Orillia.
	Engineer for Townships of Mara and Rama.	
Chipman, Willis, B.A. Sc. (McGill).....		Brockville.
Coad, Richard		Glencoe.
Coleman, R. H.		Toronto.
	Drainage Engineer, Canada Company.	
Davidson, W. S.		Arkona.
Davis, Wm. Mahlon, Grad. R.M.C.		Woodstock.
	Town Engineer, Woodstock.	
Davis, John		Guelph.
Doupe, Joseph, D.L.S., C.E. (McGill)	7 Princess Street,	Winnipeg.
Duchesnay, Edmond Juchereau, B.Sc. (Laval) *. Chapleau via Biscotasing.	Division Engineer, Canadian Pacific Railway.	
Ellis, Henry Disney	435 Ridout Street,	London.
Evans, John D.		Trenton.
	Chief Engineer, Central Ontario Railway.	

- Fawcett, Thomas, D.T.S. Gravenhurst.
 Foster, Frederick Lucas 176 Argyle Street, Toronto.
 Furlonge, Wm. H. Port Arthur.
 Mining Engineer.
- Galbraith, John, M.A. ; Assoc. M. Inst. C.E., D.T.S. Toronto.
 Professor of Engineering, School Practical Science.
- Gaviller, Maurice, C.E. (McGill) Collingwood.
 Gardiner, Edward St. Catharines.
 Engineer for County of Lincoln.
- Gibson, Peter Silas, B.Sc., C.E., M. Sc. (University of Michigan), Willowdale.
 Engineer for Township of York.
- Johnston, Wm. Oswald Whitby.
 Jones, John H. Sarnia.
 Engineer for County of Lambton.
- Jones, T. Harry, B.A.Sc. (McGill) Brantford.
- Keefer, Thos. C., M. Inst. C.E., Vice-Pres. Am. Soc. C.E. Ottawa.
 Kirk, Joseph Stratford.
 Ex-Engineer for County of Perth, Engineer for Township of Mornington.
- Kirkpatrick, George B. Toronto.
 Chief Clerk, Survey Branch, Department Crown Lands.
- Klotz, Otto Julius, D.T.S., C.E. (Ann Arbor University) Preston.
 In charge of astronomical work, British Columbia.
- Lumsden, Hugh David, M. Inst. C. E. Montreal, P. Q.
 Canadian Pacific Railway.
- Laird, J. S., P.L.S. Essex Centre.
- McAree, John, D.T.S. (Graduate S. P. Sc.) 245 Parliament St. Toronto.
 McNabb, John Chisholm Chatham.
 Chief Engineer, Erie and Huron Railway.
- Maddock, Junius Arthur Lindsay.
 Miller, Frederick, B.A.Sc. (McGill). Napanee.
 (Student Inst. C. E.).
- Moore, John M. London.
 McGeorge, W. G. Chatham.
- Niven, Alexander Haliburton.
- Ogilvie, William Ottawa.
- Pope, Robert Tyndall, B.A., T.C.D., Ireland Bracebridge.
 Proudfoot, Hume Blake, (C.E., University, Toronto) Clinton.
 Drainage Engineer for nine Townships.
- Reilly, William Robinson Regina, N.-W. T.
- Sankey, Villiers 17 Toronto Street, Toronto.
 Selby, Henry W. Stayner.
 Engineer for Township of Nottawasaga.
- Sewell, Henry DeQ., Assoc. Mem. Inst. C.E. Rat Portage.

Speight, Thomas Bailey	Toronto.
Stewart, Elihu	Collingwood.
Sproatt, Charles C. E	Toronto.
	City Engineer, Toronto.
Traynor, Isaac	Dundalk.
Unwin, Charles	17 Toronto Street, Toronto.
VanNostrand, Arthur J.	Toronto.
Wicksteed, Henry King, B.A.Sc. (McGill)	Port Arthur.
	Thunder Bay Colonization Railway.
Wilson, Alfred	Toronto.
	Chief Engineer, Canada Company.
Wilson, Hugh	Mount Forest.
Webb, Major Adam C.	Brighton.

PROCEEDINGS
OF THE
ASSOCIATION OF
PROVINCIAL LAND SURVEYORS
OF ONTARIO,

AT ITS SECOND ANNUAL MEETING HELD AT TORONTO,
ON MARCH 1ST, 2ND, AND 3RD,

1887.

*The Third Annual Meeting will be held at Toronto, on Tuesday,
21st of February, 1888.*

PRINTED FOR THE ASSOCIATION
BY
C. BLACKETT ROBINSON, 5 JORDAN STREET,
TORONTO.

NOTICE.

Members are requested to examine the advertisements carefully, and it is hoped they will patronize those who advertise with us.

The attention of members is called to the list of Standing Committees as given on page viii. The duties of these committees are fully set forth in the "Report of the Provisional Executive Committee," page 20 of Proceedings for 1886.

PREFACE.

*To the Members of the Association of Provincial Land Surveyors
of Ontario:*

THE Executive Committee herewith presents the Proceedings of the Association at its Second Annual Meeting, held in Toronto, on March 1st, 2nd, and 3rd, 1887.

The Proceedings of our Association at its first meeting were well received by our own members, and also by our exchanges.

Our very young association is manifesting great energy, and we urge upon all members to aid the officers and the several committees in carrying on the work of the Association.

We hope this Report will meet with your approval.

Respectfully submitted,

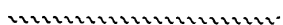
EXECUTIVE COMMITTEE.

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ASSOCIATION OF
PROVINCIAL LAND SURVEYORS
OF ONTARIO.

ORGANIZED 23RD FEBRUARY, 1886.



Officers for 1887=88.



PRESIDENT.

George B. Kirkpatrick, P.L.S., Crown Lands Dep't, Toronto.

VICE-PRESIDENT.

John Galbraith, M.A., A.M., Inst. C.E., School of Practical Science,
Toronto.

SECRETARY-TREASURER.

Willis Chipman, B.A.Sc., Brockville.

COUNCILLORS.

Matthew J. Butler, A.M. Inst.; C.E. M. Am. Soc. C.E., Napanee.
Villiers Sankey, P.L.S., 17 Toronto, Street, Toronto.
Peter Silas Gibson, B.Sc., C.E., M.Sc., Willowdale.

AUDITORS.

George Brockitt Abrey, P.L.S., Toronto.
Lewis Bolton, P.L.S., Listowel.

BANKERS.

Bank of Montreal.

STANDING COMMITTEES.

LAND SURVEYING.—V. Sankey (Chairman); A. Niven, W. R. Aylsworth, T. O. Bolger, R. Coad, T. H. Jones.

ENGINEERING.—M. J. Butler (Chairman); Prof. Galbraith, W. M. Davis.

DRAINAGE.—W. R. Burke (Chairman); H. B. Proudfoot, R. H. Coleman, J. L. Bowman.

LEGISLATION.—E. Stewart (Chairman); P. S. Gibson, A. C. Webb.

PUBLICATION.—J. McAree (Chairman); T. B. Speight, H. J. Browne.

ENTERTAINMENT, (Dinner Rooms, etc.)—F. L. Foster (Chairman)
A. J. VanNostrand, H. D. Ellis.

INSTRUMENTS.—G. B. Abrey (Chairman); H. Wilson, Thos. Fawcett.



PROGRAMME OF THE
Association of Provincial Land Surveyors of Ontario

AT ITS SECOND ANNUAL MEETING, HELD IN TORONTO,
MARCH 1ST AND 2ND, 1887.

NOTICE.—The Association will meet *pro forma*, on February 22nd, according to Article VII. of the Constitution, but will be adjourned for the transaction of business for one week.

BY ORDER OF EXECUTIVE COMMITTEE.

PROGRAMME.

Tuesday, March 1st—Morning, 10.30 o'clock.

Meeting of the Executive and all Standing Committees.
Arrangement of instruments exhibited.

Afternoon, 2 o'clock.

Reading of minutes of previous meeting.
Reading of correspondence and accounts.
Report of Secretary-Treasurer.
President's annual address.
Report of Committee on Land Surveying, P. S. Gibson, Chairman.
Report of Committee on Drainage, H. B. Proudfoot, Chairman.

Evening, 8 o'clock.

Report of Committee on Engineering, Prof. Galbraith, Chairman.
Paper—Solar Azimuths, John McAree.
Paper—Electric Lighting of Small Towns, F. F. Miller.
The Minto Provincial Drainage Scheme. (General Discussion.)

Wednesday, March 2nd—Morning, 9.30 o'clock.

Meeting of Committees.

Morning, 10 o'clock.

Report of Committee on Instruments, G. B. Abrey, Chairman.
Report of Committee on Legislation, G. B. Kirkpatrick, Chairman.

(As some very important changes are proposed in the Survey Act, all surveyors should attend this meeting to discuss fully this report.)

viii. ASSOCIATION OF PROVINCIAL LAND SURVEYORS.

Paper—Assessment of Benefits in Drainage Surveys, Willis Chipman.

Paper—Trussed Beams, Prof. Galbraith.

Paper—Crown Surveys, Elihu Stewart.

Paper—Highway Bridges, M. J. Butler.

Paper—Mining in Port Arthur District, H. DeQ. Sewell.

Afternoon, 2 o'clock.

Report of Committee on Publication, Willis Chipman, Chairman.

Report of Auditors, G. B. Abrey and Lewis Bolton.

Paper—Micrometer Measurement of Distances, Wm. Ogilvie.

Discussion of Papers in last Annual Report.

Unfinished business.

Nomination of officers.

New Business.

Adjournment.

Full discussion after each paper.

Bring with you report of last meeting for reference.

Please attend all meetings promptly.

A meridian has been carefully laid down on the grounds of the Parliament Buildings for testing solars.

Annual Dinner at the Walker House on the evening of the second day.

To make the exhibition of instruments as complete as possible, the Committee requests each member to bring some surveying instrument to the meeting, or anything else that will be of interest to the profession.

The exhibition will continue both days.

Some interesting instruments have already been promised for exhibition.

If you have any matter referring to Land Surveying, Drainage, Engineering, Instruments, Legislation, or Publication to bring before the Association, communicate with the chairman of the committee to which the subject belongs, or to the secretary.

Annual subscription received at any time before April 1, 1887.

WILLIS CHIPMAN, *Sec-Treas.*

Brockville, February 1, 1887.

About three hundred programmes were mailed to the Land Surveyors of the Province.

ASSOCIATION OF
PROVINCIAL LAND SURVEYORS
OF ONTARIO.

MINUTES OF THE SECOND ANNUAL MEETING.

MARCH 1ST, 2ND, AND 3RD, 1887.

The Association met at 2 p.m. on March 1st in the Canadian Institute, the rooms at the Parliament Buildings being in use by the Legislative Assembly.

The Association was called to order by President G. B. Kirkpatrick, at 2 p.m.

Before proceeding to the first order of business in the Programme, H. H. Stephens and H. D. Ellis were appointed Scrutineers to examine the ballots for officers for 1886-87.

Upon motion the minutes of last meeting, as printed in the Proceedings, were taken as read.

No correspondence or accounts of importance were read to the Association.

The Secretary-Treasurer presented his annual report, which, upon motion, was received.

The President then read his annual address.

In the absence of P. S. Gibson, Chairman of the Committee on Land Surveying, Villiers Sankey presented the report of this committee with the proposed amendments to the "Act respecting Land Surveyors and the Survey of Lands."

Upon motion the report was received.

The proposed amendments were then taken up section by section, and discussed by the Association—that part of the Act referring to plans being left over by the Committee.

The Report of Committee was then adopted by the Association.

Mr. Proudfoot, Chairman of the Committee on Drainage, presented his Report, with proposed amendments to the Ditches and Water-courses Act, and to that part of the Municipal Act that refers to drainage.

Part of the proposed amendments were adopted by the Association, and others were referred back to the Committee.

Report of the Scrutineers was then received and adopted.

Association adjourned at 6 p.m.

EVENING SESSION, 8 O'CLOCK.

Prof. Galbraith presented the Report of the Committee on Engineering, which, upon motion, was received.

J. McAree being absent, his paper on "Solar Azimuths" was left over.

F. F. Miller read a paper on the "Electric Lighting of Small Towns," illustrated with drawings and different types of lamps. A vote of thanks was tendered Mr. Miller.

The Minto Drainage Scheme was next discussed.

The Secretary read extracts from a circular, issued by the promoters of this scheme, to show its objects and the means of attaining them.

At the request of the Association, Mr. F. S. Dobson, of Harriston, addressed the meeting, explaining fully the proposed scheme. (See page 120 of this Report.)

Association adjourned at 12 o'clock.

WEDNESDAY, MARCH 2ND, 10 A.M.

The paper on "Solar Azimuths," by John McAree, was read by the Secretary in his absence.

Upon motion the paper was received.

G. B. Abrey, chairman of the Committee on Instruments, presented his report, which, upon motion, was adopted.

The Committee on Legislation presented no report.

A paper on the "Assessment of Benefits in Drainage Surveys" was read by Willis Chipman, which, upon motion, was received.

Prof. Galbraith next read a paper on "Trussed Beams," which was received upon motion.

Adjourned at 12 o'clock.

Resumed at 2 p.m.

The President expressed his opinion that it would be impossible to take up all the business remaining unfinished in one afternoon, and suggested the advisability of continuing the session another half day.

Moved by A. Niven, seconded by H. D. Ellis, "That another session be held on 3rd March, from 9 to 12 in the forenoon." Carried.

Several notices of motion were then given to come up for discussion at the adjourned meeting.

The paper of E. Stewart, on "Crown Surveys," was next presented, and received upon motion.

In the absence of H. DeQ. Sewell, his paper on "Mining in the Port Arthur District" was read by the Secretary.

Upon motion this paper was received.

The Secretary presented the Report of the Committee on Publication, which, upon motion, was referred back to the Committee.

The Auditors' Report, not being ready, was left over until the next day.

W. Ogilvie next presented his paper on the "Micrometer Measurement of Distances," which, upon motion, was received.

The unfinished business was left over until the next day.

The President then called for nominations of officers.

ELECTION OF OFFICERS.

Mr. Niven moved that Mr. G. B. Kirkpatrick be re-elected president of the Association for the ensuing year. He thought, he said, that it would be a very good thing to keep Mr. Kirkpatrick in office for at least another year. The Association now had things in fairly good running order, and might hope to have them even more perfect by next year. Besides, when they had a good man in office he believed the best thing they could do was to keep him there.

Mr. Sankey seconded the nomination, and remarked that the personal experience which he had had with Mr. Kirkpatrick during the year made him feel that if they were to change presidents now

when the Association was about half way through its process of firmly establishing itself, as it were, the result would be serious. No better man than Mr. Kirkpatrick could be found, for reasons in general, to fill the office; and no man so good could be found, in the matter of getting legislation enacted on behalf of the Association.

There was no other nomination, and Mr. Kirkpatrick was re-elected chairman amid hearty applause. He acknowledged the compliment by remarking:—

“I am sure, gentlemen, I need not do more than return you my thanks for the honour conferred on me. I did, myself, think that it might be better to have a new president every year, but since you have decided otherwise, I shall be happy to continue to do all in my power to advance the interests of the Association. I thank you again for the honour you have done me.”

Prof. Galbraith nominated Mr. Nevin for vice-president: “My reason for doing so,” he said, “is, that there is no work attached to the office. It is simply an honorary position; and I think that as this is a Land Surveyors’ Association it would be better that the gentlemen who fill the most honourable positions in its gift should be practising surveyors. I have not practised myself for seven or eight years, and I would very much prefer to see men who are in active practice filling positions of this kind.

Prof. Galbraith’s motion was seconded, and Prof. Galbraith was then himself re-nominated for the office of vice-president, a ballot to be taken on the nominations during the month next ensuing after the meeting.

Mr. Klotz then moved that Mr. Willis Chipman be re-elected secretary-treasurer during the ensuing year. He remarked:—

“If there is any officer in the Association who deserves election by acclamation it is Willis Chipman. He is the father of the Association. He does not look very fatherly (laughter), but, nevertheless, I don’t think we can deprive him of that credit. He has worked more than anybody else in getting up the Association and bringing it to its present state of activity, and I hope that he will be elected by acclamation.” (Applause.)

Mr. C. F. Myles seconded the motion, and the president, in putting it, said:—

“I can only add that I agree with Mr. Klotz that it would be simply a loss to this Association if we were to lose the services of Mr. Willis Chipman. He has been the life and soul of it, to my knowledge, and I don’t think we can possibly do better than re-elect him, and give him a hearty vote of thanks for his services in the past.”

Mr. Willis Chipman was then re-elected secretary-treasurer. He acknowledged the election by remarking:—

“I thank you sincerely for your very hearty vote of thanks, and for my re-election to the office of secretary-treasurer. I have worked

very hard during the year for the Association, and so have all the officers. We have done much more work than those who have not been officers can imagine. I will do next year, as I did last year, all in my power to promote the interests of the Association." (Applause).

The following were then nominated as councillors for the ensuing year :—

M. J. Butler, A.M.I.C.E., M.A.S.C.E.....	Napanee.
H. B. Proudfoot	Clinton.
Elihu Stewart	Collingwood.
Villiers Sankey.....	Toronto.
P. S. Gibson.....	Willowdale.
W. R. Aylsworth.....	Deseronto.
John McAree, D. T. S.	Toronto.

Moved by Otto J. Klotz, seconded by John McAree, "That the sum of \$40 be voted to the Secretary-Treasurer as a small remuneration for his services and personal expenditures he has incurred in connection with his office." Carried.

Mr. Timson, of Toronto, one of the oldest mathematical instrument makers in America, and who claims to have made the first solar compass for Mr. Burt, was then introduced to the Association, and greeted by the President.

The Association adjourned at 5.30 p.m., when an hour was spent in examining the instruments exhibited.

THURSDAY, MARCH 3RD.

MORNING SESSION, 9 TO 12.

President took the chair at 10 o'clock; over thirty members present.

Moved by V. Sankey, seconded by H. D. Ellis, "That the Committee on Survey Act be instructed to enquire into the Registry Act, with a view of amending those portions thereof that relate to registered plans, and that a special committee of three be named by the chairman." Carried.

The chairman then appointed V. Sankey, P. S. Gibson and G. B. Abrey, with V. Sankey as convener, to enquire into said Act.

H. B. Proudfoot presented his amended report on "Drainage Acts," which, upon motion, was adopted.

The Report of the Committee on Publication was then presented, and, upon motion, was received and adopted.

The Report of the Auditors was then presented, and, upon motion, received and adopted.

Ruyter Sherman and E. Walter Rathbun, articted pupils, were proposed as associate members, and were elected as such by ballot.

Moved by M. J. Butler, seconded by A. Niven, and

Resolved, "That, in the opinion of this Association, the bonus to be paid by any articted pupil to the surveyor to whom articted shall not be less than \$200." Carried.

Moved by Willis Chipman, seconded by Otto J. Klotz, "That sub-sec. 1 of Article X. of the Constitution be repealed, and that the following be substituted therefor:—

"The fee for membership for active members and associate members shall be \$3 per year, payable in advance; and that the Secretary be instructed to prepare ballots, as per Article VIII. of the Constitution." Carried.

Moved by Wm. Ogilvie, seconded by G. B. Abrey, "That the draft of the Bill attached to this motion, respecting the appointment of 'Boundary Commissioners,' be referred to the Legislative Committee; and a copy of this draft be embodied in the Annual Report for the consideration of the members of this Association, in order to a thorough discussion of the matter at the next annual meeting." Carried.

Moved by C. F. Miles, seconded by H. W. Selby, "That the thanks of this Association be tendered to Messrs. Foster and Potter, of this city, for the fine exhibit of instruments displayed during the present session of this Association, and that a copy of this resolution be forwarded to these gentlemen." Carried.

An hour was then spent in discussing some difficult problems arising in practice.

The Association adjourned at 12.30 p.m.

CIRCULAR No. 9.

RESULT OF ELECTIONS.

<i>For Vice-President :</i>		<i>For Councillors :</i>	
Professor Galbraith	57	Villiers Sankey	51
Alexander Niven	23	M. J. Butler	46
		P. S. Gibson	43
<i>Amendment to Constitution :</i>		J. McAree	33
For	62	H. B. Proudfoot	31
Against	10	E. Stewart	27
		W. R. Aylsworth	15

I therefore declare the following officers elected:—For Vice-President, Professor Galbraith; for Councillors, V. Sankey, M. J. Butler, P. S. Gibson. I also declare the Amendment to the Constitution carried.

(Signed) WILLIS CHIPMAN,
Secretary.

MEMBERS IN ATTENDANCE AT THE SECOND ANNUAL MEETING.

Abrey, G. B.	Davis, Wm. M.	Niven, Alexander.
Aylsworth, W. R.	Davidson, W. S.	Ogilvie, Wm.
Aylsworth, C. F.	Ellis, H. D.	Proudfoot, H. B.
Bolton, Lewis.	Esten, H. L.	Rathbun, E. W.
Bowman, G. L.	Fawcett, Thomas.	Sankey, Villiers.
Bowman, H. J.	Foster, F. L.	Selby, H. W.
Bray, Edgar.	Galbraith, Prof.	Speight, T. B.
Browne, H. J.	Gaviller, Maurice.	Stewart, E.
Burke, Wm. R.	Hanning, C. G.	Sanderson, D. L.
Butler, M. J.	Jones, T. H.	Stephens, H. H.
Bazett, Edward.	Kirkpatrick, G. B.	Sherman, R.
Brown, W. A.	Klotz, O. J.	Tyrrell, J. W.
Campbell, D. S.	McAree, John.	Unwin, Charles.
Chipman, Willis.	Miller, F. F.	VanNostrand, A. J.
Coad, Richard.	Myles, C. F.	Vicars, John.
Colman, R. H.	Murphy, C. J.	Wheelock, C. R.
Casgrain, J. P. B.		

REPORT OF THE SCRUTINEERS.

We have examined the ballots, and found the following officers elected for 1886-87:—President, G. B. Kirkpatrick; Vice-President, Prof. Galbraith; Executive Committee, M. J. Butler, Prof. Galbraith, Villiers Sankey; Secretary-Treasurer, Willis Chipman (by acclamation); Auditors, G. B. Abrey, Lewis Bolton. Two ballots were rejected, but they would have made no difference in the final count.

H. D. ELLIS,
H. H. STEPHENS.

Toronto, March 1st, 1887.

REPORT OF THE SECRETARY-TREASURER.

MR. PRESIDENT,—The undersigned Secretary-Treasurer begs leave to submit the following report on the business of the Association during the first year of its existence.

We began with a paid-up membership of twenty-five, which has now* increased to seventy—seventy surveyors, live men, fully awakened to the benefits of organization.

* January 1st, 1887.

Our membership is not confined to Ontario alone, as we have one member from the Province of Quebec, two members from Manitoba, and one member from the North-West Territories, representing a territory from Montreal to Regina, a distance of nearly eighteen hundred miles.

Regina, Winnipeg, Rat Portage, Port Arthur, Chapleau, Ottawa and Montreal, along the line of the C. P. R.; Parry Sound, Bracebridge, Gravenhurst, Haliburton, Penetanguishene and Collingwood, north of Toronto; and nearly every city and town in the southerly part of the Province has one or more representatives. Hamilton, Kingston, Peterboro', Pembroke, Cobourg and Owen Sound are the chief cities and towns not represented.

The Provisional Executive, appointed by the Association to conduct the business of the Association until the election of the officers, arranged for publication of Constitution and By-laws with their report, and several professional papers, which we hope met with your approval. We also solicited advertisements from bridge companies, instrument manufacturers, and dealers in engineers' and surveyors' stationery, etc., our success in which is due to the exertions of Mr. McAree.

After the election of the officers of the Association by letter-ballot, in March, 1886, the Standing Committees were struck by the Executive.

During the year two meetings of the Executive were held in Toronto, the first resulting in the President's circulars of August 2nd, 1886. The second meeting was held on December 10th and 11th, at which the first draft of a programme was adopted. We had at our meeting last year prophets who foretold pecuniary embarrassment if anything like a report were published. I have, therefore, attempted to be as economical as possible with the funds of the Association, and can report, at the end of the first year, a substantial surplus instead of a deficit.

Arrangements were also made this year with the Grand Trunk Railway, the Canadian Pacific Railway, and the Northern and North-Western Railways, by which members attending the General Annual Meeting were granted reduced rates for the return trip.

A statement of receipts and expenditure of the Association to January 1st, 1887, is appended.

WILLIS CHIPMAN,
Secretary-Treasurer.

STATEMENT OF RECEIPTS AND EXPENDITURES OF THE ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO, 1886-87.

RECEIPTS.

1886-87. To fees, 1886-87—seventy at \$3	\$210 00
“ “ Advertisements	47 00
Total	\$257 00

		EXPENDITURE.	
1886.			
Feb.	By Preliminary Circulars and Postage.....	\$7 00	
"	" Advertisements in <i>Mail and Globe</i>	6 00	
"	" Stationery	2 00	
			15 00
Mar.	" Letter-heads, Ballots and Envelopes	\$8 25	
"	" Circulars, Postage and Stationery	5 75	
			14 00
"	" Sketching and Lithographing.....	\$21 50	
"	" Printing 700 Proceedings	68 40	
June	" Postage, Freight, Stationery, etc.	8 90	
			98 80
"	" Minute Book and Lettering	2 00	
"	" Ohio Reports, Duties and Postage, etc.....	6 85	
"	" Michigan " " "	6 30	
"	" Indiana " " "	5 60	
Dec.	" Circulars, Postage, etc.	2 40	
"	" Balance December 31st, 1886.....	106 05	
	Total		\$257 00

REPORT OF AUDITORS.

The undersigned Auditors beg to report as follows:—That we have examined the books and accounts of the Secretary-Treasurer, W. Chipman, Esq., and have annexed to this report a statement showing the amount of receipts and expenditures, which shows a balance on hand of \$106.05. We find vouchers for \$103.90, being for printing and engraving. The balance of the expenditure, viz., \$47.10, there are no vouchers for, being for postage, duty, freight, stationery, etc., for which Mr. Chipman could not very well obtain vouchers.

All of which is respectfully submitted.

G. B. ABREY,
LEWIS BOLTON,
Auditors.

REPORT OF COMMITTEE ON LAND SURVEYING.

MR. PRESIDENT,—The Committee on “Land Surveying” beg to report as follows:—

The necessity of having the Surveyors’ Act amended being of the most vital importance, a meeting of the Committee was called on December 10th and 11th, 1886, to discuss and extend the amendments, as proposed by the Board of Examiners, as drawn up at the meeting held in October. This meeting of the Committee was attended by seven members and several other surveyors, and the whole Act was taken up, section by section, and a draft of the Act, as now amended, is presented herewith.*

* Not printed in these Proceedings.

Your Committee have endeavoured to get at all the necessary changes, but find that, in order to make the amendments entire and perfect, the greatest amount of personal experience from all parts of the Province should be brought to bear on the subject.

In view of the fact that the consolidation of the Provincial Acts is to be completed this year, your Committee would strongly urge that every effort be used to put the Act in as perfect a shape as possible, and that the Committee on Legislation be instructed to bring the same before the proper authorities.

(Sgd.) VILLIERS SANKEY,
For Chairman.

REPORT OF DRAINAGE COMMITTEE.

The Committee met pursuant to notice on 10th December, 1886. The following members were present:—H. B. Proudfoot, Clinton, Chairman; W. R. Burke, Ingersoll; J. L. Bowman, Berlin; R. H. Coleman, Toronto. This being the first meeting of the Committee, the principal business of the Committee was the consideration of correspondence addressed to the Secretary of the Association in response to the circular from the President on the subject of the revision of the Drainage Acts.

After the fullest discussion the following amendments,* which we have had printed, and copies of which are attached hereto, were adopted by the Committee, and, on being submitted to the Executive, were approved by them, and which, with the correspondence relating thereto, we now submit to the Association.

Carried as amended.

On behalf of the Committee,

H. B. PROUDFOOT,
Chairman.

REPORT OF COMMITTEE ON ENGINEERING.

MR. PRESIDENT AND GENTLEMEN,—As Chairman of the Committee on Engineering, I see by the programme of our meeting that I am expected to make a report. There are reports and reports. The present one belongs to the latter class. After describing as fully as the nature of the case will permit what the Committee on Engineering has done, I shall attempt briefly to outline what it has not done. To perform this task properly would require the patient determination of

* These amendments are not printed in these Proceedings.

the German *savant*, who cheerfully and enthusiastically devotes his life to collecting the materials for the preface and introduction of the work which is to make for him name and fame among a remote posterity, sublimely unconscious of the fact that men are mortal and that he is but a man. Gentlemen, such being the case, I think that you will agree with me in considering it better that I should, before undertaking an apparently endless task, give you facts relative to what we have done. We have never had a meeting, we have never—but I see that I am diverging from the straight and narrow path. In endeavouring to tell you first what we have done, I seem to be irresistibly impelled to dilate on the greater, but to you less important, part of our subject, viz., what we have not done. Let me make one more attempt; we have done—nothing. My ideas seem to be getting vague. Whether the statement just made is a successful attempt to do what I set out to do, I cannot tell; I leave you to judge. Affirmative and negative no longer appear to possess positive meaning; but, again, the idea occurs to me, why should they? What is there affirmative in positive, or what is there positive in negative? Questions such as these it is not for us to settle; I leave them to the Committee on Legislation. Having thus cleared the way, it now becomes me to describe, in an equally lucid manner, a few of our sins of omission. As Chairman of this Committee I feel that I ought to have proceeded somewhat in this way. I should have carefully prepared an estimate of the travelling expenses of the various members of the Committee to Toronto, adding ten per cent. for contingencies, such as circulars, postage, etc. I should then have drawn upon our affable Secretary-Treasurer for the amount, and notified each member of the Committee that I was ready to pay his travelling expenses if he would kindly consent to putting in an appearance at our Committee meeting. No, I fear that would have been proceeding without due caution. Before sending out this notification, I would have waited until the Secretary had accepted my draft, and then proceeded as above. I am sorry to confess, gentlemen, that I did none of these things. I feel that I merit heavy condemnation. I can make no defence of my conduct. I can only state my reasons, and leave myself in your hands. I had no confidence in our Secretary-Treasurer's willingness to honour my draft. The cause of this want of confidence I cannot explain; it seemed to be a part of my nature which impelled me with irresistible force to act as I did. I feel that in justice to that worthy officer I should at least have afforded him this opportunity to forward the interests of the Association. You all suffer in consequence of this want of action and want of confidence on my part. Otherwise I feel certain that we should have had a brilliant report to offer you, teeming with life and enthusiasm.

Another course was open to me. I might have written to the members of the Committee, and asked them to come to Toronto, or to any other city, town, township, concession, section, block, gore, common, lot, or parcel of land which might seem to them, each and several, all and singular, more or less centrally situated and better adapted as a place for a committee meeting than the aforesaid city of

Toronto. This I did not do ; my reasons I must for ever conceal. I have already put the Secretary-Treasurer in a condition bordering on insanity ; but my reputation for discretion would be irreparably destroyed if I were to do or say anything to ruffle the feelings of a numerous and athletic committee.

Still a third course was open apparently. Some of you may ask why I did not write to the various members of the Committee, and by dint of much importunity extort from them promises to furnish papers for the annual meeting. This seemed even to myself a proper mode of proceeding, but fuller consideration dispelled the idea. I reflected that such a proceeding could not under any possible stretch of the imagination be considered a committee *meeting*, and committees are nothing if they don't meet.

I felt, again, that our Secretary would attend to the matter of getting papers. He attended to me. The consequence is that to-morrow you will be inextricably wound up in a mass of complicated and involved formulas, formulas which might be endured with some show of interest if relating to the trussed turkeys to be discussed, I believe, by this Association to-morrow evening at the Walker House, but which under any other circumstances—I mean the formulas, not the turkeys,—should only be looked upon with disgust and horror by every well-regulated mind. Indeed I feel that the members of this Association, as the time for the reading of that paper approaches, would be perfectly justified in considering it to be about the approximate time to take their greatest elongation from the place of meeting for the purpose of setting up the instrument I was going to say, but that would hardly express my idea ; I should rather say, for the purpose of indulging in permissible, in fact I might say necessary, refreshment.

My worthy colleague, Mr. Butler, has also been approached with success by our indefatigable Secretary, and I feel sure that his paper on " Highway Bridges " will go far to make up for the deficiencies of our Committee, and relieve it to a great extent from the odium which it has in every other respect so justly incurred.

Gentlemen, my task is done. It has been by no means a light one. Defending one's colleagues and oneself from anticipated charges of neglect of plain duty is not a pleasant occupation. My greatest apprehension is that perhaps I have said too much. Perhaps it would have been the part of wisdom to have glossed over our deficiencies, and never mentioned our breaches of trust. However, the time for regret is past. What is done is done, and the Committee on Engineering for the year 1886-87 now give up their trust, and ask to be sentenced quickly, and receive a quick discharge.

Respectfully submitted,

J. GALBRAITH,
Chairman Engineering Committee.

REPORT OF COMMITTEE ON INSTRUMENTS.

MR. PRESIDENT AND GENTLEMEN,—It would seem to be the duty of every Committee to bring in a report to this meeting, and, if a Committee has no report to bring in, then I take it they should put it in writing, stating the fact.

Now, as Chairman of the Committee on Instruments, I would say that many of that Committee reside away from the city, and it was inconvenient to get an attendance as a committee here; besides, there was not much for them to do except see that some one should prepare a paper, to be read at this meeting, pertinent to the subject of which they had charge, and also to have as good a collection of instruments present for exhibition as possible, and some minor matters.

I wrote to all the members of the Committee soliciting a paper on the subject of "Instruments," but could not get any one to prepare one, and I regret to say none has been prepared, though the field is open, wide, and an interesting and useful one.

Next I solicited the members of the Committee and the mathematical instrument makers of our own city, Messrs. Hearn & Harrison, of Montreal, and some five of the principal makers of instruments of the States to send an exhibit. As you see, our own city makers have come with a fine show. In these glass cases may be found all the necessaries of our profession, together with many of the luxuries of our requirements and desires as well; and I hope that these exhibitors may be well reimbursed by increased sales for their trouble in showing so fine an exhibit.

The other makers found it too much bother to attend at this time, but many of the American makers invited gave encouragement, and promised to come with a full outfit at a future time. I made enquiries of the Customs, and learned that foreign exhibitors would be required to pay the full amount of the duty (25 per cent.) on entering, then enter into a bond, and, on exportation of the exhibit, and proof of the same being furnished the Customs Department at Ottawa, that Department would refund all excepting 25 per cent. of the duties paid; that is, it would cost the foreign exhibitors $2\frac{1}{2}$ per cent. of the invoice value of the instruments exhibited in the way of duties, over and above some charges and the trouble, etc. Also, the exhibition would require to be made in a bonded warehouse; but our obliging collector at this port agreed to bond any room or building which we might desire for the purpose of exhibition, so that no inconvenience from that source might occur. I also see in this room that many of the members of the Association have brought for exhibition their instruments, and I see they range from the oldest to the newest designs. I shall have pleasure in describing some novelties and others that I have myself brought, as well as giving a general description of the other exhibits; and I presume the other members of the Association that have brought instruments will explain their usefulness and their beauties also.

G. B. ABREY, P.L.S.,
Chairman.

REPORT OF LEGISLATIVE COMMITTEE.

This Committee had nothing to report.

REPORT OF COMMITTEE ON PUBLICATION.

MR. PRESIDENT,—We, your Committee on Publication, beg leave to report as follows:—

We received tenders for printing our first Report of Proceedings, accepting that of C. Blackett Robinson, the lowest tender, at the rate of ninety-five cents per page. The lithographing and designing of the two cuts cost us \$21.50, but are, we think, interesting features of the Report.

For advertisements we charged \$8 per full page and \$5 per half page.

Of the 700 Reports printed we sent 200 to the Michigan Society, receiving in exchange 75 copies of their Report for the years 1884 and 1885, the Report of 1886 not yet being printed. To the Ohio Society we sent 110 copies, receiving in exchange 75 copies of their Report, and to the Indiana Society we also sent 110 copies, receiving in exchange 75 copies.

About 300 copies of our Report were distributed among the Provincial Land Surveyors throughout the Province. One copy of each of the State Reports above mentioned was sent to each member of the Association.

Your Committee would advise the following charges for advertisements in the next volume of Proceedings: full page, \$6; half page, \$3.50; for a less space, at the rate of 25 cents per square inch.

Your Committee would also impress upon the members the advisability of patronizing those who advertise with us, as the amount raised from this source is nearly half the cost of publishing the Report of Proceedings.

WILLIS CHIPMAN,
Chairman.

PRESIDENT'S ADDRESS.

Gentlemen of the Association of Provincial Land Surveyors of Ontario:

In welcoming you to our Second Annual Meeting, permit me, in the first place, to congratulate you on the successful inauguration of a society, the want of which has long been felt, and which, I am convinced, has been a serious loss to our profession as a whole. Union and co-operation are magical watchwords in other branches of work, and the time has come when, if we wish to succeed in elevating and

advancing the profession of a land surveyor, we must unite, and no longer remain isolated and unknown to one another. A general advance in knowledge is taking place all along the line, the facilities for education for men about to enter on the life of a surveyor are unsurpassed anywhere. I need only mention the Ontario School of Practical Science in Toronto, the Royal Military College at Kingston, and the Engineering School at McGill University in the city of Montreal to illustrate this, and if we do not, as a body, advance with the rest we shall find ourselves hopelessly overmatched and dragged down from the position which a well-educated and practical set of men should occupy in the community.

STATISTICS.

I find that from the year 1784 to the present time there is a record of the appointment of six hundred and ninety-seven land surveyors for the Province. Of these I have a record of two hundred and sixty as dead, leaving three hundred and seventy-two to be accounted for. Of these I estimate that about two hundred and fifty are in the practice of their profession, whilst others have, since their appointment, entered the sacred ministry, the legal profession, the medical profession, the civil service, banking and loan companies, or, lastly, have attained high eminence as engineers, and are to-day chief engineers of some of our leading lines of railway. Our Association numbers seventy-five active members, and I would urge upon each and all the desirability of getting their brethren throughout the Province to fall into line, and join the Association not only for their own sake but for that of the profession at large. I am persuaded that by no other means can we, as a body, either improve our own condition, cultivate a spirit of *esprit du corps*, or properly fulfil the multitudinous duties required of a surveyor in these days. The time has gone by when with a compass and Jacob's staff a surveyor was considered to be fully equipped for his professional duties. At the present time every surveyor should be a well-read man: the subjects on which his opinion is often asked are varied. He should be able intelligently and composedly to give evidence in our courts of law, to stand his ground before the cross-examination of the opposing counsel, to understand the law of evidence, and to be able, impartially, to sift the wheat from the chaff in the conflicting statements made to him when getting up a case. Again, he should be thoroughly versed in municipal law so as to be able to advise and assist municipal councils in relation to roads and bridges, ditches and watercourses, and to aid in educating public opinion up to the point of appreciating the advantages to be derived by individuals and municipalities in availing themselves of the provisions for securing permanence to the limits of their lots, for the drainage of their swamp lands, and such like improvements; in a word, he has to combine the practical with the scientific.

In this connection I would urge on our young surveyors the wisdom of losing no opportunity of acquiring information and of preserving it for use about their fields of operation. Much valuable information has been lost forever from the unsystematic way in which surveyors

have kept their notes in the past. In the public surveys the field notes of late years will compare favourably with those of any country, but in those of private surveys there is room for vast improvement. A systematic survey of the Dominion, similar to that of the Ordnance Survey of Great Britain and Ireland, is among the possibilities of the near future, and our surveyors, from their training, should be the men to whom to entrust the work.

I am glad that an Exhibition of Instruments forms one of the features of our meeting, and I bespeak a careful examination of them as marking the great advance in that line in modern times.

As an interesting specimen of the past I transcribe a letter written in the last century by the Surveyor-General in response to His Excellency's, the Right Honourable Guy, Lord Dorchester, Governor-General of the Province of Quebec, Order-in-Council of January 4th, 1791, to report a list of the instruments remaining in the office of the Surveyor-General, or in the hands of the several Deputy Surveyors. It is as follows:

[Copy.]

“QUEBEC, 31ST January, 1791.

“SIR,—In answer to yours of the 28th inst., requiring me to furnish the Land Committee with a list of the instruments remaining in the Land Surveying Office and in the hands of the several Deputy Surveyors, I have to inform you that, as no allowance of instruments has ever been made to the Land Surveyor-General of the Province of Quebec, of course, there are no instruments appertaining to his office, those made use of in his department being the private property either of himself or of his deputies, and of the number in their possession I can only mention such as were commissioned out from London by me about six years ago, and sent me by Messrs. Watson and Keshleigh, being six of the best improved horizontal theodolites, for the following gentlemen, viz.: Mr. O'Hara, at Gaspé; Mr. Vondevelden, Chaleur Bay; Mr. McCarthy, St. Thomas; Mr. Frey, Detroit; Mr. Aitkins, Kingston, and one for my son, grooved with cross-levels. Three more were likewise sent out by me when in England two years ago, and are at present in the hands of Mr. Depincier, Mr. Pennoyer, and Mr. Bedard. The whole of these instruments have circular protractors of the same divisions and dimensions of the instruments, with spar bar needles, agate cap'd, and I have now ordered out three more for Messrs. B. Germain, Bouchette, and Plamondon. Exclusive of these, there are many other good instruments belonging to the Deputy-Surveyors, Mr. Chewett having, at some expense, provided himself with two sets, and Messrs. William Fortune and Jones with one good one each, also Mr. J. McDonald, and I have seen some at Montreal in the hands of Messrs. Papineau and Delisle.

“I am not aware that any further instruments are at present wanted in my department, but that, in a great measure, depends on the nature of the work to be performed, and persons employed, as I should be loth to trust in any unskilful hands my capital set of instruments, consisting of all sorts necessary for carrying on a general sur-

vey, or making astronomical observations, made by the best artists in London. They have already been proved by me in settling the longitudes and latitudes in the northern district of North America, as inserted in the Philosophical Transactions, and with which Mr. Sproule and Mr. Wright ascertained the longitude and latitude of Gaspé and Isle of Anticosti. As they were much deranged by being removed from their boxes by Mrs. Holland, to prevent their being carried off by the Americans, while she and her family were their prisoners in the year 1776, I was under the necessity of taking the principal ones with me to England, where they underwent a thorough repair in Mr. Ramsden's hands, except a quadrant of the old construction, which was left in my office, where it has been nearly ruined.

“ I have the honour to be, Sir,

“ Your most obedient servant,

“(Sgd.) SAMUEL HOLLAND,

“ Hon. Hugh Finlay.”

“ *Surveyor-General.*

Ordered to lay on the table.

Another point to which I would draw the attention of the Association is the great want of a compilation of decisions of the courts on the various land cases which have come before them. Such a work would be invaluable, and I commend it to your consideration whether an attempt should not be made to have one compiled. Similar works are in existence in the United States. In the “Engineers' and Surveyors' Manual,” by M. McDermott, C.E., published in Chicago in 1879, I have noticed that there is a chapter devoted to “Geodetical Jurisprudence,” which contains a large number of decisions of the Supreme Courts of several States. I may add that the author is an old Provincial Land Surveyor of this Province.

I would suggest, too, that efforts be made to procure biographical sketches of the early surveyors, with photographs of them when possible, and that this be made a feature in our Association reports. Many, no doubt, are not to be had; but, with care, I am satisfied that we may rescue a goodly number from oblivion. During the last year I have obtained photos of several of our old surveyors, which are at the disposal of the Association.

If there is time, I would suggest a discussion of a practical nature as to the lasting quality of the posts planted in the early days when left to a state of nature; what timber is most durable for posts; what kind of soil they will stand longest in; also, is the number of rings of growth in a healthy tree over a blaze an absolute and unfailing proof of the age of a survey? To such questions as these all can contribute their share of information, and some reliable data may be obtained.

As an interesting contribution to the history of our profession, I have made some extracts from the old documents of record in the

Department of Crown Lands. I find that in the year following the cession of Canada by France to Great Britain, by the Treaty of Paris in 1763, a report of the Committee of Council for Plantation Affairs sets forth the propriety of appointing a Surveyor-General of Lands in the Colony of Quebec, to which is added "an estimate of the expenses attending general surveys of his Majesty's dominions in North America for the year 1764." An Order in Council was passed on February 10th, 1764, approving thereof, and Captain Samuel Holland was duly appointed. He nominated and appointed John Collins as the first Deputy-Surveyor-General, on September 8th, 1764, and his commission as such was issued by his Excellency Guy Carleton, Governor-General of Quebec, May 2nd, 1775. He was further empowered by his Excellency Frederick Haldimand, Governor-General of Quebec, on May 17th, 1784, to administer the oaths directed by law as well as the oath of allegiance. Captain Holland also nominated and appointed Philip R. Frey to be one of the Deputy-Surveyors of lands in the upper district of the Province of Quebec, on December 22nd, 1784, who was duly sworn in at Detroit, on March 30th, 1785. He was appointed to conduct surveying operations at Detroit and Niagara on the 19th January, 1785, by Captain Holland. Copies of these documents are appended, as follows :

EXTRACT FROM SURVEYOR LETTERS, D., PAGE 27.

[Copy.]

To the King's Most Excellent Majesty :

MAY IT PLEASE YOUR MAJESTY,—We, your Majesty's Commissioners for Trade and Plantation, beg leave humbly to represent to your Majesty that, in the consideration of measures proper to be pursued for the dividing, laying out and settling such parts of your Majesty's American dominions as it is expedient for your Majesty's service to grant as soon as possible, in order that your subjects may avail themselves of the advantages which such settlement will produce to the trade, navigation and manufacturing of this kingdom, we find ourselves under the greatest difficulties arising from the want of exact surveys of those countries, many parts of which have never been surveyed at all, and others so imperfectly that the charts and maps thereof are not to be depended upon, and in this situation we are reduced to the necessity of making representations to your Majesty, founded upon a little or no information, or of delaying the important service of settling these parts of your Majesty's dominions.

For these reasons it is our duty humbly to recommend to your Majesty in the strongest manner that no time should be lost in obtaining accurate surveys of all your Majesty's North American dominions, but more especially of such parts as, from their natural advantages, require our immediate attention.

To effectuate this purpose, we would humbly submit to your Majesty whether it may not be expedient that for the present, and with a view to this temporary service, your Majesty's dominions upon

the continent of North America should be divided into a Northern and Southern District, with a Surveyor-General of Lands to be appointed for each to act under such instructions as he shall receive from time to time from this Board.

If your Majesty shall be graciously pleased to approve what we here propose, we doubt not but speedy orders will be given for carrying this measure into execution, and we beg leave humbly to lay before your Majesty, for your consideration, the annexed proposals offered us by Captain Samuel Holland, who has great knowledge of the northern parts of America, and who has not only distinguished himself as a brave and active officer, and able engineer in your Majesty's service, but also as a skilful surveyor, in the accurate map he has made of the settled parts of your Majesty's Colony of Quebec; and we beg leave to observe to your Majesty that these proposals appear to us to arise entirely from Captain Holland's zeal for your Majesty's service, as he desires no additional emolument, being well satisfied with your Majesty's gracious intention of appointing him to the office of Surveyor of Lands in your Majesty's Colony of Quebec.

We are further humbly of opinion that the extraordinary expenses which he proposes for this service are perfectly reasonable and necessary; but we humbly recommend that two sets of instruments mentioned in his estimate should be allowed, lest the work should be interrupted by any accident happening to any of them.

All which is most humbly submitted.

(Signed) HILLSBOROUGH.
ED. ELLIOTT.
ORWELL.
BAMBER GASCOYNE.

4th February, 1764.

[Copy.]

AN ESTIMATE OF THE EXPENSES ATTENDING GENERAL SURVEYS OF HIS MAJESTY'S DOMINIONS IN NORTH AMERICA FOR THE YEAR 1764.

	£	s.	d.
To an allowance for a Deputy-Surveyor at Quebec, during the time the Chief Surveyor is employed in making surveys in other parts of the northern district.....	100	0	0
To 2 assistant surveyors, to be employed in the general survey, at 7s. per day each	254	10	0
To 1 draughtsman at 5s. per day	91	5	0
To an additional of 1s. 8d. per day, and to 1 serjeant £1 1s; 10s. one corporal, and 6d. per day to 12 private men, to assist in such survey, as camp, colour and chainmen, and to make signals along shore and on the tops of mountains.....	155	2	0
To extraordinary expenses for horses and guides, etc.....	100	0	0
To an allowance for two sets of proper instruments for the surveyor of the northern district	416	15	0
	1,117		12 0

At the Court of St. James', the 10th day of February, 1764.
Present—The King's Most Excellent Majesty in Council.

Upon reading at the Board a report from the Right Honourable the Lords of the Committee of Council for Plantation Affairs, dated the 4th of this instant, in the words following, viz. :

“Your Majesty, having been pleased by your Order in Council of the 21st of December last, to refer unto this committee a representation from the Lords Commissioners for Trade and Plantations, proposing that accurate surveys should be made of your Majesty’s North American dominions, but more especially of such parts as, from their natural advantages, require immediate attention, and to effectuate this purpose they submit whether it may not be expedient, and with a view to this temporary service, that your Majesty’s dominions upon the continent of North America should be divided into a Northern and Southern District, with a Surveyor-General of Lands to be appointed for each, to act under such instructions as he shall receive from time to time from the said Lords Commissioners, the said Lords Commissioners did at the same time humbly lay before your Majesty a memorial they received from Captain Samuel Holland, whom they represent as a person of great merit, containing proposals for carrying a survey of the northern district into execution, together with accounts and estimates of the several particulars necessary for that service, which the said Lords Commissioners conceive to be very reasonable. The Lords of the Committee, in obedience to your Majesty’s said order of reference, this day took the said representation of the Lords Commissioners for Trade and Plantations, and likewise the several proposals contained in the said memorial of Captain Holland, into their consideration, and are humbly of opinion that it will be for your Majesty’s service that the proposals of the said Lords Commissioners, and likewise those contained in the memorial of Captain Samuel Holland, should be carried into execution as soon as conveniently may be.”

His Majesty took this day the said report into consideration, and was pleased with the advice of his Privy Council to approve thereof, and accordingly to order, as it is hereby ordered, that the Lords Commissioners of his Majesty’s Treasury do cause the several proposals contained in the representation of the Lords Commissioners for Trade and Plantations, and likewise those contained in the memorial of Captain Holland (copies whereof are hereunto annexed), to be carried into execution, except such parts thereof as relate to the appointment of soldiers, and furnishing an armed vessel and boats for the aforementioned service, with respect to which his Majesty hath this day given the necessary directions to the Lords Commissioners of the Admiralty and to the Secretary at War.

(Signed) PHIL. SHARPE.

QUEBEC INSTRUCTION BOOK 5, PAGE 9.

[Copy.]

Samuel Holland, Esq., Surveyor-General of his Majesty's Province of Quebec, and the Northern Districts.

To John Collins, Esq.—Greeting :

By virtue of the power and authority to me given by his Majesty, I do, by these presents, nominate, constitute and appoint you to be my Deputy Surveyor-General for the admeasuring, surveying, setting out of roads and lands in the Province of Quebec, agreeable to my instructions hereunto annexed, with power to the said John Collins to do, execute and perform, by himself or the Assistant Deputy or Deputies, all things whatsoever belonging to the said office, to have, hold, exercise and enjoy the same during our pleasure, together with the salary granted by Parliament, and a moiety, or half part, of all salaries, fees, perquisites, profits and advantages thereunto belonging or appertaining to the said office, subject to further instructions in the premises, and for so doing this shall be your deputation.

Given under my hand and seal at Quebec, this eighth day of September, in the fourth year of the reign of our Sovereign Lord, George the Third, one thousand seven hundred and sixty-four.

(Signed) SAMUEL HOLLAND.

QUEBEC INSTRUCTION BOOK 5, PAGE 11.

[Copy.]

PROVINCE OF QUEBEC.

COMMISSION FROM HIS EXCELLENCY GENERAL CARLETON TO J. COLLINS,
AS DEPUTY-SURVEYOR-GENERAL, MAY 2ND, 1775.

Guy Carleton, Captain-General and Governor-in-Chief in and over the Province of Quebec and the territories depending thereon in America, Keeper of the Great Seal of the said Province, Vice-Admiral of the same, and Major-General of his Majesty's forces, commanding the Northern District of North America, etc.

To all to whom these presents shall come, sendeth greeting :

Know ye, that being well assured of the loyalty, prudence and integrity of the Honourable John Collins, of the City of Quebec, in the Province aforesaid, Esq., and one of the members of his Majesty's Council for the said Province, and having had experience during the course of many years' service, of his capacity and abilities in the execution of the office of Deputy-Surveyor-General of lands of the said Province, I have thought fit to constitute and appoint, and do, by these presents, constitute and appoint him, the said John Collins,

to be Deputy-Surveyor-General of lands in and for the said Province of Quebec, to have, hold, exercise and enjoy, the office of Deputy-Surveyor-General of lands aforesaid, unto him, the said John Collins, during pleasure, together with such fees as shall hereafter be allowed, or appointed by me, or other of his Majesty's Governors-in-Chief, or Lieutenant-Governor; or other Commander-in-Chief of the said Province for the time being, by and with the consent of His Majesty's Council for the same, to be taken in respect of the execution of the said office.

Given under my hand and seal at arms, at the Castle of St. Louis, in the City of Quebec, this second day of May, in the fifteenth year of his Majesty's reign, and in the year of our Lord one thousand seven hundred and seventy-five.

(Signed) GUY CARLETON.

By his Excellency's command.

(Signed) GEO. ALLSOP.

QUEBEC INSTRUCTION BOOK 5, PAGE 1.

[Copy.]

George the Third, by the Grace of God, King of Great Britain and the Territories thereunto, Defender of the Faith, and so forth.

To our trusty and well-beloved the Honourable John Collins, of the District of Montreal, in the Province of Quebec, Esq.—Greeting:

Know you that we have thought fit to empower you, and we do hereby give and grant unto you full power and authority, to tender and administer unto all persons whom it may concern, the oaths directed by law, and the declaration followeth, that is to say, I,

do promise and declare that I will maintain and defend to the utmost of my power the authority of the King in his Parliament, as the Supreme Legislature of this Province, and to receive from such persons their subscriptions, severally, to the oaths and declarations, and what you shall do herein, you are here to make return into the office of our Clerk of the Council for our said Province, together with this Writ.

Witness our trusty and well-beloved Frederick Haldimand, our Captain-General and Governor-in-Chief of our said Province of Quebec, at our Castle of St. Louis, in our City of Quebec, the seventeenth day of May, in the year of our Lord 1784.

(Signed) FREDERICK HALDIMAND.

By his Excellency's command,

(Signed) ALEXANDER GRAY, a C. C.

LETTER BOOK, NASSAU, NO. 2, PAGE 4.

[Copy.]

By Samuel Holland, Esq., Member of the Legislative Council and Surveyor-General of the Province of Quebec, etc.

To Philip R. Frey, Gentleman :

By virtue of the power and authority to me given by his Majesty I do hereby constitute and appoint you to be one of the Deputy Surveyors of Lands, for making surveys in the Upper District of the Province of Quebec; authorizing and requiring you to execute and perform the office of a Deputy Surveyor, agreeable to the orders and instructions hereunto annexed, or to be annexed, by his Excellency the Governor or Commander-in-Chief, or from the Courts of Judicature, or from me, or from the Deputy Surveyor-General of this Province, hold, exercise and enjoy the same during pleasure, together with the fees and advantages thereunto belonging or appertaining; and you are to make your surveys agreeable to the justice and the rules of the science of surveying.

Enregistered in the Register of Detroit, page 59, by me. WM. MONFORTON, <i>Recorder.</i>	}	Given under my hand and seal at Quebec, this twenty-second day of December, one thousand seven hundred and eighty-four. (Signed) SAMUEL HOLLAND.
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I, Philip Frey, do solemnly swear on the holy Evangelists of the Almighty God that I will act impartially and do justice between man and man, as far as my knowledge doth extend in the science of surveying.

Detroit, 30th March, 1785. Before me, date as above. ALEX. MACOMB, C.P. Enregistered in the Register of Detroit, page 59, by me. WM. MONFORTON, <i>Recorder.</i>	}	(Signed) PHILIP R. FREY, <i>Deputy Surveyor for the Upper District of the Province of Quebec.</i>
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LETTER BOOK, NASSAU, NO. 2, PAGE 5.

[Copy.]

NEAR QUEBEC, 19th January, 1785.

DEAR SIR,—You will perceive by the joined instructions that I have appointed you for Niagara and Detroit, as the business in our Department, at the place of your abode, is for the present but little,

and would not afford the fixed allowance of 4s. h. c. per day. I thought best to name you for both places, to which you will, I hope, agree to, as, at Niagara, your presence shall be much wanting in laying out the lots. As I had no time to make out copies of your instructions for the commanding officer, you must make out two, and transmit them as soon as possible.

Your theodolite I shall send by the first opportunity to your friend, Mr. Mackeown, at Montreal, who has promised me to send it up to you by the first batteaux.

Mr. Jenkin William, our solicitor and Clerk of Council, is arrived last night, by the way of New York from London. I received several letters by him, among others one from William Smith, Esq., late Chief Justice of New York, and now appointed in that capacity in this Province. He tells me that he will come out next spring with our Viceroy, Sir Guy Carleton; he thinks that settlers will flash in the Province from all quarters of America, and will make work enough for surveyors. By another letter it seems my friend, Smith, will bring out another code of laws, and Sir Guy will have full instructions to improve the Province and encourage new settlers; so I hope Detroit will have soon another appearance, and the most likely spot to find a comfortable climate. My son, Jack, is sailed with Captain Bouchette to the West Indies to visit his relations; my son, Henry, has exchanged from half-pay to the 70th Regiment with Lieut. Finley in the 44th Regiment by paying the difference. By a fall out of my cariole I have hurt my head and eyes so much that I scrawled this in much pain, so you must excuse me, and believe me, with the greatest sincerity,

My dear Sir,

Your most obedient humble

Servant and friend,

(Signed) SAMUEL HOLLAND.

MR. PHILIP FREY,
Detroit.

On the 24th July, 1788, the Province of Quebec, which had up to that time been divided only into two districts, was further divided into the Districts of Lunenburgh, Mecklenburgh, Nassau, Hesse and Gaspè, with the first four of which we are at present only interested as covering what is now the Province of Ontario. The proclamation by Lord Dorchester is appended:

PROCLAMATION.

DORCHESTER, G.

George the Third, by the Grace of God, of Great Britain, France, and Ireland, King, Defender of the Faith, and so forth.

To all our loving subjects whom these presents may concern.—Greeting :

Whereas our Province of Quebec stands at present divided only into two Districts, and, by virtue of two certain Acts or Ordinances,

the one passed by our Governor and the Legislative Council, in the twenty-seventh year of our reign, and the other in the present year, provision is made for forming and organizing one or more new Districts.

Now, therefore, know ye, that our Governor of our said Province, by the advice and consent of our Council of our said Province, and in pursuance of the Acts and Ordinances aforesaid, hath formed, and doth hereby form, the several new Districts hereinafter described and named, to wit, the *District of Lunenburgh*, bounded on the east by the eastern limit of a tract lately called or known by the name of Lancaster, protracted northerly and southerly as far as our said Province extends; and bounded westerly by a north and south line intersecting the mouth of the River Gananoque, now called the Thames, above the rifts of the St. Lawrence, and extending southerly and northerly to the limits of our said Province, therein comprehending the several towns or tracts called or known by the names of Lancaster, Charlottenburgh, Cornwall, Osnabruck, Williamsburgh, Matilda, Edwardsburg, Augusta, Elizabethtown; and also one other District, to be called the *District of Mecklenburgh*, extending within the north and south bounds of our said Province, from the western limits of the said District of Lunenburg as far westerly as to a north and south line intersecting the mouth of a river now called the Trent, discharging itself from the west into the head of the Bay of Quinté, and therein comprehending the several towns or tracts called or known by the names of Pittsburg, Kingstown, Ernestown, Fredericksburg, Adolphustown, Marysburg, Sophiasburg, Ameliasburg, Sydney, Thurlow, Richmond and Camden; and also one other District, to be called the *District of Nassau*, extending within the north and south bounds of our said Province, from the western limit of the last mentioned District so far westerly as to a north and south line intersecting the extreme projection of Long Point with the Lake Erie on the northerly side of the said Lake Erie; and also one other District, to be called the *District of Hesse*, which is to comprehend all the residue of our said Province in the western or inland parts thereof, of the entire breadth thereof, from the southerly to the northerly boundary of the same; and also one other District, to be called the *District of Gaspè*, and to comprehend all that part of our said Province, on the southerly side of St. Lawrence, to the eastward of a north and south line intersecting the north-easterly side of Cape Cat, which is on the southerly side of the said river, of which all our loving subjects are to take due notice, and govern themselves accordingly.

In testimony whereof we have caused these our letters to be made patent, and the great seal of our said Province to be herewith affixed.

Witness our trusty and well-beloved Guy, Lord Dorchester, Captain-General, and Governor-in-Chief of our said Province, at our castle of Saint Louis, in our City of Quebec, the twenty-fourth day of July, in the year of our Lord one thousand seven hundred and eighty-eight, and of our reign the twenty-eighth.

(Signed) GEO. POWNALL,
Secretary.

On the 17th February, 1789, Rules and Regulations for the conduct of the Land Office Department were published. Under these, Land Boards were appointed for each of the above districts, whose duties (among others mentioned) were to receive applications for grants of land, to enquire into the loyalty of the petitioner, and, if satisfied thereof, to give to every such petitioner a certificate to the Surveyor-General, or Deputy-Surveyor for the District, who was bound, within two days, to assign the petitioner a single lot of about two hundred acres, describing the same with due certainty and accuracy. Additional Rules and Regulations for the conduct of the Land Office Department were published August 25th, 1789.

Copies of aforesaid certificates are hereto appended :

[Copy.]

SINGLE LOT.

No.

Certificate of the Board appointed by his Excellency the Governor for the District of _____ in the Province of Quebec, under the Rules and Regulations for the conduct of the Land Office Department, dated Council Chamber, Quebec, 17th February, 1789.

The bearer _____, having on the _____ day of _____, preferred to this Board a petition addressed to his Excellency the Governor in Council for a grant of _____ acres of land in the Township of _____ in the District of _____. We have examined into his loyalty and character, and find him duly qualified to receive a single lot of about two hundred acres, the oath of fidelity and allegiance directed by law having this day been administered to him by the Board, in conformity to the fourth article of the Rules and Regulations aforementioned.

Given at the Board at _____, this _____ day of _____, one thousand seven hundred and _____

To _____ Acting Surveyor for the District of _____

CERTIFICATE OF THE ACTING SURVEYOR.

No.

I assign to the bearer _____, the Lot, No. _____, in the Township of _____, in the District of _____, containing _____ acres _____ chains _____, which lot he is hereby authorized to occupy and improve. And having improved the same, he shall receive a grant thereof to him and his heirs, or devisees, in due form, on such terms and conditions as it shall please his Majesty to ordain. And all persons are desired to take notice that this assignment, and

all others of a similar nature, are not transferable by purchase, donation, or otherwise, on any pretence whatever, except by an act under the signature of the Board for the District in which the lands are situated, which is to be endorsed upon this certificate.

Given at _____, this _____ day of _____, one thousand
seven hundred and _____

Acting Surveyor for the District of

Also copy of a letter, dated July 7th, 1788, from John Collins, Deputy-Surveyor-General, to Philip Frey, Deputy-Surveyor, Niagara, publishing the appointment of different surveyors in each of the four Districts, to receive claims and applications for land from the American Loyalists and others; also copies of two letters to Mr. Philip Frey, from Deputy-Surveyor Collins, dated 31st July, 1788; also copy of instructions to Mr. Frey, from Mr. Collins, dated May 20th, 1790.

LETTER BOOK, NASSAU, NO. 2, PAGE 10.

[Copy.]

SURVEYOR-GENERAL'S OFFICE, QUEBEC,
7th July, 1788.

SIR,—It being the command of his Excellency the Governor-General, that the American Loyalists and others, admitted to become citizens of this Province, have portions of land assigned to them with dispatch and with as little trouble and expense to themselves as possible, notice is hereby given that Mr. William Chewett, at Lake St. Francis, and Mr. Patrick McNiff, at the Ottawa or Grand River, Mr. James and Hugh McDonell, at the vacant lands between Elizabethtown and Pittsburg, Mr. Alexander Aitkin, at Kingston or Toronto, and Mr. Philip Frey, at Niagara or Detroit, all Deputy-Surveyors, and now on the business of surveying at or near the respective places aforementioned, have authority to receive claims and applications for the purposes above mentioned, to be transmitted to me for his Lordship's consideration, and that the same Deputy-Surveyor will, upon his Lordship's approbation, have orders from this office to ascertain to the settlers their several respective apportionments in either of the Districts of Lunenburg, Mecklenburg, Nassau or Hesse.

(Signed) JOHN COLLINS, D.S.-G.

MR. PHILIP FREY,
Deputy-Surveyor, Niagara.

LETTER BOOK, NASSAU, NO. 2, PAGE 10.

[Copy.]

SURVEYOR-GENERAL'S OFFICE,

31st July, 1788.

SIR,—Inclosed you have a general instruction for your Government in laying out lands in future, and also a copy of his Excellency Lord Dorchester's commands in Council of the 7th inst., both of which you will please to attend to. My former letters respected a particular account of your settlement, and a plan of the same, which I now beg leave to repeat, that you send it this office by the first safe conveyance. Let your plan include the whole settlement from the head of the Lake Ontario to Detroit. I expect his Excellency Lord Dorchester will soon visit the Western country. In that case you will give his Lordship every necessary information he may require respecting carrying on the settlement in that quarter. The Surveyor-General being absent from this Province makes it necessary you appoint some agent here to present your accounts and receive your money. Let your accounts be proved, and all the vouchers for money paid by you accompany them.

I wish you health, and am with regard,

Your most obedient servant.

(Signed) JOHN COLLINS, D.S.-G.

MR. PHILIP FREY,
Deputy-Surveyor, Niagara.

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LETTER BOOK, NASSAU, NO. 2, PAGE 15.

[Copy.]

QUEBEC, 31st July, 1788.

I enclose you a copy of a late Report in Council on the business of surveys, and in furtherance of that economy which ought to be considered by all the officers of the Crown, and especially in our department, in which the expenditures have been so considerable. I add that you will use your directions in carrying your field work to no greater extent than will be necessary for your returning such a proportion as will enable the Surveyor-General to issue out of it returns for specific quantities in future directed to be granted, and suffice for the Patentee's laying out his grant with competent certainty, equal safety to himself and the Crown. It is under this idea that the actual survey of only one line along the water directed to be actually run from and to fixed boundaries, except when number of settlers ready to begin to work, and in danger from their want of knowledge in surveys of commencing in concession, may make it requisite to give the first concession a road, or rather the second concession a front line, with so much of the exterior side lines of the township and the breadth by the subdivisions

of the first concessions, as will guide those grantees in extending the side line of their own lots to the road in the rear of that concession, dividing it from the second as in the first; one grant will thus be made to connect with other prior in time. There must be the due care to ascertain the two capital stations for the breadth of the township, and to blaze healthy trees for the purpose; several of them should be distinguished by marks, and their bearing and distances from the precise spot.

A blaze through the rind and lettered, cut into the wood by such an instrument as is used by coopers in marking casks, I am told has been opened or boxed after eight years and shown the letters perfectly fresh and legible.

PHILIP FREY, ESQ.

JOHN COLLINS.

LETTER BOOK, NASSAU, NO. 2, PAGE 33, 34.

[Copy.]

SURVEYOR-GENERAL'S OFFICE,
QUEBEC, 20th July, 1790.

Instructions to Mr. Philip Frey, Deputy Surveyor of the District of Nassau:

SIR,—His Excellency having been pleased to direct that the Land Board of Nassau employ the Surveyor of their district, with ten men, to survey and mark the front lines of townships from the eastern boundary of their district to Toronto, and to carry the side line of each township one mile well marked, at such time as may best fall in with their general arrangement of the summer business of their district, if other more necessary work will admit of it.

You are to proceed to the execution of these services at such time and agreeable to such instructions as the Land Board of your district may direct, reporting to this office protraction of the work when finished.

You are directed to keep a journal and field book, writing whatever is observable for its singularity and value towards the public utility as water-falls, minerals, quarries, the quality of the land and timber, etc., etc.

And I am charged to apprise you that besides your return to me of a map and field book, you do also account for the time to be spent on it in a journal to be kept for the purpose with such minuteness and certainty as will enable you to answer questions respecting the business upon oath, if the same should be required.

There must be very strict attention paid to economy in the whole service, and the hands dismissed as soon as they can be spared; and as the accounts will all be subject to audit, you will take care to furnish the documents that will be expected in justification of every article of charge. It is not, however, his Lordship's intention by

any small savings to disappoint the useful end for which these surveys are commanded; but there must be a responsible discretion exercised in the expenses both of the time and the means.

And you are on the receipt of these instructions to communicate the same to the Land Board of your district for their information, and that they may be the better enabled to direct such further particulars as their local knowledge and experience may suggest.

I am with regard, Sir,

Your most obedient servant.

(Signed) JOHN COLLINS, D.S.G.

Approved by his Excellency Lord Dorchester,

31st May, 1790.

(Signed) HENRY MOTZ.

The following appears to have been the method adopted in carrying out surveys under this *régime*. Each Land Board had one or more Deputy-Surveyors attached to them, who performed surveys as directed by them, as the following extract from the Land Board of Nassau shows :

“Land Board for the District of Nassau, held at Niagara the 6th June, 1791.

“Present—Colonel Gordon, Commanding Upper Posts, Lieut.-Colonel John Butler, Robert Hamilton, John Burch, Robert Kerr, John McNabb, Lieut. Bruyers, R. Engineers.

“The Board having met, Col. Gordon laid before them several letters and instructions from headquarters for their guidance, which were read, also a paper signifying the appointment of Mr. Jones as Deputy-Surveyor for this District, who was sworn by the Board for that purpose. Instructions were given to the Surveyor to proceed in laying out the town of Lennox.”

The Deputy-Surveyors were appointed by the Surveyor-General, as the foregoing extracts from letters show.

The following certificate of the examination of a Deputy-Surveyor about this period will be of interest, also the oath of office to be taken by Surveyors, also the commission, as a Deputy-Surveyor for the Province of South Carolina, of Wm. Fortune, admitted a Deputy-Surveyor for the Province of Quebec, July 4, 1788.

EXTRACT FROM LETTERS RECEIVED, VOL. I., P. 41.

Pursuant to an Order from His Excellency John Graves Simcoe, Esquire, Lieut.-Governor and Commander-in-Chief of the Province of Upper Canada, etc., etc., etc.

I have examined Mr. Lewis Grant previous to his being appointed one of the Surveyors of the said Province, relative to his knowledge in the Theory and Practice of Surveying and Drawing, viz. :

In the necessary parts of arithmetic.

In the necessary parts of geometry and trigonometry.

In the necessary parts of surveying, such as :

Viz.—Surveying a regular or irregular field by the circumferentor or chain, and finding the content of the same.

Surveying a small river on the ice, and protracting the same, by the theodolite and traverse table.

Surveying a large river, intersecting its opposite side, and protracting the same by the theodolite and traverse table.

Surveying and laying out a township, regular or irregular, and protracting the same, by the theodolite traverse table and sector.

In fixing a meridian, and finding the variation of the compass.

In finding the latitude by the sun's meridian altitude.

In levelling, for the purpose of making aqueducts, etc., etc.

(Signed) W. CHEWETT,
Actg. Sur.-Gen.

Examined during the 25th, 26th, and 27th Aug., 1792.

Grand River, in the County of Stormont, 27th Aug., 1792.

 LETTERS RECEIVED, VOL. I., P. 98.

OATH TO BE TAKEN BY ALL DEPUTY-SURVEYORS.

I do solemnly swear that I will be true and faithful to the trust reposed in me as Provincial Deputy-Surveyor, and most carefully attend to the interests of the Crown in the performance of the different duties I shall be engaged in.

That I will strictly observe the ordinances, rules, and regulations now in force, or which may be hereafter established for the administration of the Land Granting Department, that I will punctually execute with fidelity and despatch whatever orders and instructions I may from time to time receive from the Governor, Lieut.-Governor, or Person administering his Majesty's Government

and the Executive Council of this Province, the Surveyor-General thereof, and every other my superior officer, in all matters respecting the duties of my office, that I will keep exact and regular journals and records of all my transactions therein, perform the services I shall be employed upon without unnecessary delay or expense, and make faithful reports on my return of all useful discoveries which I may meet with in the course of my surveys, and that I will at all times and upon all occasions honestly and conscientiously discharge the several functions of a Deputy-Surveyor with the strictest diligence, impartiality and justice.

So help me God.

LETTERS RECEIVED, VOL. I., P. 142.

Sir Egerton Leigh's Deputation to Mr. Wm. Fortune.	}	South Carolina.
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To all whom these Presents shall come, I, Sir Egerton Leigh, Baronet, Surveyor-General of his Majesty's Province of South Carolina, send greeting :

Know ye that I, the said Sir Egerton Leigh, reposing especial trust and confidence in you, William Fortune, in your knowledge, skill, and ability in the Art of Surveying, have made, nominated and ordained, deputed and appointed, and by these presents do make, nominate, ordain and appoint you, the said William Fortune, to be my lawful Deputy-Surveyor for the Province of South Carolina, to have, hold, use, exercise and enjoy the said office of Deputy Surveyor, together with all fees, perquisites and profits whatsoever thereunto belonging, which in and by an Act, entitled: "An Act to ascertain the Fees of the Surveyor-General for the time being, and his Deputies, etc.," passed the thirteenth day of April, 1733, are appointed, limited and ascertained, observing the said Act, and the instructions herewith given you, and such other lawful orders and directions as from time to time ye shall receive from me.

This Deputation to continue during pleasure.

In witness whereof, I have hereunto put my hand and seal the 5th day of May, in the Year of our Lord one thousand seven hundred 73, and the thirteenth year of his Majesty's reign.

(Signed) EGERTON LEIGH.
Surveyor-General.

The above William Fortune was duly qualified as a Deputy-Surveyor, this 7th day of May, 1773.

(Signed) J. SIMPSON.

The division of the Province of Quebec into the Provinces of Upper and Lower Canada took place in 1791. The following is the Proclamation :

LETTERS RECEIVED, VOL. I, P. 192, 193.

DIVISION OF THE PROVINCE OF QUEBEC.

ALURED CLARKE.

George the Third, by the Grace of God, of Great Britain, France and Ireland, King, Defender of the Faith, etc.

To all our loving subjects whom these presents may concern.—Greeting :

Whereas we have thought fit, by and with the advice of our Privy Council, by our Order of Council, dated in the month of August last, to order that our Province of Quebec, should be divided into two distinct Provinces, to be called the Province of Upper Canada and the Province of Lower Canada, by separating the said two Provinces, according to the following line of division, viz. :

“ To commence at a stone boundary on the north bank of the Lake St. Francis, at the cove west of Point-au-Bodet, in the limit between the Township of Lancaster and the Seigneurie of New Longueuil, running along the said limit in the direction of north thirty-four degrees west, to the westernmost angle of the said Seigneurie of New Longueuil; thence along the north-western boundary of the Seigneurie of Vaudreuil, running north twenty-five degrees east until it strikes the Ottawa River, to ascend the said river into the Lake Tamiscaming; and from the head of the said lake by a line drawn due north until it strikes the boundary-line of Hudson's Bay, including all the territory to the westward and southward of the said line, to the utmost extent of the country commonly called or known by the name of Canada.”

Witness our trusty and well beloved Alured Clarke, Esquire, our Lieutenant-Governor and Commander-in Chief of our said Province of Quebec, Major-General commanding our forces in North America, etc., etc., etc., at our Castle of St. Louis, in the City of Quebec, this eighteenth day of November, in the year of our Lord 1791, and in the 32nd year of our reign.

(Signed) A. C.

(Signed) HUGH FINLAY,
Acting Secretary.

The Province of Upper Canada was divided, the following year, into nineteen counties, viz. :—Glengarry, Stormont, Dundas, Grenville, Leeds, Frontenac, Ontario, Addington, Lennox, Prince Edward, Hastings, Northumberland, Durham, York, Lincoln, Norfolk, Suffolk, Essex, Kent. And the first Provincial Parliament met at Niagara on the 17th day of September, 1792, John Graves Simcoe being Lieutenant-Governor, in the 32nd year of George III. Chapter viii. of

the Statutes passed the first session of this Parliament altered the names of the four districts from Lunenburg, Mecklenburgh, Nassau and Hesse, into the Eastern, Midland, Home and Western Districts.

The Land Boards were abolished by Order-in-Council, dated November 6th, 1794, and it was directed that all applications for land should be made to the Lieutenant-Governor-in-Council. And from that time surveys were made under direct instructions from the Surveyor-General, in pursuance of the Proclamation of his Excellency Lieutenant-Governor Simcoe, dated February 7th, 1792, the first clause of which says that the Crown lands "are to be run out and marked by his Majesty's Surveyor or Deputy-Surveyor-General, or under his sanction and authority."

I trust I have not wearied you in giving this page out of our early history, but I confess it has a certain fascination for me, and if time and opportunity permit I may perhaps trespass on your attention for another page.

In closing, allow me to express a hope that you may have a pleasant and profitable time in listening to the papers on the agenda and in the discussions to follow; and that, with the Divine blessing, we may meet next year with an increased membership, our Association, like a vigorous young sapling, adding an annual ring, with the sap of youthful life pulsating in every pore, ever widening in interest and prospering in every department.

GEORGE B. KIRKPATRICK,

President of the Association of Provincial Land Surveyors of Ontario

Toronto, March 1st, 1887.

Mr. O. J. Klotz—I would move that the hearty thanks of this convention be tendered to the President for his interesting and able address. There is one point he has touched upon, concerning which I would like to make a few remarks, and that is in regard to the compilation of the Decisions of the Courts of Ontario regarding our surveys. I had hoped that I would be able to present here to-day a book that has been issued by the Michigan Association. It is a book for use by surveyors, a manual, in fact, of surveying, with an appendix containing all the decisions that have been made in the United States courts in regard to surveys. I think that a similar compilation might be made by this Association. We have plenty of men who are fully competent to undertake the work, and carry it out successfully. I would suggest that a committee should be appointed to take this matter in hand. That is, however, an after consideration. In the meantime I would move that a hearty vote of thanks be tendered our President for the very able and interesting address with which he has favoured us.

The resolution was seconded by Mr. Niven, and carried unanimously.

PAPERS.

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

CROWN SURVEYS.

BY ELIHU STEWART,
P.L.S., Collingwood.

MR. PRESIDENT, VICE-PRESIDENT AND GENTLEMEN,—It has often occurred to me that the reports of surveyors, as found in the Crown Lands Departments of Ontario and Quebec would furnish material for a very interesting work on pioneer life in these Provinces.

In no other quarter can we find so much reliable information concerning the physical appearance of the country in what might be called its infancy; but, in addition to this, we can glean both from what is actually stated in these reports, and also from what is fairly deducible from them, a vast amount of information concerning the early settlers in what are now our most prosperous districts. It is not too much to say that he who has read over those early reports carefully has had a glimpse of life as it existed along the St. Lawrence and the lakes when the wilderness region to the north was a veritable terra incognita, known only to the trader and the Indian. These records are intensely interesting to the members of our profession, inasmuch as, in addition to the information they contain concerning the country in those early days, they are the autobiographies of many of our professional brethren now passed to another colony. And as we read of their trials and difficulties and privations in the discharge of their duty, in the forest region along the great lakes, where now vast cultivated fields and hamlets, and towns and cities stand; where now is heard the shrill whistle of the locomotive and the happy song of free labour, but where then was only heard the dull, monotonous Indian drum, or the wild animals of the forest, we realize how similar their experience to that of the surveyor in our northern regions to-day. But it is not my intention at this time to dwell on this phase of the subject, but to say something that may be of practical benefit to the younger members of the profession, who may be entrusted in the future with the execution of such work by the Department.

It is now the usual practice to have this work done during the summer season; and any surveyor, suspected as likely to be employed, will, long before the time of receiving his instructions, have the offer of any number of applicants, who will be anxious to aid him in the performance of his work. It seems to be the general opinion of those who have never been engaged on this work that it is a mere pastime,

a sort of perpetual picnic, very closely allied with the pleasure indulged in by so many during the summer holiday season. I need not say here that this idea will scarcely survive three days' actual experience.

The surveyor should take with him two good chainmen, capable of keeping the notes, a good cook, and an assistant, capable of taking charge when the surveyor may not be able to do so. As for the other men, he can generally get them near the work, unless he is going very far from settlement. In any case do not take men who have had no experience of pioneer life. The difficulties met with by the party in charge may arise from various causes, but difficulties, and many of them, will always appear, and the surveyor will have to use his best judgment and exercise all his ingenuity to overcome them. Very frequently these will arise from defection in some of the party, and often the men you expected most from will be the first to become dissatisfied. Then, in many cases, the greatest difficulty will be found in getting to the township, and after reaching it your ingenuity will be taxed in order to comply with the instructions, and, at the same time, succeed in getting in the necessary supplies. All information that it is possible to get should be obtained in advance, or you will have the mortification of finding, when it is too late, that you could have reached the work and conducted the whole survey much more advantageously if you had proceeded on an entirely different plan. I would emphasize the necessity of having good men accustomed to such work and familiar with the hardships which they will encounter, and, in this connection, I will trespass on your time by relating my own experience some years ago.

In the spring of 1875 I was instructed to survey the Township of Machar, in the Huron and Ottawa District; and, though I had then some experience in similar work, I was verdant enough to imagine that I had secured three first-class axemen, when the same number of robust shantymen signified their willingness to accompany me. I engaged them in the Town of Collingwood, and, with them and a few others, I left by the first boat of the season for Parry Sound. On arriving there I again found, after some difficulty, a couple of men with teams, who agreed, for the sum of \$6 each per day, to take loads as far as it was possible for them to go. After three days of travelling we arrived at a point on the Rosseau and Nipissing road exactly where now stands, in all its lordly magnificence, that excellent hostelry, known by the expressive, if not euphonious, name of the Bummer's Roost. At that time we had passed some eight miles beyond the limits of settlement. Here we unloaded the waggons and dismissed our teamsters, this being the nearest point on the road to the beginning of the work. I might say, however, that, even before this, the three stalwart shantymen who, before starting from town, had expressed a longing for just such work as we had experienced, and were only desirous that it should continue longer than I anticipated, had begun to show signs of mutiny, but no open revolt had yet been proclaimed. After making a *cache* near the roadside, and leaving what we could not carry with us, we started eastward through the woods with our packs. We had not gone far before we met a newly

surveyed line, by which we were able to locate our position and calculate accurately the distance to where our work would commence. This was Saturday afternoon, and I was greatly cheered by the really excellent conduct, as well as the cheerfulness exhibited by the whole party, and the three men above referred to especially, during the evening of that day and the whole of the day following. We, of course, like good Christians, rested on Sunday, and, like the Lotos-eaters, they seemed to wish it always Sunday afternoon. Monday morning came, and, as I remember it, it was a glorious day. The weather was all that we could wish. It was about the 24th of May, neither too hot in the day time or too cold at night, and the flies had not yet made their appearance; but for some reason all the cheerfulness seemed to have departed with the Sabbath from the three stalwarts, on whose magnificent physical appearance I had looked with so much pride as they paced the streets of Collingwood; their loads, they said, were too intolerable to be borne, and they began to wish themselves in a decidedly torrid climate if they ever engaged with another surveyor. However, we finally reached the corner of the township where our work was to begin, and, I might also say, my greatest difficulties. In a day or two more it was necessary to send for more supplies, and I accordingly despatched two of these men, who, after arming themselves sufficiently for protection against the bears and wolves that then infested that region, and taking along our dog to give them timely warning of the approach of these animals, they marched, I am bound to say, cheerfully away. The distance they had to travel was not great, but it was dark of the second day before they staggered into camp thoroughly exhausted, with about enough supplies to last two days longer. I might say just here that our cook had been somewhat startled by hearing the bark of a dog about ten o'clock of the second day; and it leaked out afterwards that these two worthies had found themselves so fatigued with their heavy loads of perhaps thirty pounds each about that time that they had to spend the remainder of the day resting within a mile of the camp, and, lest the dog should return and frighten the cook by the thought that an evil beast had devoured them, they tied him securely to a tree during the time they were resting from their burdens. This state of affairs continued for a couple of weeks longer, when the flies came to our relief, and I was compelled (however reluctantly you may imagine) to part with the invaluable services of these men. I succeeded, however, in replacing them by good men from the neighbouring settlement, and completed the work without further serious inconvenience. I merely relate this bit of experience as one of many that might be cited to show the mistake frequently made by taking inexperienced men for such work. The work from beginning to end is the most arduous imaginable, and no member of the party can escape it. I do not know how many times I have made the firmest resolution not to carry a pack. I would have my party complete, and there would seem, on the start, no need that I should engage in that pastime. I have often frequently fortified myself in this resolution by not taking a packstrap for myself, but in every case, before the

first day was over, I had succeeded by some means to load myself with all I could possibly manage. By the way, I would ask those of you who have engaged to any extent in this amusement, if you did not find it conducive to meditation and reflection. If I were a moralist, and wished to induce men to think seriously of their past life, I would encourage them to engage in this work, and if sixty pounds will not do it, increase it to seventy-five or one hundred, and if this has not the desired effect, the subject is beyond hope. Perhaps some of you may not understand me on this point. Well, gentlemen, if that be the case, I can only recommend you to engage in the exercise I have mentioned, and, if you do not, before the first day is over, recall to memory more of the scenes of your innocent boyhood days, when you were free from such burdens as this, your experience will be different from mine, and I fear the reason will be your load has not been as heavy.

Next perhaps in importance to having good men comes *equipment*. Every surveyor starting on this work should be thoroughly supplied, not only with what instruments, chains, axes, etc., he will be sure to require, but with a small extra supply in case of accident. He will need to exercise his judgment in this case, so as to have all he will probably require, and at the same time keeping the whole outfit as light as possible. Thin tents, small axes and brush hooks, a small grindstone, cooking utensils, all tin, instead of heavier articles, are a few instances that I would observe in this connection. With regard to supplies, I have found that it is quite as economical to have a variety of articles as to adhere to the old system of taking only flour, pork and tea, and much more satisfactory to the party. In addition to the above I would recommend beans, sugar, dried apples, raisins, and a number of other articles in small quantities, which will readily suggest themselves. But of the staple articles, such as flour, bacon, dried apples, tea, and beans, it is well to have an ample quantity within easy distance of the work, so as to prevent the annoyance of running short before the work is finished. The cost of a few hundred pounds of these articles, even if not required, is very little compared with that of having to get a fresh supply from a distance; besides, if any are left, they can generally be disposed of to settlers in the vicinity at little loss to the surveyor.

With regard to the instruments best adapted for the Crown surveys in Ontario, in addition to the transit or theodolite and needle compass, I have found the solar instrument very valuable. A good micrometer also is of great service in the traverse of the numerous lakes nearly everywhere met with in the northern part of the Province, where the work is generally located.

The chainmen should be furnished with small books for use in the field, and every evening the notes taken during the day should be copied into a large book always kept in tent. This book I have found it convenient to have properly ruled and paged before leaving for the work. An index plan should also be made in the front of it, and on this can be marked the exact length of each line as soon as entered on its proper page. This will be convenient as the work proceeds,

as at a glance it can be seen what has been done, and how the measurements are coming out.

It is also necessary to keep this additional record in case any of the small books should be lost or become illegible through rough usage. It also greatly facilitates the work of making out the returns for the Department, as these will be an exact copy from the book, and entered in the same order.

With regard to the system adopted in these surveys by the Ontario Government I have little to say, but it has frequently occurred to me that a thorough exploration of the country in advance of survey would be in the public interest. I believe this plan is being adopted with respect to the North-Western part of the Province, and I would suggest the advisability of extending it to the districts north of Lakes Huron and Superior. The objects aimed at should be to furnish information as to the portions best suited for agricultural purposes, so that the country would be saved the unnecessary expense of surveying land incapable of settlement, and intending settlers the trouble of exploring such tracts.

Of the character of the territory itself I would like to say something to awaken an interest in it, if possible, on the part of our people, who to-day know as little of our possessions in that direction as if they were in the wilds of Africa.

It cannot truthfully be called a land remarkably well adapted throughout for the agriculturist, though a large part of it will yet be found productive. It possesses not the rich vegetable deposit of portions of the North-Western prairies, but it has an immense advantage over them in the excellence of its water in the greatest abundance, and also in the possession of its timber, while for beauty of scenery there is no comparison.

When paddling up some of those placid inland lakes, lying so still in their undisturbed solitude, I have often thought that it would well repay some of our tourists to forego at least one trip to the sea-side to look at such magnificent natural scenery lying almost at their doors. There is nothing in it awe-inspiring or majestic on account of vastness, such as may be seen on the Upper Saguenay or in the mountains of the west; but there is a weird, quiet beauty made up of the gorgeous foliage of the woods sloping down from the surrounding hills until it meets the glassy lake below, and is reflected by it, so that at a short distance away you can scarcely discern the dividing line between them.

The surveyor sees the country at the greatest disadvantage, except in respect to its natural scenery. The difficulties surrounding him are apt to create a prejudice in his mind, in which part of the blame of his troubles are very often rightly or wrongly attributed to the district in which he is engaged. In proof of this I might point to the many unfavourable reports made by the surveyor regarding townships both in the older and younger parts of the Province, which have since found favour in the eyes of the agriculturist, and become the homes of prosperous farmers, and though we can hardly hope that this territory will ever take a foremost place among the rich agricultural districts of the world, there is no reason to despair of its occupying on this

continent a position similar to that of Norway and Sweden to the continent of Europe, or that of Scotland to the British Isles.

At the close of Mr. Stewart's paper, Mr. Aylesworth moved, and Mr. Burke seconded, a resolution tendering him the thanks of the Association.

DISCUSSION.

The Chairman then invited discussion, remarking for his own part as follows:—I think I can quite agree with Mr. Stewart that a man's report is very often tinged by the success he has met with in making his survey. I know of several cases where the reports have made out lands to be thoroughly useless, which have since been divided into townships and settled. There is one I remember, the township of Russell, of which the report said, "Will never be settled for a century to come." It is not many years since that report was made, and the township is well settled now. The unfortunate man that wrote that report was probably up to his knees in water during a good part of the time that he was on his survey. (Laughter.) Then, as to the county of Kent, if we read old Mr. Riordan's reports, we find that he was above his knees in water during a good deal of the time he spent on that survey. He had to take quinine for medicine, and between quinine and water he found it almost impossible to get on; and, yet, these townships are to-day the garden of that part of the country.

Mr. Abrey—I might say that I myself have made some very bad reports on townships, since settled, but the fact that they are settled does not alter my opinion of them.

The Chairman—A man convinced against his will is of the same opinion still.

Mr. Stewart—I am very much obliged for the vote of thanks which the Association has tendered me. It was scarcely complimentary to the Association to present such a paper as I have read, but I hoped it would create discussion. I think one point deserves being discussed somewhat. I mean the reference I made to the idea of the Government sending out exploratory surveyors to ascertain the quality of land before sending a surveying party over it. In many cases the quality of the land is not known until the report of the final surveyor is made, and we are often surveying districts almost useless, while we are leaving out large districts that are really good for settling.

The Chairman remarked, with regard to Mr. Stewart's suggestion, that a good deal of money had been spent on exploratory surveys, and the result had not been encouraging. All they could do was to send surveyors where they had information that good land was to be found. This policy had been pursued for the last five or six years with success.

Mr. Stewart—I don't wish to prolong discussion, but would mention that the exploring parties sent out by the Government before sales are made, might be combined with such exploring survey parties as I have suggested.

Mr. Abrey remarked that such a policy as that suggested had been pursued in regard to Manitoulin, and had been found to answer.

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SOLAR AZIMUTHS.

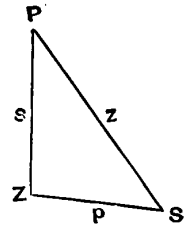
By JOHN McAREE,

D.T.S., Graduate School Practical Science, Toronto.

WHILE the method by observation of *Polaris* is undoubtedly the best for obtaining the direction of the meridian to the greatest degree of attainable accuracy, it has certain inconveniencies which should preclude its use generally in certain kinds of work where a ready method of finding the azimuth to a fair degree of accuracy, and checking it by an observation at any time during the day, is of greater importance than extreme accuracy. We say "should preclude its use," because the necessary azimuths can, in such cases, be obtained by observations of the sun. In many kinds of engineering and topographical surveying, for example, the refined method by *Polaris* is not needed, and in the land surveys of our northern and north-western country, the limitations as to the cost of the survey, and the physical character of the field, make great accuracy practically unattainable. From these considerations the method of finding the meridian by the sun should be more generally used than it is; at any rate surveyors should have such an acquaintance with it as to be able to use it whenever a proper occasion presented itself.

In the month of May, 1886, the writer, with a view to finding out for himself the degree of accuracy that could be obtained by this method, determined the azimuth of a line by a series of twenty-five observations of the sun's altitude: these observations were made with the common theodolite, reading to single minutes, the vertical arc being a semicircle only; with, of course, only one vernier, the eccentricity would not be eliminated. It was the intention to find the azimuth of the same line by observations on *Polaris* on a number of nights; but the work had to be suspended when only one determination had been made, and could not be resumed until a very short time ago, when the point could not be recovered. The work was resumed in February, 1887, when a series of 23 observations were made. Before giving the results of these observations, I will, in order to make this paper a little more complete, introduce a short discussion of the spherical triangle which is solved in the problem of finding the sun's azimuth by observing his altitude, with a view of discovering the most suitable form of triangle, viz., the form in which an error in the altitude, in the declination, or in the latitude used, will have the least effect on the value of the resulting azimuth.

In the annexed diagram of the spherical triangle in question, let the angles be denoted by capital letters, and their opposite sides by the corresponding small letters. Let P denote the pole, Z the zenith, and S the place of the sun.



We then have these fundamental equations of spherical trigonometry:

$$\begin{aligned} \cos z &= \cos s \cos p + \sin s \sin p \cos Z & (a) \\ \sin z \cos P &= \sin s \cos p - \cos s \sin p \cos Z & (b) \\ \sin z \sin P &= \sin p \sin Z & (c) \\ \sin z \cos S &= \sin p \cos s - \cos p \sin s \cos Z & (d) \\ \sin s \sin Z &= \sin z \sin S & (e) \end{aligned}$$

Now P is the hour angle which is usually denoted by t ; Z is the azimuth usually denoted by A ; S is called the parallactic angle; z is the polar distance; s is the colatitude, and p is the zenith distance or coaltitude. Let ϕ denote the latitude, δ the declination, and h the altitude. With this notation, and, remembering that the sine of an angle is equal to the cosine of its complement, the equations (a), (b), (c), (d) and (e) become transformed into the following:

$$\begin{aligned} (a) \text{ becomes} & \quad \sin \delta = \sin \phi \sin h + \cos \phi \cos h \cos A & (1) \\ (b) \quad \text{“} & \quad \cos \delta \cos t = \cos \phi \sin h - \sin \phi \cos h \cos A & (2) \\ (c) \quad \text{“} & \quad \cos \delta \sin t = \cos h \sin A & (3) \\ (d) \quad \text{“} & \quad \cos \delta \cos S = \cos h \sin \phi - \sin h \cos \phi \cos A & (4) \\ (e) \quad \text{“} & \quad \cos \phi \sin A = \cos \delta \sin S & (5) \end{aligned}$$

1st. To find the error in the azimuth due to a small error in the *latitude*, differentiate equation (1), considering ϕ and A as the only variables; thus we find:

$$d A = d \phi \left(\frac{\cos \phi \sin h - \sin \phi \cos h \cos A}{\cos \phi \cos h \sin A} \right)$$

$= d \phi \sec \phi \cot t$, by (2) and (3), or $d A \phi = d \phi \sec \phi \cot t$: (6) where $d A \phi$ is the error in the azimuth corresponding to a small error $d \phi$ in the latitude.

2nd. To find the error in the azimuth corresponding to a small error in the *declination*, differentiate equation (1), considering δ and A to be the only variables; thus we find:

$$d A = d A \delta = -d \delta \left(\frac{\cos \delta}{\cos \phi \cos h \sin A} \right)$$

which by (3) becomes $d A \delta = -d \delta \sec \phi \operatorname{cosec} t$ (7); where $d A \delta$ is the error in the azimuth due to the small error $d \delta$ in the declination.

Lastly, to find the error in the azimuth corresponding to a small

error in the *altitude*; differentiate (1), considering h and A to be the only variables thus, $d A = d A h = d h \left(\frac{\sin \phi \cos h - \cos \phi \sin h \cos A}{\cos \phi \cos h \sin A} \right)$
 $= d h \frac{\cos \delta \cos S}{\cos \phi \cos h \sin A}$ by (4), or $d A h = d h \sec h \cot S$ (8), by (5); where $d A h$ is the error in the azimuth corresponding to a small error $d h$ in the altitude.

The following Tables* have been computed by the help of equations (6), (7) and (8), showing the error in the azimuth for an error of 1' in the latitude, declination and altitude respectively, for different values of the latitude, declination and hour angle. North declination is taken to be positive.

I.—TABLE OF ERRORS IN AZIMUTH DUE TO ERRORS IN LATITUDES AND DECLINATION.

Hour.	FOR AN ERROR OF 1' IN DECLINATION.			FOR AN ERROR 1' IN LATITUDE.		
	Latitude 40°.	Latitude 50°.	Latitude 60°.	Latitude 40°.	Latitude 50°.	Latitude 60°.
11h. or 13h...	5.05'	6.01'	7.72'	4.87'	5.80'	7.46'
10h. or 14h...	2.61	3.11	4.00	2.26	2.70	3.46
9h. or 15h...	1.85	2.20	3.24	1.30	1.56	2.00
8h. or 16h...	1.51	1.80	2.30	0.75	0.90	1.15
7h. or 17h...	1.35	1.61	2.07	0.35	0.37	0.53
6h. or 18h...	1.30	1.56	2.00	0.00	0.00	0.00

II.—TABLE OF ERRORS IN AZIMUTH DUE TO AN ERROR OF 1' IN THE ALTITUDE.

Hour.	LATITUDE 40°.			LATITUDE 50°.			LATITUDE 60°.		
	Decl'n -20°.	Decl'n 00°00'.	Decl'n 20°.	Decl'n -20°.	Decl'n 00°00'.	Decl'n 20°.	Decl'n -20°.	Decl'n 00°00'.	Decl'n 20°.
11 or 13h.....	.....	4.8'	.....	5.9'	5.8'	5.7'	6.00'	7.6'	7.58'
10 or 14h.....	2.3'	.....	1.8'	.....	.....	.....	.....	3.8	.....
9 or 15h.....	.....	1.4	.....	1.9	1.9	.....	2.6	.....	2.5
8 or 16h.....	1.1	.....	0.87	.....	.....	1.6	.....	2.00	.....
7 or 17h.....	.....	0.88	.....	.....	1.3	.....	.....	.....	.....
6 or 18h.....	.....	.....	0.80	.....	.....	1.2	.....	.....	1.7

* Suggested by similar tables in "Theory and Practice of Surveying," by Prof. J. B. Johnson, C.E., of Washington University, St. Louis.

The most important inference from the above table, or from equations (6), (7) and (8) is, that the further from the meridian the sun is, when observed for azimuth, the less effect will errors in the latitude, declination and altitude have on the azimuth deduced. Table I. applies also to azimuths found by the solar compass.

To return to the subject of the observations: the first series were taken about the middle of May, 1886, and consisted, as already stated, of twenty-five observations. The observations were taken chiefly in the forenoon, none nearer the meridian than 2h. 10m.; the average hour angle being about 3h. 7m.

The probable error of the mean of the twenty-five observations was 20", and the probable error of any one observation was 1'.

The maximum deviation from the mean was 3' 12". Five observations gave a result that differed 2' or more from the mean; while ten differed 30" or less from the mean; the mean differed from the value of the azimuth given by one observation of *Polaris* at elongation by 1' 30".

The second series of observations, twenty-three in number, were taken February 14th to 25th, 1887, with a four-inch reiterating transit-theodolite, D. L. pattern, reading to 36". The observations were taken in the forenoon chiefly, and none nearer to noon than 1¼h., while the greater number were taken when the sun was more than two hours from the meridian. The probable error of the mean was 20"; the probable error of any one value was 1' 26"; the maximum deviation from the mean was 6' 42". Thirteen observations gave values differing less than 1' from the mean, and seven differed less than 30" from the mean. By rejecting three of the worst observations, the remaining twenty gave a probable error of the mean of 10", and the probable error of any one observation of 53", while the maximum deviation from the mean was 2' 18".

The mean of the azimuths differed by 1' 30" from the azimuth found by one observation on *Polaris* at elongation.

In neither series of observations were any extraordinary precautions taken with the instrument; while both attempts were those of an amateur in this particular kind of work. The time required for a complete observation—circle right and circle left—is from 6 to 10 minutes.

The method of observing was that first described, as far as the writer is aware, in Captain Deville's "Astronomic and Geodetic Calculations," and given in the *Dominion Manual of Land Surveys*. The sun's image is brought tangent to the wires in opposite sectors of the system with circle right and circle left respectively. The mean of the two readings of the horizontal and vertical limbs gives the sun's position free from instrumental errors. To avoid errors, and always get the image in the proper sector of the wires, it is advisable to adopt a certain programme of observing and adhere to it. Suppose, for example, that for "circle right" we always keep the image in the two (apparent) right hand sectors; then for "circle left" we must keep it on the (apparent) left; and keeping the image in the (apparent) lower right hand sector in the forenoon, and in the upper in the

afternoon ; then, for circle right, we shall always use the tangent screw to the horizontal limb, and the tangent to the vertical circle for circle left ; we can thus discern, on an instant's reflection, the proper screw to be used. By strictly adhering to this programme, we shall complete our observations in the shortest time, and with the least liability to error.

I have given above the results of a number of observations in which the sun's azimuth was calculated from his observed altitude, and I think I cannot more suitably conclude than by giving the result of a series of solar observations taken with a similar object in view, with a solar instrument, by Prof. J. B. Johnson, C.E., of Washington University, St. Louis. The account is given by Prof. Johnson in the Journal of the Association of Engineering Societies, volume 5, No. 2, December, 1885, from which I take the liberty of quoting. Prof. Johnson says :

"In order to determine just what accuracy was possible with a Fauth Solar Attachment on a Buff and Berger transit, I spent two days in making observations on a line whose azimuth had been determined by observations on two nights on *Polaris* at elongation, the instrument being reversed to eliminate errors of adjustment. Forty-five observations were made with the solar attachment on October 24th, 1885, from 9h. to 10h. a.m., and from 1h. 30m. to 4h. p.m., and on November 7th 42 observations between the same hours.

"On the first day's work the latitude used was that obtained by an observation on the sun at its meridian passage, being $38^{\circ} 39'$, and the mean azimuth was $20''$ in error. On the second day, the instrument having been more carefully adjusted, the latitude used was $38^{\circ} 37'$, which was supposed to be about the true latitude of the point of observation, which was the corner of Park and Jefferson Avenues in this city. It was afterwards found that this latitude was $38^{\circ} 37' 15''$ as referred to Washington University Observatory, so that when the mean azimuth of the line was corrected for this $15''$ error in latitude, it agreed exactly with the stellar azimuth of the line, which might have been $15''$ in error. On the first day all the readings were taken without a reading glass, there being four circle readings to each result. On the second day a glass was used.

"On the first day the maximum error was $4'$, the average error was $0.8'$, and the probable error of a single observation also $0.8'$. On the second day the maximum error was $2.7'$, the average error $1'$, and the probable error of a single observation was $0.86'$. The time required for a single observation is from 3 to 5 minutes. I believe this accuracy is attainable in actual practice, as no greater care was taken in the care or handling of the instrument than should be exercised in the field."

DISCUSSION.

Professor Galbraith—I should like to hear the experience of some gentleman who has used the solar compass. I have had no experience myself with it. I set to work in the grounds of the Parliament Buildings to find the azimuth of a fixed line. I used the

method of Mr. McAree as one method, and determined also by a chronometer, which I obtained from the observatory. The instants of the observations were noted by some of my students, and I simply observed the azimuths or readings of the horizontal circle. I remember the greatest difference among the four observations taken was a little over a minute—a minute and about 4 or 5 seconds. The mean of the results differed by not more than one-half minute from the extreme. The succeeding Saturday I took observations by the altitude and azimuth method. This was a great deal more precise than the other. The extreme limits were between 30 and 40 seconds in this set of observations. The mean of the four observations in this last set differed by only 1 second from the mean of the four observations in the first set. The probable error of any single observation of the second four was 14 seconds, and of the mean 7 seconds. The probable error of the finally adjusted observation was not greater than 6 seconds. I might explain what the probable error is, because it is likely to be misunderstood. By saying that the probable error is 6 seconds you do not mean that the error may not be more. You don't mean anything more than that it is probable. To give you an idea:—From all these observations the mean of the whole was not a minute astray. The probabilities are 999 to 1 against its being more than a minute astray. Calculating in the same way the chances against the mean being 10 seconds astray would be 4 to 1. So when I called the error 6 seconds, I meant that the error was equally likely to be greater or less than that amount. If you were to take a bet on it, the real error is just as likely to be within that amount as outside of it. The probable error is generally attached to an observation to show the degree of precision of it. It therefore gives a degree of confidence in it. If you say that the probable error of an observation is 20 minutes, and the probable error of another is 10 seconds, you recognize the fact that the second observation is very much more accurate than the first.

A Member—It depends upon the instrument.

Professor Galbraith—Yes. I change the lower plate each time in order to even up the effects of any irregular graduation.

Mr. Butler—Mr. President, I have not had any experience myself, but in the Journal of the Engineers of St. Louis, Prof. J. B. Johnston gives the results of some of his experiments. The results he arrives at is that, taking one observation of the Fauth Solar Attachment, the variation is not greater than a minute, and the apparatus used was very simple.

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MICROMETER MEASUREMENT OF DISTANCES.

BY WILLIAM OGILVIE,

Provincial Land Surveyor, Ottawa.

IN preparing a paper on this subject, for beginners in the profession, it would be natural and proper to begin by describing the many forms of micrometer, their uses, construction and adjustments, the advantages or disadvantages they may have, and more especially their adaptability to the purposes of land surveying, or more properly the astronomical and trigonometrical problems which the land surveyor usually meets with in the practice of his profession.

In the present instance I think nearly all this may be dispensed with, as I fancy nearly all, if not all, of the members of this Association know quite as much as I do about the various forms of micrometers and the uses to which they have been applied, and very probably many of them know more.

I may, however, classify the micrometers which might be used for our purposes, as follows :

First, a simple telescope with two wires in its focus at any convenient distance apart, this distance, of course, to remain constant, and the base to be used with it to change in length as its distance from the telescope may be greater or less. For this purpose one of the targets or vanes on it—which throughout this paper I will call discs—should be movable, or both might be movable. I need hardly say that the distance between those discs, after they have been so set that they are exactly bisected by the wires in the telescope, is to be accurately known, in order to deduce the distance of the base from the telescope. Could we accurately measure the distance between the wires, and the focal length of the telescope used, it would be a simple matter to deduce the distance from the focus of the telescope to the base, as we have two similar triangles, the focal distance of the telescope forming two sides, and the distance between the wires the third side, of one triangle; the distance from the base to the focus of the telescope forming two sides, and the length of the base itself the third side, of the other; and as the wire interval is to the focal length so is the length of the base to the distance sought.

But it is practically impossible to measure with sufficient accuracy the wire interval and focal length. So we obtain the ratio they have

to each other by setting the base up at a convenient measured distance from the focus of the telescope, and making a careful determination of the length of base the wire interval gives at that distance.

The distance from the base to the focus of the telescope, divided by the length of base so found, gives the ratio of the wire interval to the focal length of the telescope, and is a constant factor by which all lengths of base due to the wire intervals are to be multiplied to find the distance from the focus to the base. This ratio should be determined at several distances. The base must be placed carefully at right angles to the line of sight. This is not always practicable where micrometer measurements of distances is most convenient—that is, in rough country,—and in practice it is better to hold the base rod vertical and measure the angle of elevation or depression to it from the telescope, and from the known length of base and the angle of elevation or depression, reduce the base to its length at right angles to the line of sight, by multiplying it by the cosine of the angle of elevation or depression, which, though not rigorously accurate, is practically so. This is the simplest form of micrometer for distance measurement, but in practice is not so convenient for all distances as other forms to be noticed presently, as at distances which other forms of micrometer with a practical length of base would give fair results. This form would require such a length of base as to be practically out of the question, unless the base were placed horizontally, and this would require the base man to have an instrument with which to place it at right angles to the sight line, and even then its length would not permit its transport, thus a wire interval in the telescope which would give a base of say five feet at ten chains, at forty chains would require twenty feet of a base, and so on proportionately. Another objection to this form is, at long distances the projected wire images cover so much of the base that the point of intersection is hard to define, except, indeed, we take the edges of the wires. And in my opinion, worse than this is the fact that the images of the discs are very rarely, owing to irregular refraction, steady, and as both discs cannot be distinctly and critically under sight at the same instant, it is difficult to mark exactly the wire interval on the base rod; and this difficulty increases vastly with the increase of distance from the telescope to the base. In a double image micrometer the images of both discs are seen simultaneously, and this difficulty is got over. Another serious objection is that the wire interval—especially if they are long wires—may be affected by atmospheric moisture and temperature, and also by very rough handling.

This form of instrument, I think, is not suited to the needs of a survey of any great extent, such as an exploratory survey. For short distances and short times of use it may give fairly satisfactory results, and its simplicity enables us, with the aid of a spider, to always have it at hand.

To the other form of this instrument, in which one of the wires is fixed and the other movable by a screw—as in some astronomical micrometers,—the same objections apply, only that a convenient base can be used at long distances.

Another form of the wire micrometer is the telescope with one wire, as in the ordinary transit or theodolite, which wire can, by a suitable micrometer screw moving the telescope, be made to bisect the discs, and, from the readings of the micrometer head on each disc, the angle subtended by the base can be deduced—the value in arc of a revolution of the micrometer screw of course being known. I had an ordinary transit fitted with a screw of this kind by putting a divided head on to the vertical tangent screw. I found it fairly satisfactory at short distances, but I had to be careful that the axis of the telescope did not leave its place in the Y's during a movement of the screw. And to any one intending to use this form I would say emphatically, See that your telescope cannot climb in the Y, or move in any way, except revolve on its axis, while the micrometer tangent screw is being used.

We will now consider some of the double-image micrometers. The Rochon is a convenient and quick form of this, but in my opinion too much light is absorbed by its thick double refracting prisms, and there is a consequent dimness of the images, which is exactly the opposite of what is required in a good micrometer; besides this, there is a want of uniformity in the brightness of the images in all the instruments of this kind that I have seen, which is inconvenient in practice, especially so at long distances. In an instrument of this kind, with which I once made some experiments, one of the images of the discs—which were a bright vermilion—appeared a pale pink, and the other a good red. The results of some measurements, under the best atmospheric conditions, with a ten-link base at about forty chains, were anything but satisfactory, although every care was used, and every expedient tried which we thought would better the conditions, but after every expedient, and five or six trials, we gave it up as unsatisfactory. Others may have used the instrument with more satisfaction; if so, I would be glad to hear from them. As generally made, its greatest angular measurement is about thirty minutes of arc, which is too small for practice.

The only other form of the double-image micrometer I will notice is that which I have used on surveys for two seasons—one season on an exploratory survey, where there was no check on the distance determined by it; the other on a survey where it was used as a check on the chaining of the courses of a traverse survey comprising 1,849 courses. From the records of this survey I will tabulate, for various atmospheric conditions, some of the errors of the distances determined by it as compared with the same distance chained.

This instrument, or a modification of it, as made by Mr. Foster, of Toronto, I presume many of you have seen, and as my own in the original form is in the exhibition of instruments here, I will only say, in description of it, it consists essentially of a telescope with the object glass cut diametrically in halves, each half is suitably fixed in a frame which slides in another frame. To the frame holding each semi-objective, motion is communicated by a screw of the shaft, of which one half is a right hand screw, the other half a left hand screw, and each part turns in a corresponding nut fixed to its half of the object glass. On the original form of the instrument there is a circle attached, to which the motion of the screw is communicated, and on the circum-

ference of which the displacement of the semi-objectives relative to a common focus is read in minutes and seconds. The designer of the instrument evidently did not think it as accurate as it is, as he divided the limb of the circle to divisions of 20", and put on only a pointer for us to estimate by the value of parts of a division. A vernier reading to 2" would enable us to obtain more uniformity in our results, as it would eliminate all uncertainty that arises from errors of estimation in the value of parts of a division. Before using mine again I will have such a vernier put on. In Mr. Foster's modification this circle is dispensed with, and the displacement of the semi-objectives is measured by the revolutions and parts of a revolution of the screw which moves them, on the head of which is placed a circle divided to hundredths. In Mr. Foster's instrument the value of a hundredth of a revolution is about 8" of arc, and by using a magnifier tenths of a division can be easily estimated. Before using this form of the instrument we would first by trial have to determine the exact value in arc of every revolution of the screw, and tabulate them, and from them determine the value of the parts of each revolution. Or, more convenient still, set up the base we intend to use with the instrument at various distances, beginning, say, at five chains and increasing by five chains until we arrive at a distance as long as any we may be likely to use in work. At each distance determine carefully the turns and parts of a turn of the screw due to the base used and tabulate them. The use of this table is obvious. In the original form the angle being read we are saved this preliminary trouble, and all we require is a table of the factors for the angles used. These factors can be easily computed, they are the ratio of the tangent of each angle to radius.

A single reading of an angle I define as follows: first, right hand motion of screw make coincidence of images, read limb; second, continue motion until images pass each other, then, by a left hand motion of screw, make coincidence of images, read limb; third, by left hand motion of screw make semi-objectives pass in the other direction and make coincidence of images, read limb; fourth, continue motion while images pass, then, by right hand motion of screw, make coincidence, read limb. The mean of these I call a single reading. In my experience the best results were obtained by making the images of the discs about half overlap horizontally. In that position I think one can tell better when the bottom or top edges of the discs form a continuous straight line, and better results be obtained than when one makes the images overlap altogether, or makes the upper edge of one image in contact with the lower edge of the other, and *vice versa*. In this last way, too, there is danger at long distances, where the depth of the disc would not make an appreciable angle, of making two successive readings with the same edges of the discs in contact, which would have the effect of altering the length of the base used by one-half of the depth of the disc used, and this would make quite a large difference in the result sought.

To give an idea of the accuracy that can be attained by the instrument, I give the following results of measurements on a ten link base. The discs were pieces of wood painted a bright red, as they had a snow background. They were each twelve inches long by four and a

half deep. I set up three bases. Two were vertical, the other horizontal. No. 1, as I will designate it, was vertical, with the lower disc six feet above the surface of the snow; No. 2 was vertical, with the lower disc two feet above the surface, and No. 3 was horizontal, and about five and half feet above the surface. My object in placing them in this way was to determine approximately by observing on them, on different days and in different atmospheric conditions as to temperature and moisture, the effect irregular refraction would have on the angles subtended by the different bases. My opinion being that under varying conditions the angle subtended by No. 1 would be less affected or more constant than that subtended by No. 2, or the low base, while the angle subtended by No. 3, or the horizontal base, would be more constant than either of the other two. Since setting them up the weather has been so stormy, and I have been away from home so much, that I have only got three readings. As I said before, a part of the difference in the angles is probably due to the want of a vernier on the instrument. The distance from the point of sight to the bases was by chaining 42.05 chains, which is the mean of two independent chainings differing by six-tenths of a link.

February 19th.—Thermometer 26°; sky cloudy; a little snow falling; very strong wind blowing across line of sight, which made it very difficult to hold the telescope steady enough to see well; no noticeable irregular refraction. Five readings on each base.

BASE NO. 1, VERTICAL.			BASE NO. 2, VERTICAL.			BASE NO. 3, HORIZONTAL.			DISTANCE BY BASES.	
rd'g	v	vv	rd'g	v	vv	rd'g	v	vv	base.	chs.
1=8' 10.2"	-.7	.49	1=8' 11.7"	+2.2	4.44	1=8' 10.5"	+2.3	5.29	1.....	42.018
2=8 10.2	-.7	.49	2=8 09.2	-.3	.09	2=8 06 5	-1.7	2.89	2.....	42.135
3=8 11.7	+.8	.64	3=8 09.2	-.3	.09	3=8 07.5	-.7	.49	3.....	42.252
4=8 11.2	+.3	.09	4=8 08.7	-.8	.64	4=8 08.7	+.5	.25		
5=8 11.2	+.3	.09	5=8 08 7	-.8	.64	5=8 07.7	-.5	.25	mean..	42.135
mean 8' 10.9" E = ± .67			mean 8' 09.5" E = ± 1.28			mean 8' 08.2" E = ± 1.51				
E ₀ = ± .20			E ₀ = ± .40			E ₀ = ± .47				

E is the mean error of a single reading; E₀, the probable error of the mean.

February 20th.—Clear, mild day; thermometer 22°; light breeze across line of sight; no clouds; very little irregular refraction; altogether a nice day for good reading.

BASE NO. 1, VERTICAL.			BASE NO. 2, VERTICAL.			BASE NO. 3, HORIZONTAL.			DISTANCE BY BASES.	
rd'g	v	vv	rd'g	v	vv	rd'g	v	vv	base	chs.
1=8' 08 "	+.2	.04	1=8' 08."	-1.2	1.44	1=8' 07.8"	-.5	.25	1.....	42.286
2=8 06.2	-1.6	2.56	2=8 08.7	-.5	.25	2=8 07.5	-.8	.64	2.....	42.162
3=8 08.5	+.7	.49	3=8 09.2	0.0	.00	3=8 08 7	+.4	.16	3.....	42.243
4=8 07.	-.8	.64	4=8 10 5	+1.3	1.69	4=8 08.7	+.4	.16		
5=8 09.5	+1.7	2.89	5=8 09 5	+.3	.09	5=8 08.7	+.4	.16	mean..	42.23
mean 8' 07.8" E = ± 1.29			mean 8 09.2" E = ± .95			mean 8' 08.3" E = ± .58				
E ₀ = ± .40			E ₀ = ± .30			E ₀ = ± .18				

February 25th.—Clear and cold ; thermometer 14° ; a pretty strong wind blowing obliquely across line of sight ; a good deal of irregular refraction in the lower atmosphere ; images very unsteady ; not good readings.

BASE NO. 1, VERTICAL.			BASE NO. 2, VERTICAL.			BASE NO. 3, HORIZONTAL.			DISTANCE BY BASES.	
rd'g	v	vv	rd'g	v	vv	rd'g	v	vv	base	chs.
1=8' 08 5"	+1.3	1.69	1=8' 01.2"	+1.6	2.56	1=8' 07.5"	+ .9	.81	1.	42.330
2=8 06.8	- .4	.16	2=8 00 7	+1.1	1.21	2=8 06.5	- .1	.01	2.	43 006
3=8 07.5	+ .3	.09	3=7 59 0	- .6	.36	3=8 06.2	- .4	.16	3.	42.386
4=8 04.5	-2.7	7.29	4=7 58.3	-1.3	1.69	4=8 06.	- .6	.36		
5=8 08.5	+1.3	1.69	5=7 59.0	- .6	.36	5=8 07.	+ .4	.16	mean..	42.574
mean 8'07.2" E = ±1.65			mean 7'59.6" E = ±1.24			mean 8 06.6" E = ±.61				
E ₀ = ± .50			E ₀ = ± .37			E ₀ = ±.19				

I will continue these readings after I get a vernier on my instrument, and would be glad to know that some other member of the Association carried on similar experiments. It will be borne in mind that a twenty-link base would give only half of the above errors, and the probable error of reading would probably be the same with it as a ten-link base.

A word or two now on the base and its fittings. The base may be of any convenient length, but the longer it can be made without being inconvenient the better the results, the errors being probably in the inverse ratio of the lengths of the bases. This would be strictly true were there no varying conditions in the atmospheric moisture, temperature and density, all of which constitute the greatest barrier to reasonably uniform results with any form of micrometer. The discs should be of some material that will be well seen under the greatest number of possible conditions. Now, an opaque substance can be seen best by reflected light, as when we are between the sun and it; but no matter how brilliant it is, we can hardly see it distinctly when it is between the sun and us, or when its shaded side is toward us, and at long distances it becomes invisible altogether. To overcome this glaring defect I used discs of translucent material: painted glass, ground and opal glass would be as good, if not better. For winter work coloured glass would have to be used; preferably, I think, light red. This substance can be seen much better by transmitted light than by reflected, but can be seen well in any position. A bad background, of course, will affect it as much as an opaque disc; and it is always well to have an artificial background, such as a piece of black cloth, which the base-man can attach to the base-rod in the proper manner, whenever desired to do so, by a pre-arranged signal. A piece of clean, white cotton or paper is not a bad substitute for

glass. The manner of carrying the discs and attaching them to the base-rod each of us might devise for himself, and each method be convenient enough. Mr. Foster, of Toronto, has constructed for the Department of the Interior a style of frame and attachment which will be found as convenient as any. The frame holding the glass should be bevelled from the outside into the glass, so that at the glass it may be but little thicker than the glass. In this shape it can always be held so that no part of the glass will be shaded by it. The base-man should always hold the base so that the glass discs will be fully illuminated in sunshine, even if he has to turn the plane of the discs to quite a sharp angle to the line of sight. An inclination to the line of sight of 30° gives us visually one-half of the surface of the disc, and that well illuminated is better than the whole of it in the shade. When intended for use on a river or lake survey, the frame should be of light wood, and of sufficient bulk to float the metal and glass attached to it, so that, in case of accident, one would not be deprived of his apparatus. For extensive surveys of this kind the base-rod should be made of well-seasoned wood, and of such a form as to insure rigidity throughout the season. For this purpose I screwed two pieces of inch board together in the form of a **T**, and, although being alternately wet and dry, it kept its straightness throughout the season.

I am convinced that better and more uniform results would be obtained by placing the base horizontally about six feet or more from the ground than in any other position; but to so place a base would always entail a lot of extra trouble, and sometimes would be very inconvenient, if not impossible. The next best thing to do would be to have the base so made that when vertical the lower disc will not be less than six feet above ground. To enable the base-man to set and hold the base vertically, I attached a plummet to it in the angle of the **T**, the bob of which was inclosed in a small box to protect it from the wind. A universal level bubble could be used, but in rough places would require more care.

Now, as to the closeness of the results to the truth. I will say to those who have had little or no experience, do not expect too much. My experience justifies me in saying that, with care, making say three readings of the angle, and using a fairly long base (*not less than fifteen links long*), and in fair atmospheric conditions, distances of half a mile can be determined within five or six links of error; but take the same base on the same distance on a bad day and we may look for an error of fifty or sixty links, or even more, and that, too, though we use our utmost care.

It may be said that by observing in every possible state of the atmosphere, and under all conditions possible of light and shade and contour of the ground, that we could deduce very close corrections for each condition or combination. I think it would be nearly impossible to do this with any degree of certainty. The elements of disturbance entering the problem are so many and diverse, and, apart from external disturbances, our own nervous conditions enter the terms of the problem. Measuring micrometer angles, where quantities that

are barely perceptible come into prominent notice, is just about as trying on our senses as any work we can attempt. To illustrate: an error of one second of arc in the angle subtended by a twenty-link base, at forty chains distance, gives an error of four links in the distance deduced; now one second of arc at forty chains subtends about one-sixth of an inch. I think most of us will concede that, dealing with such small fractions of an inch at such a distance is fine work, work that requires the most perfect condition of our faculties to give it justice; but we are not always in even normal condition, so that, external sources of error apart, there are sources of error within ourselves. When we come to consider and combine all the different conditions of atmospheric density at different altitudes, the conditions due to different temperatures and degrees of moisture, the intensity of light and shade, I consider it impossible to ever make a table of corrections that will be anything but—in many cases—a very poor approximation. Notwithstanding all these objections, there are many places where the micrometer is invaluable; especially in mountainous countries, where chaining would be difficult or impossible, the micrometer comes in and promises closer results than the chain would give under the conditions, for it is in a rough, hilly country that we find the best conditions for micrometer work; that is, elevation above the lower disturbed stratum of air. Traversing shores, where chaining would be tedious and inconvenient, by using a base of twelve or fifteen links and distance about twenty chains, the results would be almost, if not altogether, as close as chaining. On extensive exploratory surveys it is just the instrument required. Its results can be approximately checked by latitude observations from time to time, and it enables us to make a fairly reliable survey of a large extent of country in a season. About three hundred miles of ordinary river work can be averaged per month with it.

I will now consider some of the conditions which hinder us obtaining as close results as a theoretical consideration of the instrument would lead us to expect.

First, through its prominence, and from the fact that it is the only one we cannot conveniently modify, is refraction, not refraction as taught us and tabulated for our use, but refraction as we see it at work—up and down, and across.

According to the theory of refraction, at first thought we would expect all vertical angles to be decreased by the difference of the refractions due to the altitudes of the points sighted on. But in practice we find that this is not always so, more especially in warm, moist weather, and when one of the points of sight is close to the ground, and the line of sight is parallel, or nearly so, to the ground for some distance. Then we find the angle increased, and the law that “a ray of light, in passing from a thinner to a denser medium, is bent towards the denser,” is still true, because the heated atmosphere near the ground is less dense than the cooler above; consequently, a ray of light emerging from this heated stratum of air is bent upwards to the cooler above, and the hotter and more moist the ground is the greater the refraction. The effect of this on a vertical base is that the ray from the lower disc—

if it is near the ground—is bent upwards as it rises; to the eye this projects the range of the lower disc to a point lower than it really is, while the ray from the upper disc may travel through a stratum of uniform density, and suffer little or no refraction. The consequence is, the angle subtended by the base is apparently increased, and the distance deduced from it shorter than the true distance. When the ground and the atmosphere are at the same temperature, and the light rays travelling through an atmosphere of about the same density, there is probably no refraction, and the micrometer distances will show both plus and minus errors, and be much nearer to the truth, than on a hot day or after a hot time. Again, when the ground is colder than the atmosphere, refraction probably has the opposite effect to that in warm weather, and the distances will very probably come out longer than the true distances. One thing has been often very apparent to me: on a hot day, when the line of sight to the lower disc touched close to the ground at some point in the intervening distance, the image of this disc would be refracted out of shape, often apparently being twice the depth of the upper one. *In such a case always make coincidence with the upper edges of the discs, as the lower edge of the lower disc has been refracted downward, and if you measure by it you will find your distance away out.* Often a mass of rock in the line of sight, or a sharp knoll, will have the same effect.

As I said earlier, to produce the best results with a vertical base, have the base rod long enough to have the lower disc at least six feet above ground. A horizontal base well above ground would be better, but even that is affected by irregular refraction, in that we cannot read the angles so closely in a disturbed as in a quiet atmosphere; but whether or not there is a constant direction for the differences there may be, owing to the position of the sun and the direction of the wind with reference to the sight line, I do not yet know. On the three bases I have already alluded to, I got only three determinations, and only one of those was at all disturbed by irregular refraction. For determinations of that nature one would require variable weather, as in the fall or spring, when we might have it cool, clear and steady, or hot, dull and unsteady in a short interval of time. The other hindrances of improper light and shade and bad background can, as I have already said, be remedied by the base-man with proper appliances.

I will now give a list of distances as chained in my traverse survey, and the same distances as determined by the micrometer, using an eight link base, with discs of painted glass five inches by eight. I will give no distances under twelve chains, as at about that distance the focus of the telescope used was about normal; for shorter distances it was out of normal focus, and the angles read on the circle would not be the true angles, it being graduated for the normal focal length, and I did not go to the trouble to reduce them to what they would be at normal focus. I will classify these distances under four widely different atmospheric conditions. At first I thought of putting them under four atmospheric conditions, and arranging them in grades of temperatures differing by ten degrees, beginning at thirty degrees

Fahrenheit, and using all my available distances, but I found this would entail a lot of work more than I had time for, and decided to arrange them under four atmospheric conditions, and in grades of distances differing by five chains, beginning with 12—15 chains, then 15—20 chains, 20—25, and so on, and give, as far as my records would permit, ten distances in each grade, under such conditions.

This number will give an approximation to a correction a little larger, perhaps, than it ought to be, as the distances will be selected to show—except under accidental conditions—about the range of error, thus making the sum of errors greater relative to the sum of the distances they are deduced from than they would be were all the distances taken, as one or two large errors in ten is a greater ratio than would be found were all the distances taken. All the micrometer distances were, with the exception of one or two, determined from a single reading. It must be borne in mind that an eight-link base was used in all cases. Had I used a twenty-link base at the longer distances, the probable error of the angular readings would have been about the same, but the resulting errors would only be 40 per cent. of what they are with the eight-link base.

Also, had I used larger discs I would probably have had less errors in many cases, especially the longer distances, where they were sometimes difficult to see (particularly so on gloomy days).

(See Tables pages 66-73.)

Taking the sum of the distances in each column and the algebraic sum of the micrometer errors for each column, and reducing the errors to what they would be were a twenty-link base used, except under the conditions hot and moist, nearly all the errors reduced proportionately to forty chains come well within the five or six-link limit I gave earlier. Taking the arithmetical sum of the errors, some of the errors so reduced would be increased a little. With one or two exceptions, all the distances were deduced from one reading of the angle—two or three readings would probably have reduced the errors; and very likely a part of the error is due to the want of a vernier to read the parts of divisions. Whatever part of the error is due to errors of estimation of the parts of divisions is probably pretty constant, and always in the same direction.

Summing the distances under each condition and the errors under the same condition, we get under the first condition, or “hot and moist,” a total distance of 2,438 chains and a total error of -48.37 chains, or an error of about one part in fifty short. This reduced to what it would have been had a twenty-link base been used, we get a total error of -19.35 chains, or a correction under this condition of about one part in 125 to be added. Taking the same quantities under the condition “hot and dry,” we find a total distance of 2,447.43, with a total error of -12.71 chains, or an error of about one part in 192 short. This reduced to a twenty-link base would give an error of -5.08 chains, or an error of about one part in 480 short. Under the condition “cool and moist,” the total distance is 1,679.01 chains, with a total error of +1.56, or an error of about one part in 1,076 long; this reduced to a twenty-link base gives sixty-two

links of an error long, or a correction of one part in about 2,690 to be subtracted. Under the condition "cool and dry," the sum of the distances is 1,765.4 chains, and the algebraic sum of the errors thirty links, which is practically nothing, being only one part in 5,885. The arithmetical sum would give a much larger error. Were all the columns filled up the errors would be much larger under the last two conditions, but not beyond or even up to the limit I gave. Summing all the conditions, we get a total distance of 8,329.84 chains, or 104 miles, with a total algebraic error of 59.24 chains, of which 48.37 chains belong to the worst condition, "hot and moist." This total error reduced to a twenty-link base would give us an error of 23.69 chains in the total distance, or about one part in 400 of a correction to be added. I do not think the algebraic sum of the errors for the whole season and distance of 367 miles would be nearly as large a ratio to the distance as this. Taking the columns forty to forty-five chains under each condition, we find under "hot and moist" an aggregate distance of 429.77 chains and an aggregate error of 11.02 chains; this reduced to a twenty-link base would be 4.41 chains, or about forty-one links error short to a half mile. Under "hot and dry" we have 425.45 chains distance, and an algebraic total error of 2.52 chains; this reduced to a twenty-link base gives an error of 1,008 chains, or about 9.5 links per half mile. The aggregate under "cool and moist" is 127.37 chains, and an error of -17 links; with a twenty-link base this would give 7 links, or about 2 links per half mile. The aggregate under "cool and dry" is 83 chains and an error of +20 links; with a twenty-link base this would be 8 links, or about 4 links per half mile.

All those measurements were made along the line of the Canadian Pacific Railway, where the heat, radiated from the bare gravel, ties and rails, reminded one of—well, of the Tropics, and caused a disturbance in the lower atmosphere that probably never would be experienced elsewhere—especially so after a heavy shower of rain or a wet day. The probability is, I think, strong that we would never find errors of the same magnitude on a survey of a grassy country, or on a river or lake survey. Moreover, the errors on a river or lake survey would probably have a different sign from those of a survey on bare, unsheltered ground, as the water is generally cooler than the atmosphere, and the lower atmosphere cooler than that a few feet above. It will be noticed in the long courses that three of the errors have the + sign. Those were from the summit of one ridge to another across a valley, where the line of sight was from fifteen to thirty-five feet above ground most of the way. Long distances measured on the same day, but on a level, had the opposite sign.

A portion of the errors are no doubt due to errors of graduation of the instrument, but I am not in a position to say how much. And, as this paper has drawn out beyond the length I intended, I will now leave it to the members of the Association to draw their own inferences and make what use of it they may see fit, feeling that I am well rewarded for it if I have added one idea to the general stock of knowledge and experience.

CONDITIONS.—Hot and Moist. TEMPERATURE.—70° to 100° in the Shade.

12-15			15-20			20-25			25-30		
Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.
14.19	13.91	-.28	17.67	17.52	-.15	24.47	24.06	-.39	28.68	28.47	-.21
12.31	12.37	+.06	17.80	17.82	+.02	20.19	19.97	-.22	26.01	25.01	-1.00
12.99	12.94	-.05	18.23	18.50	+.27	25.76	25.28	-.48	29.79	28.65	-1.14
13.18	13.18	.00	17.33	17.15	-.18	23.53	23.38	-.15	26.76	26.19	-.57
13.10	13.05	-.05	19.07	18.99	-.08	24.31	23.80	-.51	28.79	27.69	-1.10
13.78	13.76	-.02	15.67	15.66	-.01	22.15	22.03	-.12	25.84	25.23	-.51
13.01	13.03	+.02	16.73	16.42	-.11	20.55	20.30	-.25	27.17	26.61	-.56
13.28	13.26	-.02	17.33	17.27	-.06	20.93	20.56	-.37	29.65	29.00	-.65
12.35	12.38	+.03	18.87	18.78	-.09	23.29	23.00	-.29	26.97	26.70	-.27
13.75	13.79	-.04	19.78	19.65	-.13	21.45	21.33	-.12	25.55	25.37	-.18
131.95		-.35	178.48		-.52	226.63		-2.90	275.21		-6.19

Per 40 ch. - .11 ch. Per 40 ch. - .116 ch. Per 40 ch. - .90 ch.
 Reduced to 20 link base. .046 ch. .20 ch. .36 ch.

MICROMETER MEASUREMENT OF DISTANCES.

30-35			35-40			40-45			45-		
Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.
34.72	34.04	-.68	35.55	34.45	-1.10	44.84	44.40	-.44	60.32	*58.32	-2.00
32.48	31.68	-.80	36.12	*34.45	-1.67	40.48	39.92	-.56	45.82	45.41	-.42
34.91	34.53	-.38	39.12	38.37	-.75	41.86	*40.11	-1.75	47.91	*45.46	-2.45
32.30	31.79	-.51	35.56	34.27	-1.29	44.60	*41.77	-2.83	52.31	51.61	-.70
30.77	30.29	-.48	36.04	35.32	-.72	41.88	41.25	-.63	47.23	47.14	-.09
31.25	30.56	-.69	35.67	34.44	-1.23	42.42	41.99	-.43	52.31	51.61	-.70
35.32	34.97	-.35	35.55	34.45	-1.10	43.15	41.82	-1.33	47.30	46.62	-.60
32.65	32.01	-.64	35.26	34.14	-1.12	41.86	*40.11	-1.75	45.68	*44.21	-1.47
31.15	30.89	-.26	36.11	*34.45	-1.66	43.61	43.26	-.35	47.19	*45.83	-1.36
32.30	31.79	-.51	35.32	34.96	-.36	45.07	44.12	-.95	61.75	*60.45	-1.30
327.85		-5.30	360.30		-11.00	429.77		-11.02	597.81		-11.09

Per 40 ch. - .62 ch.
.25 ch.

Per 40 ch. - 1.22 ch.
.49 ch.

Per 40 ch - 1.02 ch.
.41 ch.

Per 40 ch. - .88 ch.
.35 ch.

Those marked with an asterisk (*) were read in a very hot temperature, about 100° in the shade.

CONDITIONS.—Hot and Dry. TEMPERATURE.—65° to 100° in the Shade.

12-15			15-20			20-25			25-30		
Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.
13.63	13.64	-.01	15.52	15.52	.00	20.73	20.80	+.07	25.47	25.36	-.11
13.98	14.05	+.07	19.14	19.33	+.19	24.27	23.91	-.36	26.77	26.75	-.02
13.52	13.45	-.07	18.89	18.83	-.06	20.67	20.58	-.09	25.37	25.55	+.18
15.00	15.00	.00	17.19	17.22	-.03	20.36	20.27	-.09	25.85	26.05	+.20
12.99	12.99	.00	17.19	17.18	-.01	22.12	22.15	+.03	29.56	29.57	+.01
13.76	13.76	-.01	18.39	18.22	-.17	21.55	21.63	+.08	29.77	29.89	+.12
12.27	12.26	-.01	17.87	17.84	-.03	23.28	23.60	+.32	27.30	27.48	+.18
13.60	13.56	-.04	18.39	18.22	-.17	21.95	21.92	-.03	26.57	26.35	-.24
14.60	14.66	+.06	17.90	18.00	+.10	23.14	23.13	-.01	24.76	24.77	+.01
13.89	13.85	-.04	17.82	17.74	-.08	20.59	20.50	-.09	26.66	26.66	.00
136.70		-.06	178.30		-.20	218.74		-.17	268.08		-.38

Per 40 ch. - .01 ch.
Reduced to 20 link base.

Per 40 ch. - .045 ch.
-.018

Per 40 ch. - .031 ch.
-.012 ch.

Per 40 ch. - .056 ch.
-.022 ch.

MICROMETER MEASUREMENT OF DISTANCES.

30-35			35-40			40-45			45-		
Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.
32.85	33.00	+ .15	37.07	37.50	+ .43	42.42	41.99	- .43	46.68	44.25	- 1.43
32.61	32.29	- .32	36.42	36.35	- .07	41.39	40.69	- .70	49.60	48.53	- 1.07
32.70	33.03	+ .26	37.39	36.93	- .46	41.88	41.26	- .62	51.22	49.62	- 1.60
31.15	30.90	- .25	36.60	36.25	- .35	42.73	42.97	+ .24	61.75	60.45	- 1.30
30.80	30.89	+ .09	37.83	37.59	+ .26	42.39	41.98	- .41	54.79	53.85	- .94
31.53	31.58	+ .05	37.94	37.46	- .48	40.88	40.80	- .08	46.86	45.88	- .98
33.43	33.57	+ .14	36.55	36.46	- .09	40.78	40.34	- .44	51.53	50.89	- .64
30.13	30.37	+ .24	35.59	35.64	+ .05	44.78	44.48	- .30	45.99	45.68	- .31
31.83	31.82	- .01	35.57	34.49	- .08	44.90	44.76	- .14	56.50	55.94	- .56
34.91	34.45	- .46	36.87	37.04	+ .17	43.30	43.66	+ .36	66.93	66.15	- .78
322.01		- .09	367.30		- .44	425.45		- 2.52	530.85		- 9.61

Per 40 ch. - .01 ch. Per 40 ch. - .048 ch. Per 40 ch. - .24 ch. Per 40 ch. - .72 ch.
 - .004 ch. - .019 ch. - .096 ch. - .29 ch.

The condition, "Hot and Moist" was when the sun was shining strongly after a heavy rainfall; "Hot and Dry" was during a continuance of dry, hot weather.

CONDITIONS.—Cool and Moist. TEMPERATURE.—From 30° to 65°.

12-15			15-20			20-25			25-30		
Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.
14.19	14.32	+ .13	18.94	18.96	+ .02	20.62	20.77	+ .15	27.66	27.76	+ .10
13.43	13.53	+ .10	16.91	16.99	+ .08	20.00	20.04	+ .04	27.12	27.11	- .01
14.71	14.76	+ .05	17.35	17.45	+ .10	21.47	21.42	+ .05	25.24	25.28	+ .04
13.30	13.44	+ .16	19.05	19.31	+ .26	20.02	20.01	- .01	25.34	25.34	.00
14.72	14.76	+ .04	15.62	15.68	+ .06	21.22	21.27	+ .05	26.21	26.25	+ .04
13.08	13.12	+ .04	17.32	17.33	+ .01	21.95	21.97	+ .02	27.88	27.91	+ .03
14.40	14.40	+ .00	18.99	19.07	+ .08	23.02	23.10	+ .08	27.87	28.01	+ .14
14.68	14.77	+ .09	18.33	*18.40	+ .07	24.87	24.82	- .05	28.14	28.25	+ .11
14.71	14.76	+ .05	17.51	17.50	+ .01	22.12	22.12	- .00	28.84	29.15	+ .31
13.44	13.53	+ .09	19.97	20.02	+ .05	23.49	23.49	00	27.21	27.18	- .03
140.66		+ .75	179.99		+ .74	218.78		+ .23	271.51		+ .73

Per 40 ch. .21 ch.
Reduced to 20 link base.

Per 40 ch. .16 ch.
.06 ch.

Per 40 ch. .04 ch.
.016 ch.

Per 40 ch. .11 ch.
.044 ch.

MICROMETER MEASUREMENT OF DISTANCES.

30-35			35-40			40-45			45-		
Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.
31.02	31.05	+ .03	36.71	36.72	+ .01	40.65	40.65	.00	59.55	58.96	- .59
33.90	33.82	- .08	39.74	*39.81	+ .07	44.12	*44.02	- .10	78.34	*79.71	+ 1.37
34.04	34.24	+ .20	34.01	33.96	- .05	42.73	42.70	- .07	56.73	*56.43	- .30
31.18	31.02	- .16							60.65	60.35	- .30
34.56	34.67	+ .11							86.69	86.85	+ .16
30.89	30.93	+ .04							62.04	60.77	- .127
30.52	30.56	+ .04									
226.11		+ .18	110.46		+ .03	127.50		- .17	404.00		- .93

Per 40 ch. .04 ch.
.016 ch.

Per 40 ch. .01 ch.
.004 ch.

Per 40 ch. .05 ch.
.02 ch.

Per 40 ch. .09 ch.
.036 ch.

* Those were read while it was raining. The micrometer distance, 79.71, was across the valley of the Eagle River, and was nearly all the distance 12 to 15 feet above ground.

CONDITIONS.—Cool and Dry. TEMPERATURE.—From 30° to 65°.

12-15			15-20			20-25			25-30		
Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.
14.32	14.43	+ .11	16.68	16.79	+ .11	21.58	21.62	+ .04	22.53	22.51	-.02
12.54	12.60	+ .06	17.51	17.60	+ .09	24.98	25.02	+ .04	29.41	29.48	+ .07
13.20	13.25	+ .05	19.14	19.17	+ .03	24.16	24.23	+ .07	28.52	28.49	-.03
12.87	12.96	+ .09	16.17	16.20	+ .03	24.21	24.29	+ .08	25.64	25.59	-.05
14.60	14.65	+ .05	16.01	15.97	-.04	22.75	22.81	+ .06	28.88	28.75	-.13
13.89	13.94	+ .05	15.98	16.06	+ .08				25.51	25.67	+ .16
14.22	14.29	+ .07	18.45	18.53	+ .08				25.96	26.00	+ .04
			19.73	19.76	+ .03				28.32	28.10	-.22
			17.76	17.81	+ .05				25.30	25.36	+ .06
			16.55	16.50	-.05				23.27	23.22	-.05
95.64		+ .48	173.98		+ .41	117.68		+ .29	263.34		-.17

Per 40 ch. .20 ch.

Reduced to 20 link base.

Per 40 ch. .095 ch.

.04 ch.

Per 40 ch. .10 ch.

.04 ch.

Per 40 ch. .026 ch.

.01 ch.

MICROMETER MEASUREMENT OF DISTANCES.

5	30-35			35-40			40-45			45-		
	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.	Chain.	Mic.	Error.
	33.90	33.84	-.06	38.44	38.76	+32	42.12	42.24	+12	60.95	60.30	-.65
	33.75	33.75	.00	39.69	39.67	-.02	40.88	40.96	+08	58.31	57.61	-.70
	35.56	35.68	+12	38.75	38.65	-10				46.79	46.39	-.40
	34.49	34.38	-11							46.60	46.20	-.40
	33.50	33.64	+14							53.54	53.36	-.18
	34.24	34.25	+04							69.02	68.81	-.21
										121.41	*123.66	+2.25
										50.27	49.93	-.34
										66.35	66.35	00
										52.00	51.35	-.65
	205.44		+.17	116.88		+20	83.00		+.20	625.24		-1.28

Per 40 ch. .032 ch. Per 40 ch. .07 ch. Per 40 ch. .10 ch. Per 40 ch. .09 ch.
 .013 ch. .028 ch. .04 ch. .036 ch.

* This distance was across the valley of the Eagle River, and for over two-thirds of the way was from 20 to 35 feet above ground. It was taken at sundown on a cool evening with the sun shining full on the discs. Two readings, 2' 13" .5 and 2' 13" .75.

DISCUSSION.

Mr. Klotz moved a resolution, tendering him the thanks of the Association, at the same time remarking as follows:

“I am very much pleased with the paper, and I think it will be the means of bringing the micrometer more prominently before the notice of surveyors and of extending its use among them. It is an instrument that deserves a good deal of attention, and will undoubtedly be largely used in the exploratory surveys of the future, and I recommend it most heartily to any surveyors going out. I would strongly impress upon surveyors that, in using any instrument whatever, they should use it in both positions; that is, in *circle right* and *circle left*, and, in using the micrometer, to use the right hand motion of screw and the left hand motion of screw. In the use of the instrument formerly used for this purpose many errors would be avoided by so doing, and in the use of the micrometer the lost motion of the thread would be avoided. Another thing I would point out is that, in taking a reading, the instrument should not be turned far forward past the picket, because every instrument has more or less of torsion, which I found by experience in a long traverse survey over the C. P. R., in which I used this instrument. I found that if I turned my instrument twice I got a difference of reading amounting to a maximum of .014 of a degree, by three complete revolutions of the instrument. This amount of difference I could obtain by unwinding and turning in the opposite direction. I would recommend always taking two readings circle right and two readings circle left, giving twelve readings for the angle. Each of the three verniers would be read completely, not only the decimal of a degree, but the whole degree, to avoid any error. From a comparison of a series of measurements by the chain and measurements by the micrometer, under ordinary circumstances, equally favourable to both systems, I have determined that the probable error of a reading of chain measurement is about six links per half mile. An assistant of mine measured a piece of land in a tangent of the C. P. R. in the Rocky Mountains by the chain system, and made it 34 chains 65 links. I took several readings right hand and left hand with my micrometer, and made it 34 chains 45 links. My chain assistant chained it over again, and found that his measurement was wrong, while mine was correct.”

Prof. Galbraith asked what means there was of insuring the base being at right angles to the line of sight in holding the machine horizontally.

Mr. Ogilvie said he had never used the instrument horizontally, but merely suggested it. His opinion was that the angles would be more constant, and that refraction would affect it far less than would be the case in a vertical position.

Prof. Galbraith—But do you think it would be practicable in ordinary surveys with the time at your disposal to assume that the mean line of sight is at right angles to the base?

Mr. Ogilvie—Well, suppose that it were a degree out of the vertical, the difference in the result would be so slight as to be scarcely appreciable.

In connection with the micrometer which Mr. Ogilvie exhibited, he also drew attention to a new tripod, manufactured by Messrs. Troughton & Sims, with a traversing bead. It was preferable to the ordinary American instruments, he said; could be brought down to a circle of two or three inches, and could be set up in a minute or two.

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

ASSESSMENT OF BENEFITS IN DRAINAGE SURVEYS.

BY WILLIS CHIPMAN
P.L.S., B.A.Sc., Brockville.

WHILE we find the literature on "ditch making" quite voluminous, there is very little published on assessment of benefits. In the sixth and seventh annual reports of the Ohio Society of Surveyors and Civil Engineers are papers on "The Problem of Just Apportionment of the Cost of Ditch Improvements," by E. B. Opdycke, C.E., which are the most exhaustive I have seen on this subject. Another paper in the sixth annual report of the same society, by J. L. Geyer, C.E., on "The Principles Involved in making Ditch Estimates and Assessments," is also very interesting.

The elements which determine the area benefited or taxed, and the proportion of such tax, may be conveniently considered under two heads, *legal* and *physical*.

The determination of the topography of the area enclosed by the water-shed, nature of soil, rainfall, etc., and the laying down of the results upon a proper plan, may be considered as the physical elements that enter this question, and must vary with every case.

The *legal elements* may be considered as a constant, the *physical elements* as a variable.

The statutes concerning ditch making and ditch assessment in the United States appear more advanced, more concise and clearer than our Ontario Statutes. The law there, as defined by statute and court decisions, appears to be:

(1) That the lower lands owe a servitude to the upper lands, the owner of a dominant or superior heritage has an easement in the servient or inferior tenement, for the discharge of all waters which by nature rise in, or flow, or fall upon the superior.

(2) While an upper owner cannot construct new water channels across his land and discharge water on the lower land, he can improve his lands by drainage into a natural watercourse that flows through the lower land, increasing the flow in such watercourse, even though the increased flow damages the lower lands.

(3) Surface depressions where water naturally runs in times of excess, are to be construed as watercourses.

Some of the general principles Mr. Opdycke arrives at in his first paper regarding the assessment of benefits are as follows:

- (a) Benefits increase as the elevation of the land decreases.
- (b) Lands near the outlet should be assessed less than the lands more remote.

Three of Mr. Geyer's general principles are :

(1) "The lands at or near the source of improvement are usually more benefited than those near the outlet, because in a state of nature these lands, everything else being equal, are worth less than land near the outlet, for the very reason of this distance from sufficient opportunity for drainage ; now if this improvement accomplishes the bringing of the outlet to said lands, it renders them as valuable as the lands below, therefore the benefits are greater here.

(2) "Lands on a tributary, and not having a direct drainage, should be assessed only to assist in the construction of the portion *below* the confluence.

(3) "No land should be assessed sufficient to bring this improvement to the upper line of said land assessed, unless this upper side is the limit of water-basin ; because that otherwise the lands above would have the outlet brought up to them without an assessment for the same. The lands above should not only be assessed to build their due proportion through length of same, but also a proper amount for the outlet below."

Here in this Province the law appears to differ slightly from the law across the border. "The Ditches and Watercourses Act," sec. 3, sub-sec. 2, provides as follows :

"Every such ditch, or drain, shall be continued to a proper outlet, so that no lands, unless with the consent of the owner thereof, will be overflowed or flooded through, or by the construction of any such ditch, or drain, and it shall be lawful to construct such ditch, or drain, through one or any number of lots, until the proper outlet is reached." Section 9 of the same Act provides that the engineer may order the opening of a ditch across the lands of persons not interested, at the expense of the upper owners, without being trespassers.

Section 590 of the "Municipal Act, 1883," provides that "if any municipality, company or individual, by any means, cause waters to flow upon and injure the lands of another municipality, company, or individual, the municipality, company, or individual, causing waters to flow upon or injure such lands, may be assessed by the engineer for the construction of such drain or drains as may be necessary for conveying from such lands the waters so caused to flow upon and injure the same."

The first point to consider, assuming the physical elements determined, is the limits of the area benefited, after which, the proportion of benefit to each parcel benefited.

I have concluded to present my views as to the method of determining the area benefited, and the proportion of cost to be assessed on each parcel of land, in the form of a series of propositions based upon definitions and axioms.

DEFINITIONS.

“Benefit” means the increased market value of the land after the work is done.

“Improvement” means the increased value of the land, not taking into account the cost of the works.

“Cost of works” includes all expenses of surveys, plans, estimates, ditching, removing obstructions, pumping machinery, purchase of mill sites, etc., etc., as fully defined by statute.

“Assessment” is the proportion of the cost of works paid by any parcel of land.

 AXIOM I.

The assessment for benefit cannot exceed the benefit derived, or the improvement of the land.

AXIOM II.

The assessment for benefit must be in exact proportion to the benefit derived.

 NOTES ON THE AXIOMS.

Axiom I. is self evident. Axiom II. becomes evident from reading Sec. 570, Chap. 18, Stat. of Ontario, 1883, part of which reads as follows:

“Stating as nearly as may be, in the opinion of such Engineer or Surveyor, the proportion of benefit to be derived therefrom by every road and lot, etc., etc.” Again in Sub-Sec. 3 of same Sec. 570: “For assessing and levying in the same manner as taxes are levied, upon the real property to be benefited by the work, a special rate sufficient for the payment of the principal and interest of the debentures, and for so assessing and levying the same, as other taxes are levied, by an assessment and rate on the real property so benefited (including roads held by joint stock companies, or private individuals), in proportion as nearly as may be to the benefit derived by each lot or portion of lot and road in the locality.”

Again in Sub-Sec. 7 of same Sec. 570, we find: “The proportion of benefit to be derived from any works by different parcels of land or roads may be shown, etc.”

The words and terms “improvement,” “benefit,” “assessment,” “cost of works,” as they appear in Chap. 18, Stat. Ontario, 1883, are very vague and confusing.

In the following propositions we will assume that the principles of *ditchmaking* have been fully mastered and understood by the engineer or surveyor.

PROPOSITION I.—THEOREM.

The benefit to a parcel of land must always equal the fraction of the cost of the works assessed on such parcel of land.

This is evident from the following consideration :—

If a parcel of land benefited by the construction of certain works be worth a certain sum after the completion of such works, then the value of such parcel before the commencement of the work must be the same amount, minus the fraction of cost of works borne by said parcel.

Therefore the benefit, etc.

PROPOSITION II.—THEOREM.

The area benefited need not be the whole area enclosed by the water-shed.

Let A, B, C, \dots etc. . . Y, Z be several owners in the area of the water-shed, Z , being at the outlet, A at the source.

If any person's land, as M 's, is situated above the watercourse or ditch so that it is not benefited in any way than by Axiom I., the assessment must be nothing.

His land may have been fully ditched before, or it may be so perfectly drained by nature as to require no ditching or underdraining, or it may be rocky or of such nature that draining cannot improve it.

Therefore it is unjust to tax the whole water-shed in every case.

PROPOSITION III.—THEOREM.

The area benefited cannot be bounded by any one contour line.

The surface of the water in an efficient ditch or watercourse must have a fall towards the outlet and cannot, therefore, be parallel to any contour.

Let B and Y be two owners having same area of land, B 's land being near the source, Y 's near the outlet, each parcel of land being similarly situated, the same distance from the watercourse, and at the same height above the surface of the water in the watercourse; then the improvement derived by each is the same, but the contour line passing through Y 's land will be below B 's land; also the contour line that includes all the benefited areas near the outlet will generally not include all the areas benefited near the source.

Therefore the area benefited cannot be bounded by any one contour line.

PROPOSITION IV.—THEOREM.

A parcel of land near the source should pay more than a parcel nearer the outlet, the improvement in land being the same.

Let A, B, C, \dots Y, Z be different parcels along a watercourse or ditch. A being at the source, Z being the first above the outlet, each parcel being equally improved by the construction of the ditch or improvement of the watercourse, then Y should be assessed higher than Z , X than Y , etc., etc.

If *Z* were the only parcel, then this land should be assessed for all works to drain it, and no more.

Suppose parcel *Z* worthless or eliminated, then *Y* should be assessed for all work on parcels *Y* and *Z* to drain *Y*. If *Y* and *Z* are both eliminated, then *X* should be assessed for total cost of all of works on parcels *X*, *Y* and *Z* to drain *X*, etc., etc., from which it will be seen that if each parcel is assessed, independent of every other parcel, that the nearer the source the parcel is situated the higher the assessment should be.

Therefore a parcel of land near the source, etc.

COROLLARY 1, PROPOSITION IV.—When the assessment equals the benefit derived, the works must stop at that point.

COROLLARY 2.—If there is but one obstruction to be removed, and that situated at the outlet, then lands near the source should be assessed the same as those near the outlet.

PROPOSITION V.—PROBLEM.

To determine the limits of the area benefited.

Let the area enclosed by the water-shed be accurately shown on a map, with contour lines at different elevations.

Locate thereon the main watercourses or ditches, and tributaries, and all other ditches and underground drains for subsoil drainage that are necessary to drain the whole area.

Deduct or mark off from this total area those lands not benefited, as more particularly mentioned in Proposition I.

Deduct or mark off also any area in which the assessment of fraction of cost exceeds benefit or is greater than the improvement of the land. (Corollary 1, Proposition IV.)

NOTE ON PROPOSITION V.—We can assume a case in practice in which the surface of ground is such in the water-shed that it gradually increases in elevation as we approach the source, and also that the surface of the ground is parallel with the grade line of the constructed ditch. In this case, if the water-shed is unlimited in the direction of the source, then the amounts assessed on the different parcels increase as we approach the source and are therefore unlimited, but we cannot assess where the tax is greater than value of land; this, therefore, will limit the length of the work constructed.

It may be said that the next parcel above should pay something towards the works, and thus destroy the whole proposition, but it is evident that if the next owner above discharges any water into the works that the size, and therefore the cost, must be increased for the whole length to the outlet, and all at the expense of this upper owner. This amount being greater than the benefit to land, we must conclude that this land cannot be benefited.

PROPOSITION VI.—PROBLEM.

To determine the proportion of benefit to each area.

Let the area enclosed by the water-shed be carefully shown as in Proposition V.; also show the area benefited.

$A, B, C, \dots X, Y, Z$ be different parcels of equal area, A being near the source, Z at the outlet.

Eliminate all parcels but A , then, as in Proposition IV., this parcel should pay for cost of works from parcel A to outlet, which we will call a —being a sum to efficiently drain parcel A .

	by eliminating all but A this parcel should pay a
“ “ “ B “ “	b
“ “ “ C “ “	c
“ “ “ etc. “ “	etc.
“ “ “ Y “ “	y
“ “ “ Z “ “	z

Thus the proportion to be assessed on each parcel is the ratio that each of the sums a, b, c, \dots , bears to the sum $a + b + c + \dots + y + z$.

It will be seen that the total cost cannot be determined until the area to be assessed is determined—that is, Proposition VI. cannot be done until we have determined where the work is to end.

In practice this will be found by trial calculation.

The conclusions arrived at in these propositions are at first sight paradoxical, and I must say that in applying them to practice I was at first somewhat puzzled, but upon closer study the mists partially cleared away. I confess the problem is a difficult one.

It can be demonstrated mathematically, however, that although when a work is completed from source to outlet that the land near the source should bear a higher assessment than one near the outlet; yet, if only the part of work near outlet is now constructed, the assessment for this much of the work decreases as we approach the source, from the point where construction ends to the source.

In practice make the parcels A, B, C, \dots , as large as possible, taking for the unit land fully saturated, in which soil water is lowered at least three feet after the completion of the work. Land not fully saturated before the commencement of the work, and land in which the soil water is lowered to a less depth than three feet below the surface, should be assessed in a lower proportion.

[This paper is quite incomplete, the difficult problems of apportioning the assessment on lands situated at different distances from the watercourse, on lands timbered and cleared, and on lands with different soils, has been left for some future paper. I will not say that I had not time to complete the paper, but admit that I considered I had advanced enough of what many members might think “heretical doctrine” for one session of this Association. Next year we have been promised papers on Drainage by some of our members who have had great experience in drainage works. I regret exceedingly that none of these members could prepare a paper this year, although urged strongly to do so by the Executive and the Drainage Committees.]

DISCUSSION.

Mr. Coad—Mr. Chipman’s ideas are very good. I would like to ask if he has any scale of the difference he would make in assessing the lots? The ditch would be made larger as you go down stream; would you leave the lot above free of the extra cost of the extra size of the ditch or not?

Mr. Chipman—Mathematically the higher parcel of land should pay sufficient proportion to drain the water off it altogether.

Mr. Coad—Then, what would you assess the next lot above? Suppose the bottom lot was two feet six inches, and the next up was two feet, would you make the next lot pay for the extra six inches?

Mr. Chipman—I would make an approximate estimate of the cost of draining each lot. Then put them in proportion. Each would pay its proportion of the total cost.

Mr. Coad—In the first place you were speaking of the man up stream draining into a natural course, and according to the American law the water would be allowed to run down over the next man, and the first man would not be liable. Do you think that right?

Mr. Chipman—I think in the long run it would be. I think it would be better to let the man below take care of it. Then every man would be obliged to drain his own farm.

Mr. Coad—Another question—suppose the lot to be perfectly free of water. Are we to understand that you would assess lands back half a mile from the drain as much as you would lands quarter of a mile from it?

Mr. Chipman—No; that does not follow.

Mr. Coad.—Another question that comes up in districts where we are constructing large drains is this: Suppose we go to work and construct a large drain that carries water from branch drains. We enlarge the drain and make an assessment upon the lots on the branch drains. Would you assess the lots equally, or would you assess the man up stream higher than the man below?

Mr. Chipman—Theoretically the man up stream would be assessed higher than the man further down.

Mr. Coad—The main drain is already constructed, and the branch drain is made. Then you find that the main drain is not large enough to carry off all the water, and you enlarge it, and you have to make an assessment all over the branch drains that go into the main drain. The first lot on the branch we will call "A," the next "B," and so on. Would you assess all the lots equally?

Mr. Chipman—Of course the work is not yet completed. I would make an assessment as if it were completed, take the difference, and charge them with it. On the original assessment, if the ditches were rightly assessed, "A" should pay more; and then, when the work is finally completed, I should take the difference between the total assessment and the first assessment, and assess him for it.

Mr. Coad—The principle of making the one pay more than the other is the proper one. Suppose the drain through the first lot is constructed, and you are assessing for outlet. There has been a great deal of discussion as to whether that lot should be assessed.

Mr. Chipman—The man above pays more on the first assessment. If you reverse them you must reverse the order of assessment.

Mr. Coad—Mr. McGeorge and Mr. Jones of Sarnia assess this land all the way up the stream equally.

Mr. Chipman—I do not think that it will hold mathematically or theoretically.

Mr. Coad—They say that the branch drain takes as much off one lot as it does off the other, and that consequently all should pay equally.

Mr. Chipman—I do not believe that is the right principle. I also do not believe that it should be done by guess-work, though a guess could be better made by an engineer than by a layman.

Mr. Coad—We have a great many arbitrations in the West about drains. They spend about two-thirds of their money in the West in digging drains, and the other third goes to the lawyers. (Laughter.)

Prof. Galbraith—There is one point which is not quite clear to me. Suppose you take lot "Z" for the outlet. As I understand it, the amount to be paid by that lot would be regulated as follows: finally, when the whole drainage has been completed and the whole cost settled, then the amount it cost to enlarge it should be partially borne by that first lot. Suppose the first lot never needed any drainage, would it be fair to assess it?

Mr. Chipman—No, but the area benefited need not be the whole area enclosed by the watershed.

Prof. Galbraith—That removes my difficulty.

Mr. Coad—The lot would not be benefited, but if the water should ascend into this drain there would be a certain amount of liability.

Mr. Chipman—Yes, but people do not pay any attention to it.

Mr. Coad—A case arose in which the water was drained three miles into the head of the ditch by nature. In such a case we would have no right to assess him for that.

Mr. Chipman—If it gave him the benefit of the outlet he should be assessed for it whether he took advantage of it or not.

Mr. T. H. Jones—The case comes up where a large number are not benefited. The main drain has to be made larger on account of the water that comes down from the lots above them. Should these persons be assessed for the extra ditch needed to carry off the water that comes down from those above them?

Mr. Chipman—If it can be shown that the people below have dug enough to drain their own land, then the people above should be assessed for the total cost of enlarging. You cannot assess them under the Ditches and Watercourses Act, of course, but under the Municipal Act.

Mr. Davis—That very point would raise any amount of trouble.

Mr. Chipman—I would like to get the opinion of this Association in regard to the difference in the assessment of timbered and cultivated lands.

Mr. Coad—I make very little myself, but I know that it is a question that is often brought up.

Mr. Chipman—Down East I assess timbered lands about half, as very few farmers clear all their land.

Mr. Davis—I assess them just about the same.

Mr. Jones—I always assess timber lands about three-quarters the amount of the cultivated. I consider that land that is not cleared is not benefited to the same extent as land that is cleared.

Mr. Burke—Farmers say that if you dig a drain through a swamp you will ruin the timber. I would like to have the opinion of the Convention on that point. I have had them come to me, and ask me to allow them for it in the assessment.

Mr. Chipman—The raising or lowering of water will affect the growth of timber.

Mr. Coad—It will injure spruce, tamarack, and swamp elm.

Mr. Davis—A certain amount of water is necessary to the growth of timber, but very wet land is not favourable to its growth.

Mr. Bolton—It is true that if you dig a drain down through a black ash swamp it will kill the timber, but I have known cases where the timber has been improved by the draining of the land.

Mr. Chipman—In our part of the country I have assessed the cultivated land higher than the other, because the probability that a man will clear his land is about one in two.

Mr. Stephens—I would like to ask you how you assess roads in municipalities. I would like to have the experience of the Convention on this.

Mr. Chipman—I find out how much money has been expended on the road. I capitalize that and assess the roads for that amount. I do not know whether it will hold out or not. There is even a greater difficulty than that, and that is in the case of railroads.

Mr. Miller—The Grand Trunk has a special provision in its charter, which provides that it cannot be assessed for a ditch on the main line.

Mr. Chipman—Under the Ditches and Watercourses Act?

Mr. Miller—Under any Act.

Mr. Chipman—I have a case now under way. I assessed the C. P. R. for five hundred dollars, and I do not know whether they will pay it or not.

Mr. Butler—There is the difficulty of applying Provincial laws to Dominion railways.

Mr. W. R. Aylsworth—The Grand Trunk has a special provision, and my impression is that it applies only to the main line. I do not think that it would apply to those branches acquired since the provision was made.

Mr. Coad—A case arose on the Mooretown branch of the Michigan Central. The railway was not assessed at all. The land that we wanted to drain was so situated that we had to dig about four feet into theirs to reach a large canal, and the judge decided against us merely on account of these few feet.

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

TRUSSED BEAMS.

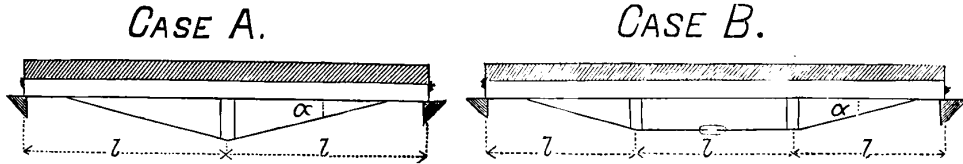
BY J. GALBRAITH,

M.A., Asso. M. Inst., C.E., D.L.S., Professor of Engineering in School of Practical Science, Toronto.

WHEN the weight to be supported by a wooden beam is so great as to render necessary a cross section unduly large, it is the custom, in many instances, to use a beam of convenient cross section, and to make it of sufficient strength by placing a short strut under its centre, which is supported by a tie-rod inclining upwards both ways from the foot of the strut and fastened to the ends of the beam. In longer spans two struts are used, the space between them being one-third the length of the beam; the centre portion of the tie-rod is horizontal, the other two portions being inclined and fastened to the ends of the beam. In this case it is usual to make the tie-rod in two equal lengths, connected at the centre point by a turnbuckle.

The tie-rods and struts constitute the trussing. It is sometimes convenient to make the beam in two parts, lying side by side, and pass the ends of the tie-rod up between them; when this is done the two halves are separated by wooden keys, and are strongly bolted together. It is in most cases desirable that, when the beam is supporting its full load, the points where the struts are placed should be on the same level as the ends. The surest way of securing this is to put a small amount of camber in the beam, before the load is applied, by screwing up the rods, and to test the levels after the load is on; if the points at the struts are then not at the proper level the load may be removed, in some cases, and the rods again adjusted. If it is not possible to remove the loads, as, for instance, where the beam supports a floor in process of construction, jack-screws may be used to support the weight while the rods are being adjusted. I doubt that there is any formula which will enable the necessary amount of preliminary camber to be determined beforehand. The object of the present paper is to give formulas by which the cross sections of trussed pine beams and of the tie-rods and struts may be determined. The cross section of the beam is to be rectangular and uniform from end to end, and the load uniformly distributed. The conditions to be fulfilled are the following: (1) The beam must be stiff enough to resist injurious bending, either vertically or horizontally, under the compression produced by the tie-rods. (2) The stresses due to this compression, combined with those due to the weight carried by the beam, must not exceed the safe limit. (3) The beam at the struts must be at the same level as at the points of support. (4) The stresses in the trussing must not exceed the safe limits.

For convenience the letter *A* will be used to denote the case where the beam has a single strut in the centre, and *B* where the beam has two struts equally distant from the ends and from each other.



Let *l* denote the length in inches of the beam between the end and the first strut; thus, the whole length of the beam in case *A* is $2l$, and in case *B* is $3l$.

b, the breadth of the beam in inches.

h, the depth of the beam in inches.

α , the angle of inclination of the inclined portion of the tie-rod to the horizontal.

g, the greatest compression in pounds per square inch produced in the beam from the combined effect of the load and the strain on the tie-rod. This compression (*g*) exists at the lowest point of the cross section at the strut in both cases *A* and *B*.

q, the load on the beam in pounds per lineal inch; thus, $2ql$ is the total load in case *A* and $3ql$ in case *B*.

m and *n* are numerical co-efficients.

$$\begin{array}{ll} \text{In case } A, m = 15 & \text{In case } B, m = 12 \\ n = 12.5. & n = 22. \end{array}$$

Then we have in both cases

$$b = \frac{ql}{20g} \left\{ m \frac{l}{h^2} + n \frac{\cotan \alpha}{h} \right\} \quad (I.)$$

Having first decided upon a safe value for *g* the above equation will give a value of *b* corresponding to any assumed value of *h*. We may thus have any number of pairs of corresponding values of *b* and *h*. In order to select the pair suitable for our purpose, we must introduce the condition that the beam shall have sufficient stiffness to resist unsafe bending under the strain of the tie-rods, which condition is not included in the above equation. This condition is expressed by the inequality :

$$\frac{S}{bh} < \frac{1}{K} \frac{5000}{1 + .008 \left(\frac{L}{d} \right)^2} \quad (II.)$$

where *S* is the total compression in pounds produced by the action of the tie-rods on the ends of the beam. *K* is a numerical factor of safety against flexure; *d* is in some cases = *b*, and in others = *h*; and

L in some cases = l (cases A and B), and in others $2l$ (case A) or $3l$ (case B), or some value intermediate between l and $2l$ or $3l$.

We shall now describe how the values of d and L are to be decided. If the beam is so well supported against side bending as to be liable to bend only in a vertical plane, $d = h$ and $L = b$ in both cases A and B . This is generally the case, *e.g.*, where the beam supports a floor; the joists, if partly butting against it on both sides, or if well spiked to it, will prevent side bending; also, where the beam forms a girder of a bridge, the cross-ties and cross bracing support it sideways. If the beam has no such support against side bending, d must be made = b , and $L = 2l$ in case A , and $L = 3l$ in case B , to provide against side bending; d must also be made = h and $L = l$ to provide against undue vertical bending. If the beam has side support, but only at such intervals as to render it doubtful whether it will yield or not, d must be taken = b and $L =$ the unsupported interval. In all cases d must be made = h and $L = l$ to provide against undue vertical bending.

The formulas which give the total stresses in pounds in the trussing are the following :

Let R = pressure exerted by strut against beam.

S = end pressure exerted by tie-rod against beam.

= also tension in horizontal part of tie-rod in case B .

T = tension in inclined part of tie-rod.

Then $R = \frac{5}{8} ql$ case A .

$R = \frac{11}{16} ql$ case B .

$S = \frac{5}{8} ql \cot a$ case A .

$S = \frac{11}{16} ql \cot a$ case B .

$T = \frac{5}{8} ql \sqrt{1 + \cot^2 a}$ case A .

$T = \frac{11}{16} ql \sqrt{1 + \cot^2 a}$ case B .

By dividing the above values of R , S and T by the admissible stresses per square inch for the materials, the cross sections of the trussing will be determined.

It must be observed, however, that if this division gives too small a cross section for the strut, to resist bending, the cross section must be increased. This may be done in most cases without calculation, since an overplus of strength in the strut is of little consequence. In long struts, however, Gordon's formula should be applied.

As it is generally convenient to make the tie-rod of uniform cross section, both in horizontal and inclined portions (case B), the cross section determined for the inclined portion should be adopted for the whole.

The area of the tie-rod obtained as above is its smallest area, *viz.*, that given by the bottom of the thread in the screwed ends—thus, in order to economise material, it may be advisable to upset the screw ends. If the strain of the tie-rod is applied to the end of the beam through a cast-iron plate, this plate must be of sufficient area not to crush into the wood.

We shall now illustrate the application of the above formulas by some examples:

First example, case A.

A railroad girder, 16 feet in length, to support a load of 2,400 lbs. per lineal foot, including half the weight of bridge, $\cot \alpha = 4$, $g = 600$,

$$\text{We have } l = 8 \times 12$$

$$q = \frac{2400}{12}$$

$$\cot \alpha = 4$$

$$g = 600$$

$$m = 15$$

$$n = 12.5$$

$$\text{Then } b = \frac{\frac{2400}{12} \times 8 \times 12}{20 \times 600} \left\{ 15 \frac{8 \times 12}{h^2} + 12.5 \frac{4}{h} \right\} = \frac{2304}{h^2} + \frac{80}{h}$$

Assume $h = 14$; then we shall have $b = 17.46$, say 18".

Thus this girder may be built up of three pieces, each 6" \times 14", side by side, separated by wooden keys, and bolted together.

Before finally accepting these dimensions we must test them for bending under the end compression due to the tie-rod. From the construction of the bridge there will be no danger of side bending. We have thus only to see if the above dimensions give security against vertical bending:

$$S = \frac{5}{8} ql \cot \alpha = \frac{5}{8} \times \frac{2400}{12} \times 8 \times 12 \times 4 = 48000 \text{ lbs.}$$

$$\frac{S}{bh} = \frac{48000}{18 \times 14} = 190 \text{ lbs. per square inch.}$$

$$\frac{1}{n} \frac{5000}{1 + .008 \left\{ \frac{L}{d} \right\}^2} = \frac{1}{3} \frac{5000}{1 + .008 \left\{ \frac{8 \times 12}{14} \right\}^2} = 421 \text{ lbs. per square inch.}$$

$$\text{And } 190 < 421.$$

Thus the dimensions $b = 18''$
 $h = 14''$ will do.

To determine the cross section of the tie-rod we have area of tie-rod cross section = $\frac{T}{f}$ where f is the admissible stress per square inch.

Take $f = 10000$ lbs.

$$\text{Then } \frac{T}{f} = \frac{\frac{5}{8} \times \frac{2400}{12} \times 8 \times 12 \sqrt{1 + 16}}{10000} = 4.95 \text{ square inches.}$$

It would be advisable in this case to use two tie-rods passing through the spaces between the three portions of the beam; rods of $1\frac{3}{4}''$ diame-

ter at bottom of screw-thread will give nearly the above cross section. The compression on the strut :

$$R = \frac{5}{4} ql = \frac{5}{4} \times \frac{2400}{12} \times 8 \times 12 = 24000 \text{ lbs.}$$

If the strut be of wood, 7" x 7" would be amply sufficient for strength, but in order to make neat connections it would be better to make it larger. If made of cast iron the strut will be amply strong if sufficiently large at the lower end to receive the rods with a good bearing, and gradually enlarging towards the upper end, so as to fit the beam properly.

Second example, case *B*.

A floor girder, 24 feet long ; load, 600 lbs. per running foot— $\cot a = 5$.

$$\begin{aligned} \text{here } q &= \frac{600}{12} \\ l &= 8 \times 12 \\ \cot a &= 5 \\ g &= 800 \\ m &= 12 \\ n &= 22 \end{aligned}$$

$$b = \frac{\frac{600}{12} \times 8 \times 12}{20 \times 800} \left\{ 12 \frac{8 \times 12}{h^2} + 22 \frac{5}{h} \right\} = \frac{345.6}{h^2} + \frac{33}{h}$$

Assume $n = 9$ ", then $b = 7".94$, say 8".

We must now, before accepting these dimensions, apply the test for stiffness under the compression due to the tie-rod :

If the girder is well supported sideways by the joists we shall only require the condition of vertical stiffness :

$$\frac{S}{bh} = \frac{11}{10} \frac{ql \cot a}{bh} = \frac{11}{10} \frac{600}{12} \times \frac{8 \times 12 \times 5}{8 \times 9} = 367 \text{ lbs. per square inch.}$$

$$\frac{1}{k} \frac{5000}{1 + .008 \left\{ \frac{L}{d} \right\}^2} = \frac{1}{k} \frac{5000}{1 + .008 \left\{ \frac{l}{h} \right\}^2} \text{ in this case}$$

$$= \frac{1}{3} \frac{5000}{1 + .008 \left\{ \frac{8 \times 12}{9} \right\}^2} = 872 \text{ lbs. per square inch, and } 367 < 872.$$

The dimensions 8" x 9" therefore fulfil the necessary conditions. If this beam were not supported sideways at all we should have

$$\frac{1}{k} \frac{5000}{1 + .008 \left\{ \frac{L}{d} \right\}^2} = \frac{1}{k} \frac{5000}{1 + .008 \left\{ \frac{3l}{b} \right\}^2} = \frac{1}{3} \frac{5000}{1 + .008 \left\{ \frac{3 \times 8 \times 12}{8} \right\}^2} = 146.$$

And 367 is not < 146.

This beam is thus not of sufficient breadth under this condition. If we assume $h = 6\frac{1}{2}''$ we shall find b about $13\frac{1}{2}''$, which dimensions will be found to satisfy the conditions of stiffness, both vertically and horizontally, under the longitudinal compression due to the tie-rods.

To determine the cross section of the tie-rod we have

$$\begin{aligned} \text{Area} &= \frac{T}{f} = \frac{11}{10} \frac{ql \sqrt{1 + \cot^2 a}}{f} = \frac{11}{10} \times \frac{600}{12} \times 8 \times 12 \frac{\sqrt{1 + 25}}{10000} \\ &= \frac{26928}{10000} = 2.69 \text{ square inches.} \end{aligned}$$

which corresponds with a diameter of nearly $1\frac{7}{8}''$. The compression in the strut is given by

$$R = \frac{11}{10} ql = \frac{11}{10} \times \frac{600}{12} \times 8 \times 12 = 5280 \text{ lbs.}$$

Similar remarks apply to the dimensions of the struts as in the previous example.

The values to be given to g depend upon the judgment of the engineer. Where the beam is subject to loads suddenly applied and removed, g should be taken smaller than in cases where the greater portion of the load is stationary. It should also be taken smaller with poor material than with good.

The factor of safety, k , should be made greater with poor material than with good.

Values of g from 600 to 800 and $k = 3$ will suit good, fairly-seasoned pine.

The value $L = l$ in the condition for stiffness in a vertical plane should more properly be $L = \frac{3}{4}l$ case *A*, and $L = \frac{1}{5}l$ case *B*, but practically the value given is near enough, and errs on the side of safety.

When an assumed value of g gives dimensions which may not please the eye, such as in example 2, where we had $b = 13\frac{1}{2}''$ $h = 6\frac{1}{2}''$ with $g = 800$, dimensions more nearly equal to each other may be obtained by assuming a smaller value of g . Thus if we had in this case assumed $g = 600$, we should have found $b = 11''.6$ $h = 9$ satisfy all the conditions.

The condition, as given above, to ensure sufficient stiffness against the end pressures is simply the condition that the average pressure per square inch on any cross section shall be $\frac{1}{K}$ part of the breaking pressure given by C. Shaler Smith's adaptation of Gordon's Formula to pine posts. It may be considered by some that $K = 3$ gives too small a margin for safety. A little consideration will show that this probably is not the case.

When a post breaks under the average pressure per square inch

$\frac{5000}{1 + .008 \left\{ \frac{L}{d} \right\}^2}$ fracture takes place only on account of the end pressures continuing after bending takes place, and causing stresses in the

material, which increase very rapidly with the bending up to the breaking point. This will happen when the stresses are due to external loads on the post which are free to follow up the bending, so to speak. The case is entirely different when the compression is produced by truss-rods. In this case the bending of the beam tends to relieve it of pressure, and the only way in which the pressures can follow up the bending is by the truss rods being shortened by being screwed up, an operation which evidently cannot be performed by the trussed beam itself. I am inclined to think that the chances are that the value $K = 3$ would, in many instances, be unnecessarily large.

It would be impossible, in a short paper, to give the investigation of the above formula. The object of the paper is to place in the hands of builders and architects, rational formulas of easy application, which will secure trussed beams with properly proportioned parts, and to relieve them from the necessity of simply copying what has been done before, or of trusting to mere guess work.

DISCUSSION.

Mr. Butler asked if the beam hinged over the strut, in the design shown by Mr. Galbraith, or if the beam were continuous?

Prof. Galbraith—The formula is based on the supposition that the beam is continuous. The other method is that generally used, and is much simpler, but this is complicated.

In reply to another question, Mr. Galbraith said he practically considered the rods in his design at the foot of the strut. He thought that was quite sufficient. In testing the rods it would be advisable to give the foot of the strut a slight tap to keep it in position.

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HIGHWAY BRIDGES.

BY M. J. BUTLER,

P.L.S., Assoc. M. Inst. C.E., M. Am. Soc. C.E., Napanee.

IN reading the various papers published in the proceedings of the different Societies of Engineers throughout the United States, on the subject of Highway Bridges, the trouble with our cousins seems to be that their Bridge Commissioners are either corrupt or incompetent. In two treatises on this subject published in the United States the same wail is to be found, so there must be something in it. Where there is so much smoke, it is probable there is some fire. In this Province matters are somewhat differently arranged; and while it is a rare thing to find lettings made by competent men, there is no reason to doubt the honesty of purpose which generally actuates our municipal officers in such matters. Still, with us, as in all other communities enjoying perfect liberty of action in the choice of municipal officers, it frequently happens that some honest farmer or storekeeper is pitch-forked into a position requiring the education and judgment of an engineer, and from motives of false economy it is rare that such professional advice is taken as the importance of the subject warrants.

As this paper is not intended to be a history of highway bridge building, no particular description of present practice will be given, except incidentally, as prevailing practice happens to coincide with portions of the work here presented. In the following pages it is the writer's intention to attempt a practical treatment of the subject, and to endeavour to make plain for beginners some of the principles of design. As yet our counties have built but few iron bridges; but where they have, the work has been done by reliable bridge companies, and the results have been good. The time is rapidly approaching when all bridge renewals will be of iron, and as bridge builders and bridge companies are springing into existence to meet the increased demand, it behooves our County Engineers to post themselves on the subject as far as they can. The safest plan will always be to have plans and specifications prepared by an expert bridge engineer, and to have the completed structure accepted by him, so as to make sure the work has been properly done. Unfortunately many men of good average intelligence can see no difference between one iron bridge and another (it requires an expert to do so), the difference in cost being, in their minds, only a measure of the greed of the bridge company. A poor iron bridge is about the worst investment any county can make, and as a commercial axiom it may be written

that the supply will always suit the demand; and when our county officers begin to buy the cheapest offered, because it is the least in first cost, then we will get poor defective traps like our cousins across the line.

In answer to the question, What constitutes a really good bridge? it may be said that in a first-class bridge all parts are of equal strength, that the design is of such character as to admit of exact and rigid analysis, that the material is so distributed that it will resist the strains to which it is subjected, that all parts will be accessible to the paint brush, and rendered easy for inspection.

It was formerly, and is still to some extent, the custom to specify a certain factor of safety for all bridges; and while it sounds well in the ears of inexperts, to say the bridge is strong enough to bear five, six (or whatever factor was adopted) times the greatest load that can ever come upon it, still as a matter of fact such bridges do fail. It is doubtful as to what is intended by a factor of safety of six, say. Does it mean $\frac{1}{6}$ of the breaking load? If so, the true factor is only three or thereabout. It has been demonstrated by Wöhler and other experimenters that material should not be strained up to or beyond the limit of elasticity; that repeated renewals of loads, unless very much below the elastic limit, will cause rupture quite as surely as the single application of the breaking load. Now, the elastic limit is only about one-half of the ultimate strength, and when we take into account the effects of shocks, blows, corrosion, secondary and incalculable strains, it will not seem at all wonderful that failures in bridge constructions have occurred. Modern practice specifies certain unit stresses to which members may be subjected, well within the limits of the elasticity of the material, and when that practice is followed in conjunction with a carefully prepared strain sheet, good results are obtained.

In the writer's opinion no more foolish practice could be indulged in than that of adopting light loads for bridges, and as there is good authority for such practice, he thinks it advisable to devote a few minutes to this branch of the subject. In the standard specifications prepared by Mr. Theodore Cooper, M. Am. Soc. C.E., there are three different types of loading designated as "A," "B" and "C." Bridges in Class A are intended for cities and large towns where road rollers and other heavy loads frequently pass. The loads recommended are 100 pounds to each square foot of floor for all spans up to 100 feet, eighty pounds for all spans over 200 feet, and proportionately for intermediate spans, or a concentrated load of fifteen tons, no span to be for a less load than 2,000 pounds per foot. Class B is intended for towns, villages, etc., where excessively heavy loads only occasionally pass. The loads recommended are eighty pounds to the square foot for spans up to 100 feet, sixty pounds for spans 200 feet, and proportionately for intermediate spans, or a concentrated load of eight tons on two pair of wheels eight feet centres. Class C is for rural districts, and the loads recommended are the same loads as for Class B, or a load of five tons on two pair of wheels eight feet centres.

Prof. J. A. L. Waddell, in his excellent work on "Iron Highway Bridges," also advises a similar classification for live load. In the writer's opinion no highway bridge should be designed for a less live

load than 100 pounds to the square foot of roadway, for the following reasons. All bridges are liable to the passage of heavy traction engines, concentrating from four to eight tons on two pair of wheels seven feet centre to centre, or to the passage of road rollers which weigh from ten to twelve tons, to large crowds of men, or to specially heavy loads of iron, stone, grain, etc. To the writer's knowledge a bridge designed to carry eighty pounds to the square foot failed under loads of large stone used in the construction of a bridge necessitated by a new line of railway in the back country. In another case an old bridge was broken down by a crowd of men dancing on it at the time. Of course these two examples were wooden bridges, and it is altogether likely that the deterioration of the material was a factor in their failure. In wooden bridges calculate on excessive loads, and use low unit stresses.

Of course it will be said that the cost of providing for such large loads will be excessive; from numerous designs made by the writer, he is satisfied that the increased cost of a first-class bridge, *i.e.*, for the heavy load specified over one of the lower class of loads will not exceed from five per cent. to eight per cent. The items which go to make up the cost of a bridge are as follows:

1. Raw material, rolled and plate iron 55 per cent.
2. Work on same in shop 15 "
3. Transportation by rail, etc 3 "
4. False work and erection 12 "
5. Profit and administration 15 "

Of the above, (1) would be affected by providing for the greater loading; (2) scarcely at all; (3) to a certain percentage only; (4) not at all; (5) probably not at all, depending on circumstances. With properly prepared loads, properly designed bridges of iron or steel should last for ever.

The writer believes that all bridges should be designed to carry the following loads: 1st, the dead weight of the structure; 2nd, a wind pressure of 30 pounds to the square foot, the exposed area to be taken at $1\frac{8}{10}$ times the area of one side of the bridge; 3rd, a live load of 100 pounds to the square foot of roadway, and 80 pounds square foot of sidewalks, if any. Account to be taken in special cases of extraordinary concentrations, in the case of joisting and floor beams. Under the above loadings no members in tension to be strained beyond the following limits or unit stresses: for wrought iron—

On lateral bracing	15,000	lbs. per sq. inch.
On solid rolled beams, used as cross floor beams and stringers	12,000	" "
On bottom chords and main diagonals (forged eye bars, etc.)	12,000	" "
" " " " (plate and shape, net section)	10,000	" "
On counters and long verticals, forged eye bars	10,000	" "
" " " " plates or shapes, net section	8,000	" "
On bottom flange of riveted cross girders, net section	12,000	" "
On floor beams, hangers, and similar members, liable to sudden loading (bar iron, with forged ends)	9,000	" "
On floor beams, hangers, and other members, liable to sudden loading, plates or shapes (net section)	7,000	" "

Wrought iron in compression should be so proportioned that the maximum load will cause no greater strains than that given by the

following formulæ,
$$P = \frac{10000}{L^2 + \frac{30000 R^2}{1}}$$
 In no case must the length of a

compression member exceed 45 times the least width. Steel compression members to be proportioned by the same formula, with 50 per cent. added. P = the allowed compression per square inch of cross section.

L = the length of compression member in inches.

R = the least radius of gyration of the section in inches.

Timber compression members to be proportioned as follows :

$$P = \frac{933}{L^2 + \frac{275d^2}{1}}$$

When P = the allowed compression per square inch of cross section.

L = the length of member in inches.

d = the least diameter or side in inches.

The iron and steel used shall be capable of undergoing the cold bend tests. (The writer thinks it useless to specify the limits of elasticity and ultimate strength in a paper before a Society like this, inasmuch as the probable bridges would not justify the expense incident to the necessary testing, nor in this country is it easy to get the use of a machine, it being premised that if material will stand the simple cold bend test it is suitable for bridge construction.) The cold bend test is as follows: Specimens must stand bending cold for about 180° to a curve, the diameter of which is not more than twice the thickness of the piece. Or, when nicked with a cold chisel and broken over an anvil or vice with a sledge, the fracture shall be mostly fibrous, with but few granular specks. Steel may in addition be heated to a low cherry red, and cooled in water of about 80° F., after which it should stand bending cold in the same manner as above mentioned. The timber used should be sound, well-seasoned body timber cut from moderately large trees, free from sapwood, windshakes, large black or loose knots, worm holes or other defects. (Above all avoid the use of the word "merchantable" which is so common in specifications.)

Pine timber should not weigh more than 30 pounds to the cubic foot, nor white oak more than 53 pounds to the cubic foot, and this is the proper measure of the seasoning.

It was the writer's intention to have prepared a form of general specification for highway bridges, before he saw the admirable one issued by Mr. Theodore Cooper, M. Am. Soc. C. E., and from which he has taken the liberty to make some extracts in this paper. As they cost but 25 cents each, parties in want of such a guide cannot do better than to secure copies. They are published by the Engineering News Publishing Co., Tribune Building, New York City.

It has been thought advisable to add a list of books treating on the subject of this paper, as many beginners are at a loss to know what books to buy and where they can be obtained. The writer submits the following list, to be taken in the order given :

1st. "An Elementary Treatise on Iron Highway Bridges," by A. P. Boller. This little book is excellent in character, and is a good introduction to the subject ; the author is an acknowledged expert.

2nd. "The Designing of Ordinary Iron Highway Bridges," by J. A. L. Waddell, of the Phoenixville Bridge Company. This work is the most complete manual of designing ever published, and it is to be regretted that there are not more works of this character published ; it leaves nothing to be desired, as it is both practical and theoretical. Works of this kind would soon remove such classifications as "theoretical" and "practical" men, if applied to every branch of engineering.

3rd. "The Elasticity and Resistance of the Materials of Engineering," and "The Strains in Structures." Two excellent manuals by Professor Burr, late of Rensselaer Polytechnic Institute, Troy, now with the Phoenixville Bridge Co. These works are of a more advanced type, and probe the problems of material and design to the bottom.

4th. "The Strains in Framed Structure," by Prof. A. J. Dubois. A large quarto volume on bridge building. The work is a good one, but the author is an expert mathematician, and prefers to use the calculus in many investigations where a much more simple algebraical analysis would give quite as satisfactory and accurate results ; however, in the analysis of the ordinary types of bridge he is very plain and satisfactory. This work was the first, known to the writer, wherein the principles of design were laid down in a practical manner, by the designing of a complete bridge, *i.e.*, by taking out the strain sheet, apportioning the material to the strains, order bills, shipping bills, etc., detail plans, and everything necessary to the construction of the bridge.

5th. For the graphical treatment of strains, consult "Green's Graphic Statics, Bridges, Roofs and Arches, etc.," or "Dubois' Graphical Statics." There is also a work by Edmund Olander, published by Spon, of London, England, wherein the graphical method is used.

6th. Of course "Trautwine's Engineer's Pocket-Book" should be in the hands of every engineer. Some well-arranged data on bridge work, as on nearly everything else pertaining to civil engineering, will be found in "The Civil Engineer's Pocket Book."

7th. Engineers intending to design bridges will find that one or more of the Iron Companies' Pocket Books is well-nigh indispensable—Carnegie's is the best.

As an appendix to this paper several designs have been prepared.

No. 1 is a bowstring girder, and is probably the cheapest iron bridge of equal strength that can be built. It has in its favour less dead weight, and a more graceful and pleasing appearance. Against it is its lack of rigidity, from inability to put in overhead sway bracing, and some ambiguity in determining the stresses in the web system, and

the alternating stresses under moving loads to which the web members are subjected.

Design No. 2 is a single intersection pin connected Pratt truss bridge, and is an example of the best type of bridge construction.

Design No. 3 is for a combination bridge, and is a type of construction that has not yet made its appearance in this Province, and in the writer's opinion this is due, not to lack of merit in the bridge, but to lack of knowledge of its merits on the part of those who buy bridges. When a county does not feel able to buy *first-class iron* bridges, the combination bridge is much the superior of a *poor* iron bridge; the latter, when partially worn out, has only its scrap value, whereas, by the addition of iron struts, the combination (if properly designed) can be turned into a first-class wholly iron bridge. Combination bridges, when properly designed and built, will last from twenty to forty years.

Design No. 4 is the ordinary Queen truss wooden bridge, in use in this Province. The only point wherein the design varies from those usually built is in the lower chord; two scarfs or splices are given instead of one. As ordinarily built, one scarf is made in the centre panel, the point of maximum strain, thus necessitating two rather long sticks and less strength. The mere lengthening of a stick of timber from 13 feet to 25 or 30 feet will add from \$2 to \$4 per foot.

Cast iron blocks are placed at the foot of the braces and bolted to the chord, instead of oak, as is sometimes the custom. Oak and pine, when placed in contact, have a mutual rotting effect on each other.

Owing to the great fluctuation in the price of materials, estimates of cost would be of little or no value, and have not therefore been given.

DISCUSSION.

At the conclusion of Mr. Butler's paper, Prof. Galbraith moved a vote of thanks in the following terms:

"I think Mr. Butler's paper will be a most valuable contribution to the information we possess on the subject of Highway Bridges. The paper shows signs of close and correct theoretical knowledge, and practical experience. I don't think I have ever seen or heard a paper on the subject that combines those qualities so admirably and completely as this seems to do."

Mr. Niven seconded the vote of thanks, which was carried unanimously.

Prof. Galbraith said he was often asked by correspondents to name some reliable work that would give county engineers and surveyors simple specifications and descriptions for designs of bridges such as were to be yet found, and would have to be used for a good many years yet in back country districts, viz.: wooden bridges.

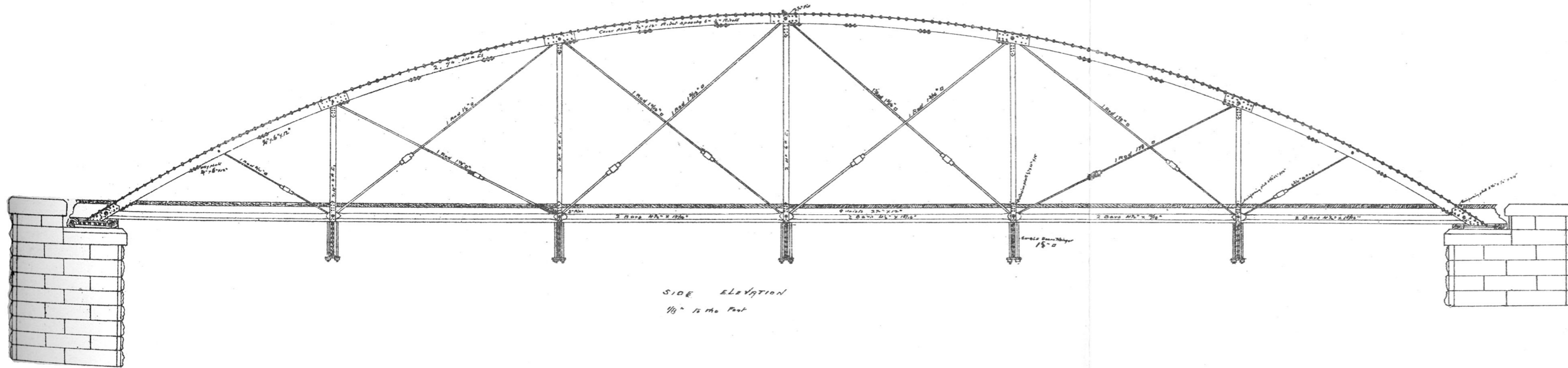
Mr. Butler said he supposed the subject was so elementary that no one had ever cared to write a book on it, but any of the standard works above mentioned would give the principles of design for a man who had a fair knowledge of mathematics.

Proceedings of the Association of Provincial Land Surveyors of Ontario,

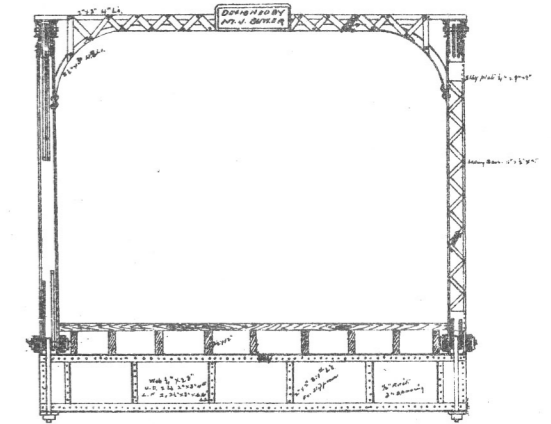
TO ACCOMPANY PAPER ON HIGHWAY BRIDGES, BY M. J. BUTLER.

1887.

PLATE No I
BOWSTRING GIRDER
HIGHWAY BRIDGE

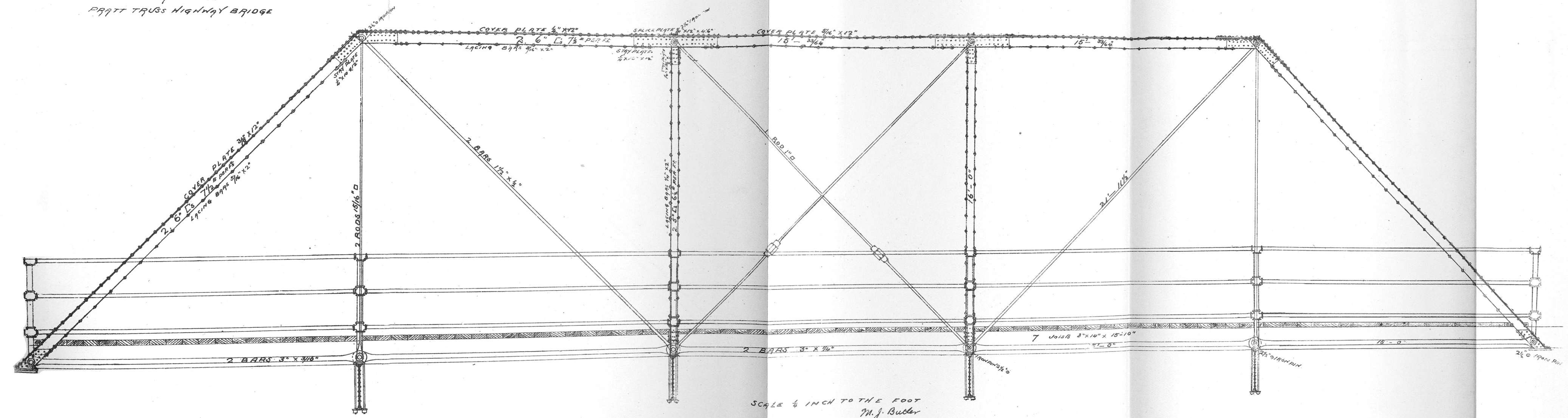


SIDE ELEVATION
1/8" = 10' Feet



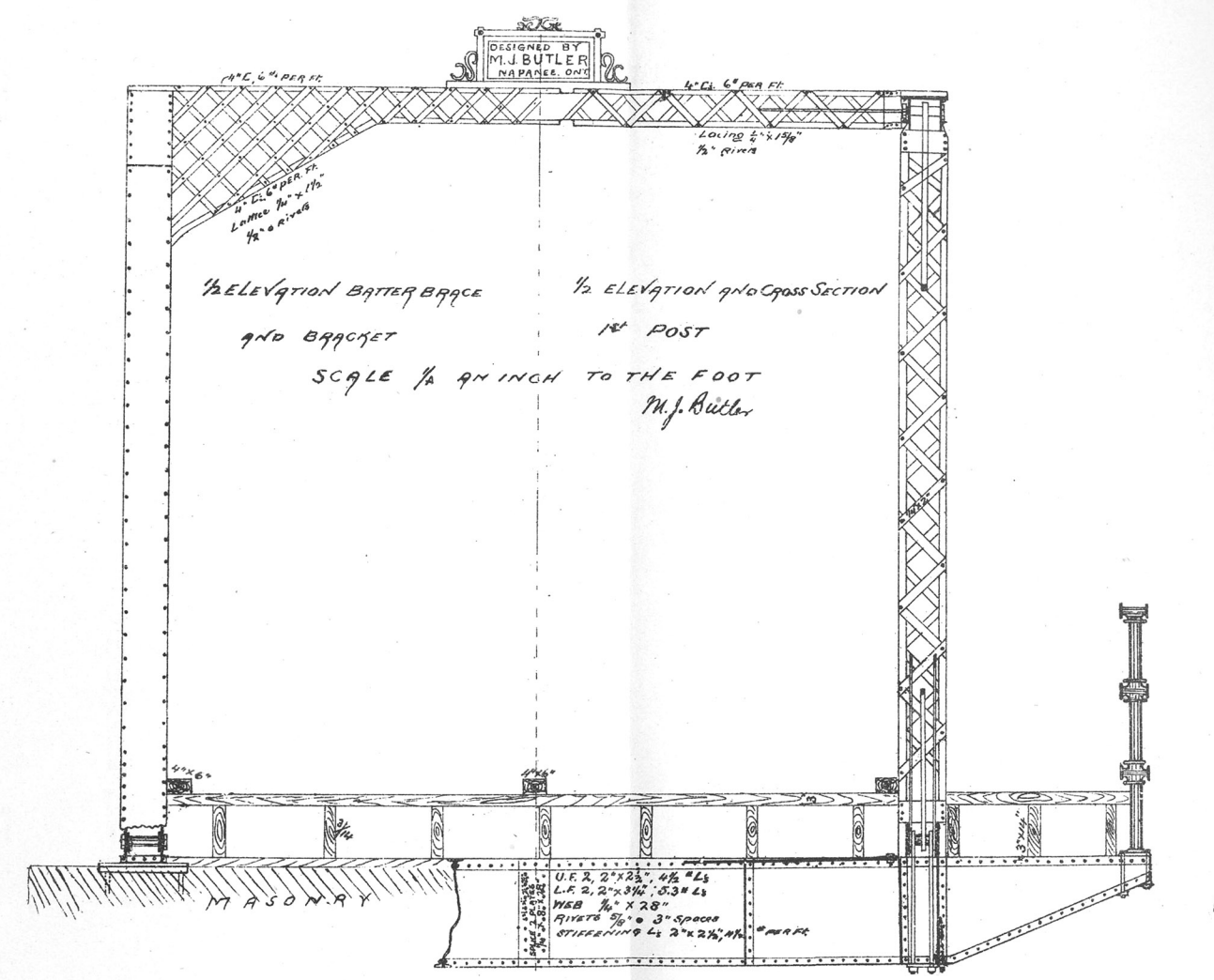
SECTION THROUGH CENTRE OF BRIDGE

PLATE No. II
PRATT TRUSS HIGHWAY BRIDGE



SCALE 1/4 INCH TO THE FOOT
M. J. Butler

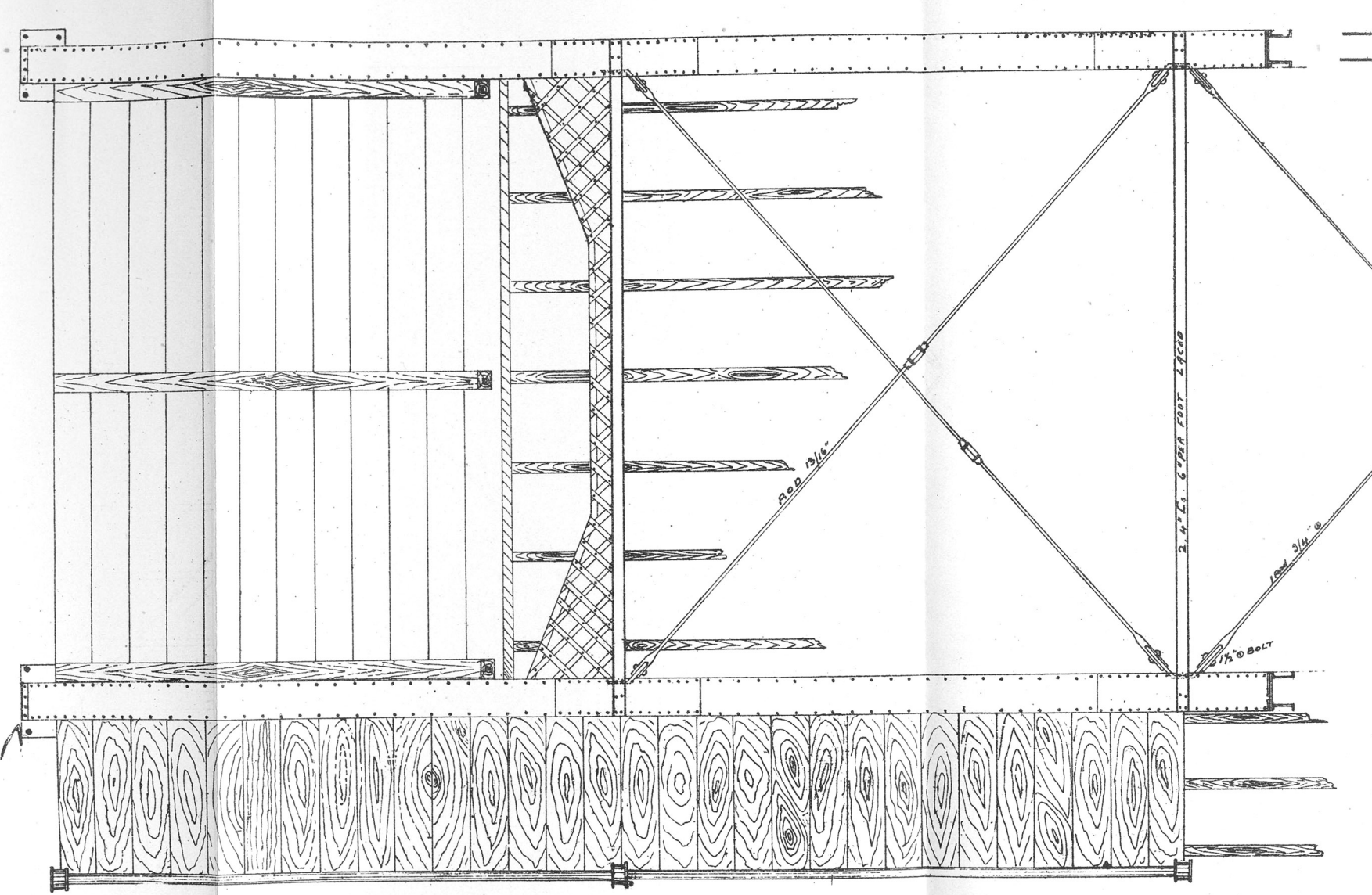
PLATE No. II
COMBINATION PRATT HIGHWAY BRIDGE



SCALE 1/4 INCH TO THE FOOT
M. J. Butler

PLATE No. II
PRATT TRUSS HIGHWAY BRIDGE

1/2 PLAN UPPER CHORD
SCALE 1/4 INCH TO THE FOOT
M. J. Butler



1/2 PLAN LOWER CHORD

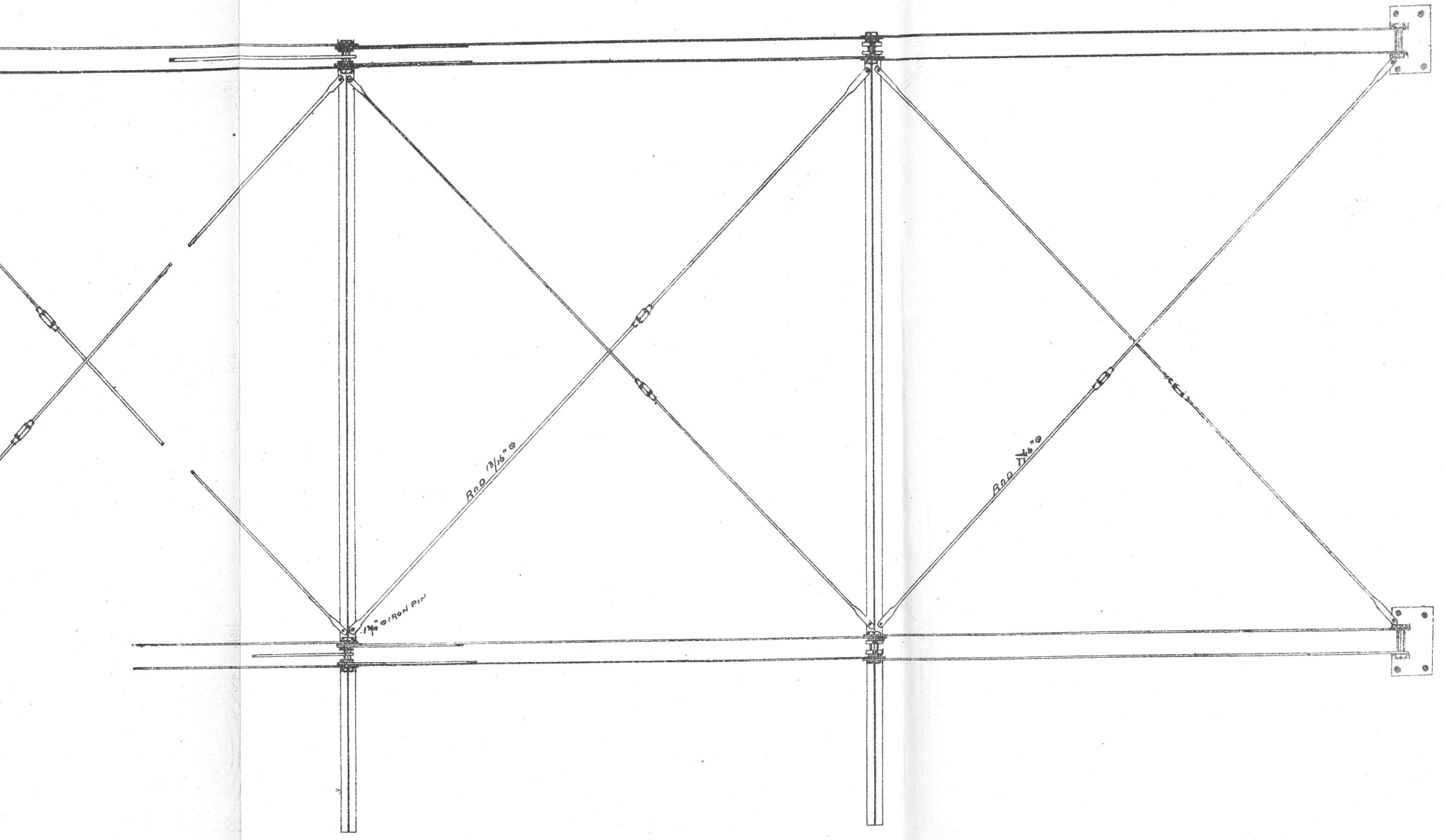
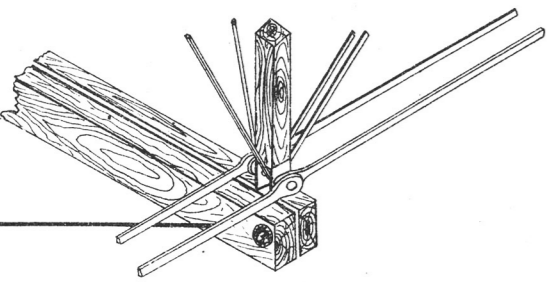
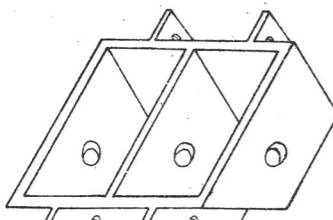
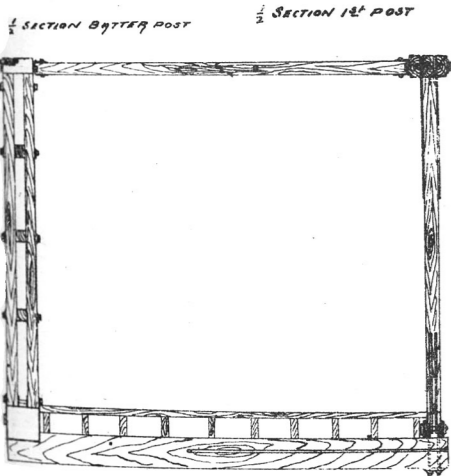


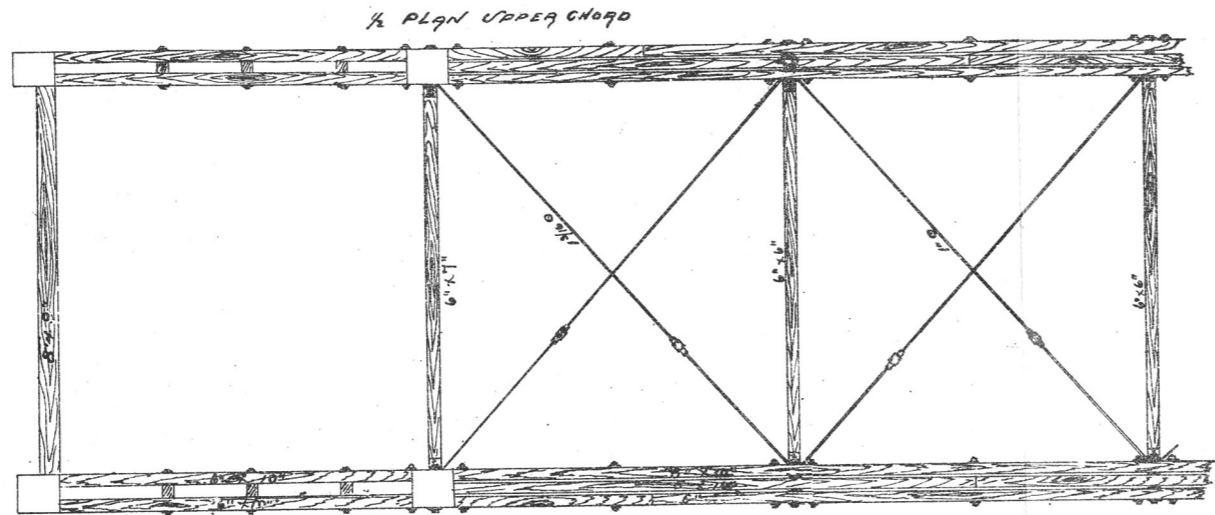
PLATE No. III
COMBINATION PRATT HIGHWAY BRIDGE



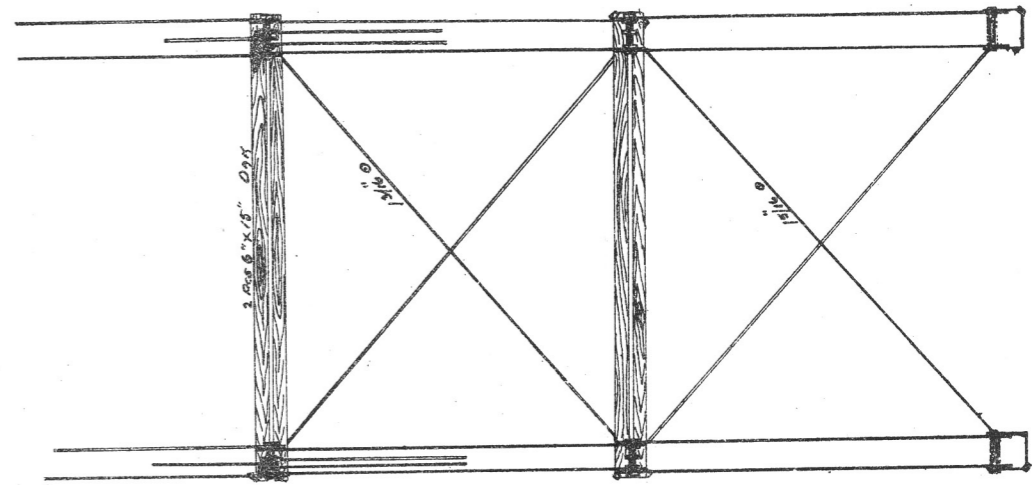
FOOT OF POST NO. 1
ISOMETRIC SCALE 1/2 INCH TO THE FOOT



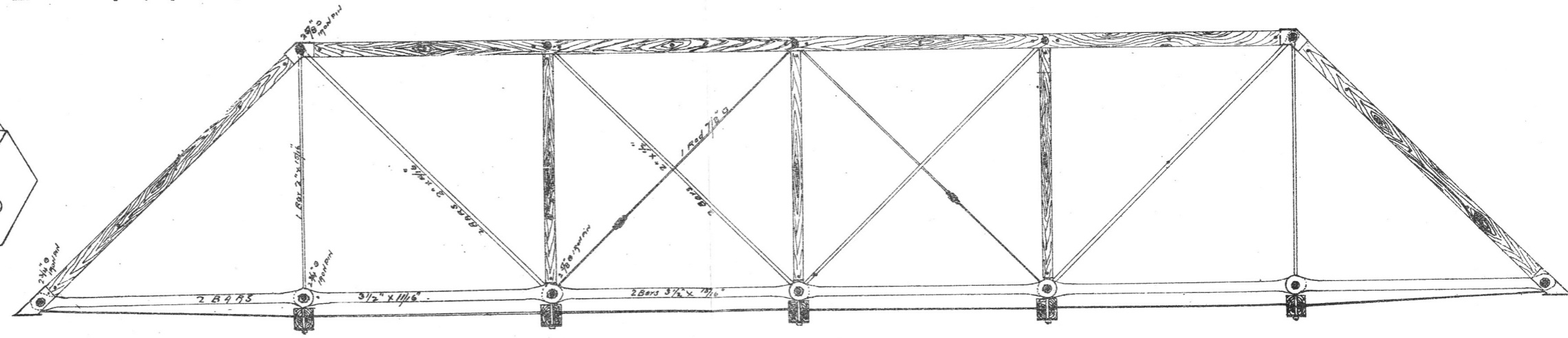
SKETCH OF JOINT BOX
NOT TO SCALE



1/2 PLAN UPPER CHORD



1/2 PLAN LOWER CHORD



SIDE ELEVATION

SCALE 1/8" TO THE FOOT

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

MINING IN THE PORT ARTHUR DISTRICT.

BY HENRY DEQ. SEWELL,
P.L.S., Assoc. M. Inst. C.E., Port Arthur.

THE mining industry in Western Algoma has gradually been for years drawing more and more the attention of Land Surveyors, and although this industry is not likely to afford employment to many Provincial Land Surveyors, other than those who have made a special study of Mining Engineering ; still, as the mining industry in Canada is fast leaving the field of speculation and uncertainty, especially in Western Algoma, where it is fast developing into a rich and undoubted field of legitimate commercial enterprise, far surpassing in richness, both in silver and gold, the hitherto unrivalled mines of Colorado, Nevada, California and Mexico, the author has thought that a short digest of these industries, and also a few comments on the working of "The General Mining Act," by which the profession has to be guided in the subdivision of Crown Lands for mineral purposes, would be interesting to the members of our Association.

THE GENERAL MINING ACT.

Sec. 9 provides that "every regular mining location shall be rectangular in shape, and the bearings of the outlines thereof shall be due north and south and due east and west astronomically ; and such location shall be one of the following dimensions, namely : eighty chains in length by forty chains in width, containing three hundred and twenty acres, or forty chains square, containing one hundred and sixty acres ; or forty chains in length by twenty chains in width, containing eighty acres."

It also lays down rules for the laying out of irregular or broken mining locations, along the margin of a lake or river where the narrow width must front on the road allowance of one chain, which is reserved along the margin of the lake or river.

This provision, so far as regards the road allowance of one chain in width along the margin of a lake or river, the author has generally found mining men consider to be a great defect, and one that is liable to inflict great injustice on the miner, more especially as mineral veins often only show up close to the water's edge, and if not traced through the road allowance might never be found further on in the location. It is also argued with a great show of reason that in most cases the rocks along the shores are so steep and precipitous that it would be impossible to utilize them as roads, and the author has always considered that the reservation of five per centum of the acreage is ample security for the provision of suitable roads ; and it would be a grace-

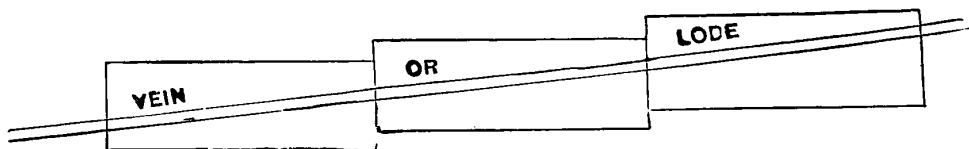
ful act on the part of the Government were they to rescind this objectionable provision.

Sec. 10 provides that in unsurveyed territory all mining locations shall be surveyed by a Provincial Land Surveyor, and connected with some known point, while Sec. 9 provides that in surveyed territory every mining location shall consist of a half section, a quarter section, or an eighth of a section.

This latter provision the author has found uniformly prevents the taking up, in a majority of cases, of land for mining purposes, owing to the large amount of useless land that would in many instances have to be taken to cover a vein, as the locations must follow arbitrary lines that have previously been laid down. This system also affords no protection to the explorer, unless he is rich enough to pay for the land himself. And now that the price of mineral land is \$2.00 an acre, against \$1.00 per acre for agricultural land, the author believes it would pay the Government to encourage the exploration of surveyed territory by permitting mining locations, when so desired, to be laid out by a Provincial Land Surveyor in the same manner as in unsurveyed territory, with such restrictions as would ensure the accurate position of the locations being located on the township map. As it is, a good deal of valuable mineral lands, that are perfectly useless for agriculture, remain unexplored and unapplied for, solely because explorers prefer to go where they can have their locations laid out to suit themselves. The author has in his mind a case in point in the recently surveyed Township of Strange, where an explorer dropped a promising vein after having spent money to find it, solely because, as he said, he could not properly locate the vein without taking up at least double the land he actually required.

LAYING OUT MINING LOCATIONS.

The practical method of laying out mining locations generally consist of a number of eighty acre lots (there being usually too much waste of land necessitated by using three hundred and twenty acre or one hundred and sixty acre lots), as the mineral veins or lodes usually occur, with some few exceptions, parallel to the formation of the country rock, which generally lies north sixty-four degrees east, astronomically. It thus will be readily understood that if the vein is located about the centre of one of the north and south boundaries, say ten chains north and ten chains south of the lode or vein, the next location will require to be jogged from four to five chains, thus :



Of course if the veins or lodes always followed a straight line, and descended vertically, any intelligent surveyor could easily make these surveys ; but it so happens that in many cases the veins get diverted by rocks or hills, and also the dip or angle of descent has to be taken

into consideration, especially when the surface of the ground varies considerably in elevation. The dip is generally to the southward, but even this cannot always be depended on. There is also a class of veins, technically called "North Veins," which cut across the formation, and lie about twenty to thirty degrees to the north of east; while last but not least is the nature and probable richness of the ore, which often has to be decided on the ground. All these points commonly have to be decided to a large extent by the surveyor, on whom most of the work in locating locations generally falls.

MINERAL BELTS.

Gold and silver-bearing veins are usually to be found within certain mineral belts, or lines of ancient volcanic disturbance, and carry a number of mineral-bearing veins. These *belts* usually extend from one to six miles in width, and, although veins are often found outside them, these are generally barren, or contain so little of the precious metals as to render them comparatively valueless. A casual glance at any map of the country, showing the mining locations that have already been surveyed, will indicate this very clearly. Take, for instance, the so-called silver "district" extending westward from the Township of Oliver. The bulk of the surveys will be seen to be contained within a well-defined mineral belt, barely three miles in width, and extending from Arrow Lake through Whitefish Lake, Silver, Rabbit and Beaver Mountains, and still eastward up to the old Shuniah Mine. Further south there is undoubtedly another strong silver belt running through Silver Islet, and very probably there may be other equally rich silver belts lying between the latter and Whitefish Lake, as well as to the north of it. The first strong gold belt that has so far been discovered appears to pass in the neighbourhood of the Huronian Mine, in the Township of Moss, and appears to be about two miles in width, but still running in the same direction. The next prominent mineral belt contains gold and a grayish mineral, probably platinum, and appears to run from near Otter Lake to Sturgeon Lake. Still further westward there is a strong gold belt running through Lake Manitou (on the road to Fort Francis); while, on the Lake of the Woods, the principal discoveries have been made within a six-mile belt, extending from Pipe Stone Point, about north sixty-four degrees east, and burying itself in the granitoid gneisses north of the Pine Portage gold mine, and which, presumably from their very close resemblance to granite, have been erroneously classified as such by the Geological Survey of Canada.

GEOLOGICAL FORMATION.

The question as to the geological formations, in which gold and silver are to be found, in Western Algoma, and the relative age of those formations is, unfortunately, at present a matter of considerable doubt and uncertainty. The fiat of the Geological Survey Department of Canada is, however, very clear and decided on this point. They say that gold is to be found in the Huronian, and silver

in both the Huronian and Laurentian formations. They say, also, that the Huronian is the later formation. The author's observations, which have been considerable, and which have extended over a period of upward of four years, have led him to the conclusion that there are several distinct geological formations in the territory, extending from Port Arthur to the western boundary of Ontario. The so-called Huronian slates in the neighbourhood of Whitefish Lake are of an entirely different colour and appearance from those which have also been classified as Huronian, situated above the height of land; and, while the former are to be found underlying the Laurentian gneiss, in the Township of Strange, and in the neighbourhood of Sand River, from Savanne westward above the height of land, the similarly classified Huronian slates invariably overlie the Laurentian. From this it would appear that there is probably some mistake in the classification of these so-called Huronian rocks.

HISTORY OF THE MINES.

Until ten years ago the means of reaching the mining district of Western Algoma with supplies was only during the summer of about six months in the year, by boats up the great lakes; and the great distance from the seat of government, together with its spare settlement, hindered the construction of proper roads, bridges, etc., necessary for cheap connection between the mines and the lake shore. These drawbacks, and the difficulty of inducing capital to make investments in a country then but little known, and which was reputed to be wild and barren, tended much to retard its development. The date of the first discovery is somewhat uncertain, but in 1845 Colonel Prince, in searching for copper at Spar Island and Prince's Bay, found, in the vein, gray copper ore carrying a high percentage of silver. In 1841 to 1842 a strong organization, the Montreal Mining Company, sent up Prof. Sheppard and a large, well-equipped party to explore the north shore of Lake Superior. This resulted in the taking up of large tracts of land, but they did no mining work. In May, 1865, the McKellar Brothers, associated with Mr. J. McIntyre, the Hudson's Bay Factor, found the Enterprise Mine, and the next year Peter McKellar found the Thunder Bay mine, with native silver and argentite, and from that date commenced the great silver mining boom of Port Arthur. From this time out discoveries were frequent and rich, until 1868, when a man named Morgan, in the employ of the Montreal Mining Company, sent up to examine and report upon their land, found the Silver Islet vein on a small rock included in the Company's land. In 1866 the Shuniah Mine was discovered by Peter McKellar. In 1868 a large deposit of baryta was found on McKellar's Island, but nothing was done to develop it until last year, when a considerable force was put on it, and a large quantity of baryta ore was taken out and shipped. The vein is about forty feet wide, and the ore is of a very good quality. In 1870 Silver Harbour, or Beek Mine, was discovered; and in 1870-71 3A, Pie Island and Cloud Bay were brought to light. Native gold was first discovered at the Huronian Mine in 1871, and at Partridge Lake in 1872. The Huronian Mine

has been worked sufficiently to prove its capability of being made into a valuable paying mine. A ten-stamp mill has been erected, and, together with the Highland and Neebish gold mines, they have been formed into a mining company, with a capital of £360,000 sterling. With regard to the success of the older mines, it may be said that at the time they were originally operated but little was known of the geological characteristics of Western Algoma, and the more modern principle of following the veins—which has since been reduced almost to a science in the United States and in Mexico—was then almost entirely unknown, so that it is hardly a matter for surprise that the Silver Islet Mine alone proved a success; and there can be but little doubt that many of these more ancient discoveries are capable of being developed into paying concerns under more skilful and able management. Indeed, in the case of the Shuniah Mine, Dr. Lehnen, the Captain of the Rabbit Mountain Mine, has stated his belief that when the Shuniah Mine was shut down they were fully four hundred feet off the vein. To turn to more modern and recent discoveries and developments, the Jarvis Island Silver Mine, situated in the same locality as the famous Silver Islet Mine (in a report dated on the 15th of September last), they had run two drifts, one eighty feet from the surface, and the other one hundred and forty-five feet. The vein in these drifts is composed chiefly of baryta, or heavy spar, and the Captain is confident that they will strike something rich when they come in contact, at the junction between the diorite and slate, where the principal bonanzas were always found at Silver Islet. The mine is owned and operated by a wealthy English company, who are working it systematically on the most approved modern principles. The other mines in operation near Port Arthur are situated in what is known as the Whitefish Valley. There are numerous fair prospects, such as Crown Point, Silver Hill, Silver Falls, Peerless Mine, Big Bear, Porcupine, and The Palisades, that have all been more or less developed, and some of them will, in all probability, if properly managed, be enumerated amongst the paying mines of the future; but so far they have not been sufficiently developed to warrant a description in this paper. There are, however, three mines in this locality that have fairly passed through the preliminary and doubtful period of their existence, and now bid fair to prove valuable and remunerative properties. These are the Beaver, Rabbit Mountain and Silver Mountain. And when it is borne in mind that all these developments result from one single year's operations, namely, 1886, some slight conception can be arrived at of the magnitude and importance of this entirely new and valuable Canadian industry. The following accounts of these three mines have been taken from the Port Arthur local papers, as the author has not had a recent opportunity of visiting them:

THE RABBIT MOUNTAIN MINE

has undergone the greatest amount of development. This mine was first opened in 1883, when some very rich ore was extracted. Among that taken out near the surface it was not uncommon to see pieces of silver glance the size of half a brick. Owing to disagreement among

the owners nothing was done in 1884, but mining was actively carried on during 1885 and 1886. The operations are chiefly confined to the main lode, but a smaller parallel vein, about fifty feet to the north-west of it, has been opened, and upward of \$20,000 worth of silver taken from a stope near the surface. The outcrop of the veins occurs in a valley, on the sides of which the edges of the horizontal black slates may be seen. A mass of trap is brought by a fault into contact with the slates along part of the smaller vein. The main lode averages about four feet in width, although it varies from two to twenty feet, and consists of white calc spar with quartz, often in crystals, which are sometimes amethystine, lining vugs, together with a little purple and green fluor spar.

In addition to the solid gangue, much of which is considered vein matter, consists of the slate traversed in all directions with reticulating strings of the spar and quartz. The silver glance is associated with more or less of the sulphides of copper, iron, lead and zinc. This character belongs to all the veins in the Whitefish region, and, indeed, to all those cutting the black slates of the Thunder Bay district generally, so that it will not be necessary to repeat the description.

On the main vein at the Rabbit Mountain Mine the principal shaft is down 170 feet. At 80 feet a drift is run north-east about 300 feet and south-west about 120 feet, and from this level cross-cuts have been driven to intersect the smaller vein to the north-west. There are two other shafts, and some stoping has been done.

The stamp-mill is built on a hillside, so that, in treating the ore, it is carried by gravitation from one process to another, and the tailings are washed away by a brook at the bottom. It is built for two batteries of five stamps each, but only one is in operation, crushing ten tons a day. In flowing from the battery the stamped rock is equally divided to two Frue vanners. The concentrates are barrelled for export to Omaha, while the tailings pass to one or another of four tanks, from which, after settling, they are shovelled into two amalgamators. After treatment in these for five hours, at a temperature of 150° Fahr., the quicksilver is strained and the amalgam distilled and smelted into bricks from twenty to upward of fifty pounds weight. A laboratory for assaying, etc., is attached to the works. The mill had been running for only two months, but there was ore enough on the surface for six months ahead, and the stock is increasing. Twelve tons of concentrates, worth about \$1,000 a ton, had been shipped up to the time of my visit. Sixty-five men are employed, of whom twenty-two are miners, the rest being mechanics, labourers, etc.

THE BEAVER MINE

is on a vein of a character similar to that of the Rabbit Mountain Mine, but running at right angles to it or in a northerly direction. It cuts through a flat-topped ridge 110 feet high, consisting of the horizontal black slates. In the face of the hill the vein shows a width of from two to three feet, but it is not so thick in the lowest level now worked. Three drifts have been driven into the hill along the course of the vein. The lowest one just referred to is 650 feet. At about

600 feet from the entrance a small lead crosses the vein, and this has been followed for forty feet to the north-east, and a winze is sinking upon it at this distance, which shows rich ore, and it increases in going down. The ore is mostly in the form of leaf argentite, associated with blende. The two upper drifts are not in so far as the third, but a good show of vein-stuff has been thrown out of them. An air-shaft is sinking on the south side of the ridge to intersect the lowest level. The mill, which is at work, is built on the bank of Silver Creek, a quarter of a mile south of the mine, from which the ore will be brought by a tramway. The ore is reduced without stamping, by means of pulverizers, one of which is Frisbee & Lucop's patent. The reduced ore will be separated by means of two of Frue's vanners and one "Golden Gate" vanner.

Seventy men are employed in connection with the mill and the mining operations, of whom eighteen are miners. Compressed air drills, worked by a sixty horse-power engine, are used.

AT SILVER MOUNTAIN MINE

they have run two drifts horizontally into the side of the mountain, the lower one being in about 275 feet, and the upper 200 feet. The upper drift is immediately above the lower about 80 feet, and runs parallel with it. Miners are working in each drift. They are also sinking a shaft to connect the two drifts; and similar shafts are to be sunk at intervals of 150 or 200 feet. There are three shafts sunk from the top of the mountain, immediately above the upper drift, it being about 80 feet from the surface down to this drift. Two of these shafts are now working. They are about 800 feet apart. One is down about 25 feet and the other 10 feet. They are both upon the vein, the object being to continue the drifts and shafts until they intersect, at which points rich ore may naturally be expected. There is also a third drift into the mountain of about 40 feet, following a stringer in this drift, which they expect to follow about 150 feet further, to intersect the upper drift. They are getting silver in the various shafts and drifts, but not in large quantities. They do not expect any large finds at this early stage of development; but the great aim and object of the manager seems, not so much the accomplishment of immediate brilliant results as the conservation of far-sighted schemes all tending to ensure the future success and permanency of the great work over which he has control. The amount of work in and around the mine is something wonderful, considering the short time this mine has been at work, namely—two and a half months ago. There are 52 men at work in and around the mines, 31 of whom are engaged in actual mining. They work three shifts of eight hours each, working day and night. There are a number of buildings. The office of the company is well built. They have an assay office, and an assayer; a blacksmith shop, engine-house and several boarding-houses.

During the past year a valuable discovery of (magnetic) iron ore has been discovered in a large deposit by the McKellar Brothers, on the Atic Okan River, in the Rainy River District. It contains seventy per cent. of iron, and is almost entirely free from sulphur

and other injurious substances. The deposit, which lies in a wide bed, contains an almost inexhaustible supply of suitable ore for the manufacture of Bessemer steel, which is now so largely in demand in the United States. The Chicago and Vert Island Stone Quarry is in operation at Nepigon Bay, about seventy-five miles from Port Arthur. About 40,000 cubic feet of this stone has been shipped during the past year, principally to Chicago. It is a red-brown sandstone, and is very popular for building purposes in Chicago, where they have been unable to supply the demand for it.

LAKE OF THE WOODS.

To the west of Port Arthur but little has so far been done in this Province, but an account of the mining operations on the Lake of the Woods forms a natural adjunct to the account of those in the neighbourhood of Port Arthur. The principal minerals found there are, gold, silver, iron, nickel, lead, antimony, cobalt, arsenic, asbestos, mica and moulding sand. Foremost amongst these ranks gold, the most precious and the most abundant. It is found in veins traversing the Huronian formations, but the richest leads are immediately adjoining the Laurentian rocks, having Huronian slates, or diorites, on one side, and Laurentian gneiss, or granitic gneiss, on the other. The gold exists in almost minute particles, which are often undiscernable in the quartz until pounded and reduced to a fine sand, when, on being washed in a pan, the fine gold shows up in surprising quantities. The principal gold discoveries, enumerated in their order of merit, are: The Pine Portage, the Winnipeg Consolidated, the Partridge Nest (or Keewatin), the Yellow Girl, the Minerva, the Woodchuck, the Sultana and Gold Hill.

THE PINE PORTAGE

is the only discovery which, so far, has been sufficiently developed to warrant its being called a mine. It was discovered in the spring of 1880. It lies at the head of Pine Portage Bay, about eight miles from Rat Portage. A shaft over one hundred feet in depth has been sunk, together with several drifts and cross-cuts. The vein, which is about six feet in width at the top, is said to be at least twenty feet wide at the bottom of the shaft, which fairly glistens in every direction with free gold and silvanite. A ten-stamp mill with two Frue vanners, to concentrate the ore, has been erected, but it has been temporarily shut down. Some idea of the richness of this mine may be judged from the fact that the Geological Survey Department of the Dominion Government give, in their published reports, the enormous assay of 22 ounces of gold to the Canadian ton of 2,000 pounds. It is a matter to be greatly regretted that so promising a mine should not be worked, especially as the vein appears to be a true fissure vein, and the amount of rich ore in it is practically almost inexhaustible.

THE WINNIPEG CONSOLIDATED

was discovered in 1881. A shaft has been sunk on this property to a depth of 135 feet, at 95 feet two drifts of 75 and 50 feet respectively,

were made, and also two drifts at 40 feet. On an average the ore contains \$90 worth of gold to the Canadian ton. The only drawback to this mine is the extreme narrowness of the vein, which is about one foot in width, but with careful and judicious management it might be made to pay handsome dividends.

THE PARTRIDGE NEST (OR KEEWATIN)

consists of two very good-looking veins from three to four feet in width. It is situated on Hay Island, and is in near proximity to the Winnipeg Consolidated, and Pine Portage, both of which latter are on the main land. A small amount of work has been done on the Partridge Nest, close to the surface. When panned out it yields a good show of gold, and if worked might possibly prove a good mine.

THE YELLOW GIRL.

is situated on an island about two miles north of a point of land called the Yellow Girl, and from which it derives its name. The vein is five to six feet in width, and is full of mineral. It is an exceedingly well-defined vein, and has probably a great future before it. Professor Chapman, of Toronto, assayed it at \$33 to the Canadian ton of 2,000 pounds.

THE MINERVA

is a promising looking vein on an island almost opposite the village of Keewatin, and a little over six miles to the south of it. It was discovered in 1881. There are reported to be no less than six veins on this property carrying gold. At a point where two of these veins converge, a shaft has been sunk for 20 feet, increasing the width of the vein from ten inches at the surface to three feet six inches, with well defined walls. Assays averaged \$47 per Canadian ton.

THE WOODCHUCK

is situated on Clear Water Bay, and is the only location in that neighbourhood that has not practically been abandoned. Some good shows of free gold have been found, but so little work has been done that it cannot be classified as anything beyond a good prospect.

THE SULTANA

is situated on an island near Pine Portage Mine. Some prospecting has been done on it last summer. The vein is large and well defined, and is said to carry a fair proportion of gold.

GOLD HILL

consists of a series of rich stringers, varying from $1\frac{1}{2}$ inches to six or seven inches in width. They are said to be very pockety, some places showing free gold, whilst other parts are entirely destitute of the precious metal. It was discovered in 1885.

SILVER AND LEAD,

in the form of galena, has been found, principally in the neighbourhood of Ptarmigan Bay and Shoal Lake, and some apparently very rich specimens have been taken from this locality; but unfortunately in the rush for gold nearer home, the search for silver and lead ores has been much overlooked. There is, however, a strong probability that some rich silver finds might be discovered were qualified explorers to seek for it.

MAGNETIC IRON ORE

of a very superior quality has been found on the Winnipeg River, and good iron ore is reported to have been found on Rainy Lake, which is probably a continuation of the Vermilion iron ore deposits.

NICKEL.

A few discoveries of this metal have been made, but so far no mining locations have been taken up for this valuable mineral. Antimony, cobalt and arsenic have been found, but so far not in sufficient quantities to work; but what has been found has been the result of accident, and no proper search has been so far made for these valuable non-metals. About three years ago several carloads of antimony ore were shipped to Chicago. Common asbestos has been found in several places in small stringers, but so far it has not been found in sufficient quantities to pay to mine. Sheet mica has been found of superior quality and size on Big Island, but the inhabitants are so indifferent to the great mineral wealth in their midst that no attempt has been made so far to mine even this mineral, which Nature has so profusely provided, and that could be so easily manipulated. Moulding sand of good quality exists in abundance in several places on the Lake of the Woods, and some good castings have been made with it. With this, also, nothing has been done. That there is also abundance of really good brick clay has been conclusively proved by the manufacture of very superior bricks; but freight charges are so high that nothing beyond local trade has so far been provided for.

In conclusion, it should always be borne in mind that a successful mine means a successful business venture, managed with judgment, skill and capital; and when properly conducted with the same care, skill and judgment that is bestowed on every other business, mining becomes more profitable than any other commercial enterprise. Mineral deposits are discoveries, but mines are made. A full knowledge and appreciation of these facts will almost invariably insure success, if the agents employed are trustworthy and efficient; otherwise, no matter how rich the deposit may be, certain failure will be sure to ensue.

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ELECTRIC LIGHTING OF SMALL TOWNS.

BY F. F. MILLER,

B. Ap. Sc., P.L.S., D.L.S., Assoc. M. Inst. C.E., Mem. Can. Soc. C.E.

BEFORE proceeding to the subject the following definitions may be observed:

The unit of resistance is called the Ohm, which is the resistance offered by 48 meters of copper wire, one millimeter in diameter, to the passage of an electric current through the wire.

The unit of electromotive force, or that force which tends to produce a transfer of electricity from one point to another in a conductor, is called a Volt.

The unit of strength or intensity is called an Ampere or Weber, and is defined by the fact that a Volt produces an Ampere in an Ohm in a second.

The unit of quantity is called a Colomb, and is defined by the fact that an Ampere gives a Colomb in a second.

The unit of capacity is called a Farad, and is defined by the fact that a Colomb in Farad gives a Volt.

In investigating the theory of mechanical electric generators there are three principles to bear in mind:

1. The energy of the electrical current and of magnetic attractions does not lie in the wire that carries the current or in the magnet, but in the space surrounding the wire or bar (magnet).

2. The current passing in a wire is a magnetic fact, as well as an electrical one.

3. Energy must be expended in order to produce magnetic or electrical work.

The space surrounding a magnet, in which the magnetic force acts, is called the field. If we hold a glass plate over a magnet, and place iron filings on the plate, and tap it, the iron arranges itself in certain positions; *i.e.*, in the form of lines upon the glass—these lines are the lines of force. It is generally assumed that these actions are carried through space by motion in the ether, which is assumed to pervade all space. A wire, carrying a current of electricity, acts similarly to a magnet in regard to the lines of force surrounding the wire, but with the difference that the lines do not emanate from the wire, but circle around it. If a magnet is passed in a coil of wire (or solenoid), a current of electricity is set up in the wire; and conversely,

if a bar of iron is placed within a solenoid having a current of electricity passing through it, the bar becomes magnetized. This current produced in the wire is called an induced current, and there are certain principles governing it; *i.e.*, there must be motion in the relation of the coil to the magnet, and the approach or recession produces currents in the opposite direction, and the strength of the current depends upon the strength of the magnet, the number of coils of wire in the solenoid, and the speed of the relative motion of the magnet to the wire.

The first generators made were called Magnetic Electrical Generators (now generally used in telephone bells), and the current was generated by revolving permanent steel magnets in front of coils of copper wire, or *vice versa*. The machines, or Dynamo Electrical machines of the present day, make use of the fact that the iron in a coil of wire is magnetized, and the current of the machine itself is used to make magnets, called field magnets, in front of which the coil (Armature) is revolved. These machines may be divided into three classes (according to the winding of the Armatures, and types of all three are in use in Canada), namely:

1. The Cylindrical, or Gramme Armature, illustrated by the Ball, Fuller, Wood, Van Depoele and Hochhausen.
2. The Drum Armature, illustrated by the Thomson-Houston and Wright.
3. The Disk Armature, illustrated by the Brush.

From the fact, in the generation of currents, that the stronger the magnet the more lines of force, the stronger is the current generated, the theory of an effective current is that the coils of wire should cut as many lines of force as possible in the shortest time. In order to thus get an effective machine there are four conditions, namely:

1. The Armature should have a high circumferential velocity, within certain limits, of course.
2. It should be placed in a very strong magnetic field.
3. It should have many turns of wire, each enclosing as great a space as possible.
4. The resistance of the Armature should be small.

A short history of electric lighting may now be noticed.

About 1810 Davy produced the first arc light by means of two soft pieces of carbon and a battery. In 1844 Foucault improved this by using hard carbon and a battery. In 1831 Faraday discovered the relation of magnets to electric currents. This remained a laboratory experiment until 1856, when Prof. Holmes called the attention of Trinity House to the use of an alliance machine for lighthouses, and, after repeated trial, the Elder Brethren adopted the light on Dungeness in 1862. Continuous improvements have been made to late dates, and the probability is that the arc light is as near perfect now as it ever will be.

With the improvements of the generators the lamps have also been improved from the two simple holders, fed by the hand of Davy, to the examples now before you. The electric light may be divided into two kinds, the arc and the incandescent. The arc light is made by using lamps similar to the above-mentioned ones, which feed together carbon rods as they are consumed by the current. The incandescent light is made by heating a film of carbon or other substance to a high temperature in vacuum, by passing an electric current through it, the current being produced by an ordinary generator, wound for the purpose, or from a battery, or from accumulators, and, as the two latter are expensive methods, the former is generally used.

The difference in the current of arc and incandescent lights is that the arc requires a high electro-motive force and small quantity, and the incandescent the opposite. The reason is that the arc lamps can be placed along a wire, the wire running from lamp to lamp and back to the machine; and, as the lamp requires a current of say 9 amperes and 45 volts each, the current would be, for a 50-light plant, 9 amperes and 2,500 volts, which would be a fair arc circuit. Whereas, to replace the above, 500 incandescent lamps would be required of say 1 ampere and 50 volts each, or a total of 25,000 volts—a current which is impracticable—so, instead of placing the lamps in that position they are placed as follows, each lamp forming a connection between the positive and negative poles of the generators. To carry this current a very large wire is necessary, which adds to the cost. A system has been patented in the States, by Geo. Westinghouse, to do away with this expensive wiring in this way. A current similar in strength say to the arc current is generated, but it is an alternative current; and it is used to generate a current in each house for the use of that house only.

In regard to the cost of a plant, from a number of examples, the following is a very good rule, providing the length of conducting wire is not excessive: Consider the price of machine and lamps at \$100 per lamp, then add \$1,000 for the first 20 lamps and \$500 for each subsequent group of 20 lamps; *i.e.*, \$3,000 for a 20-light plant, \$5,500 for a 40-light plant, etc. The above cost simply covers the machine, lamps, wiring and connection to the motive power. The building and power must be added to the above, and they vary in different places and according to the capital and taste of the company.

In regard to the working expenses we might assume the power as one horse-power per light, or 50 horse-power for 50 lights. This is excessive, as it really takes from $\frac{2}{3}$ to $\frac{9}{10}$ of a horse-power per light. The cost of engine can be arrived at by taking the coal consumption per hour. As an example, take a 50-light plant, and suppose the engine to consume four pounds of coal per hour per horse-power, which is a fair consumption. Coal consumption would be 200 pounds of coal per hour, or, an average of five hours per night would be half a ton of coal per night, or 180 tons per year; in round numbers, \$1,000 per year for coal. One man can attend a 50-light plant and engine, and can be obtained at \$500 per year; carbons, 75 per night, or 27,000 per year, in round numbers, at \$16.50 per 1,000, \$450; oil, brushes,

segments, etc., at \$100; collection of income and breakage, \$200; total, \$2,250 per year. The income, at 25 cents per night per light, is \$12.50 per night, or \$4,500 per year, in round numbers. Suppose plant to cost, set up, \$9,000, and take 10 per cent. off the above revenue for the depreciation in the value of the plant, we have \$1,350 left, or a 15 per cent. dividend. As to the use in mills the following example applies: The machinery for two mills (each using a machine and four lamps) cost \$1,400, set up. They run all night, and therefore consume 24 carbons per night, or about 8,000 carbons per year, at \$16 per 1,000, \$128 per year. Suppose the breakage and wear and tear to amount to \$72 per year, the total yearly expenses amounts to \$200, considering the power and attendance after. The coal oil for these mills cost \$400 per year; saving in insurance, \$80 per year. Total saving is \$480 per year. This, then, leaves \$280 to pay for power, interest and attendance. The power costs nothing, as they use water and have an abundance; and the attendance is less than it was for coal oil, as the machine-man attends to the electric lamps at no extra cost.

NOTE.—The author showed examples of the various lamps, and showed illustrations and explained the working of the various machines.

EXHIBIT OF INSTRUMENTS.

Mr. Ogilvie, of Ottawa, exhibited and described :

1. A Lugeol Micrometer Telescope, such as is now being used in the Traverse Surveys in the North-West Territories (see his paper on this telescope in this volume of Proceedings, also page 54 of Proceedings of 1886), which is simply a portable Heliometer.

2. A small German "universal" instrument of good design and very finely finished. Its telescope is in the position of the telescope axis of ordinary instruments, and at right angles to the line sighted. The line of sight is reflected at right angles by a mirror placed in front of the object glass. Focal length $4\frac{3}{4}$ inches. Notwithstanding short focal length, this instrument defined sharply and clearly, and is credited with reading to 15". "A complete epitome of an observatory."

Mr. Burke, of Ingersoll, exhibited a "Gurley Mountain Transit," with extension tripod. This allows legs of tripod to be shortened to nearly half the usual length, convenient for "portaging." This instrument is compact, light, convenient to use, and substantial.

Mr. Speight, of Toronto, exhibited an Anster Polar Planimeter. An instrument for measuring areas of plats. This instrument is of German make. The area is integrated and added up by the machine, the result being read off the measuring wheels.

Mr. Butler, of Napanee, exhibited a Polar Planimeter, of which he and Mr. Fessenden are joint inventors. The tracer is constructed to follow the curve of a parabola of special dimensions. Some theoretical advantages are claimed for their instruments by the inventors, the revolving wheel being much larger than the wheel in Anster's (see page 54, Proceedings 1886).

Mr. Sankey, of Toronto, exhibited a "Mechanical Traverse Table," recently patented. This instrument may be set to any required course, when the latitude and departure of that course may be at once read off. The instrument shown has the circle divided to quarter degrees and the distance, latitude and departure scales divided to 20 to the inch. This instrument was manufactured for Mr. Sankey by Mr. Foster.

Mr. Chipman, of Brockville, exhibited a Compass of "ye olden tyme," the one used by R. Sherwood, D.P.S., on the Crown Surveys in the Counties of Leeds, Grenville, Carleton, Lanark and Frontenac, between 1790 and 1820, and had, no doubt, seen many "squibby" days.

Mr. Cook, of Brockville, exhibited :

1. A peculiar instrument, what American makers might call a Mining Surveyor's Transit. This instrument, said to be 200 years old, attracted considerable attention from its peculiar construction. The standard is in the form of a segment of a circle, greater than a semi-circle, with centre above the compass box, and the plane of this circle being about $1\frac{1}{4}$ inches on one side of vertical centre of instrument. The telescope is rigidly attached by an arm which is centred at the centre of the circular segment, and telescope is then depressed or elevated by a cogged pinion working into cogs, the circumference of above described standard. The telescope could only look one way without reversing 180° in azimuth; but could be directed vertically, and was furnished at each end by sight vanes which were probably more used than the telescope. The horizontal plates were also moved by rack and pinion motions. This instrument was manufactured by Heath and Wing, but no date.

2. Small nautical sextant.

3. Clinometer.

Professor Galbraith exhibited :

1. Mountain Transit, manufactured by Gurley, with solar attachment, and shifting tripod head.

2. Lugeol Micrometer, mounted on a tripod, with ball and socket joint, and vertical and horizontal axes.

3. Nautical Sextant, 8" arc.

Mr. Abrey, P.L.S., of this city, exhibited a number of instruments, and described those of exceptional or novel construction; the following may be mentioned :

1. A 6-inch Reiterating Transit, made by Troughton and Sims, designed for and imported by the Dominion Government, for use in the standard line surveys in the North-West Territories. The instrument stands on three levelling screws covering a broad base, and attached to a framed tripod stand. The circle is read by three equidistant verniers to $0^\circ.004$ (decimally divided). The telescope has $1\frac{1}{2}$ inch clear aperture, and is sufficient for observations of *Polaris* while the sun is several hours high. Several eye-pieces, ranging from 12 to 60 diameter, are provided. Striding and plate levels are divided and read to about 10". The vertical finding circle is attached to the axis of telescope, and does not connect with the standards. The instrument is found to meet all of its requirements in an efficient manner.

2. A Goniometer for horizontal angles, made by Young & Sons. This instrument has two telescopes which may be set to any angle with each other, they have each of them their axis vertically over the spindle of the instrument. It is a strong, handy instrument for most kinds of work.

3. A Goniometer for horizontal angles only, made by Troughton and Sims for the Trigonometrical Survey of Great Britain; the limb

is 12 inches, read by three verniers to 10", the telescope is of 20 inches focal length, the centre is of steel. The lower limb has an endless screw motion for setting to zero, the standards are short and telescope does not transit but may be reversed in the Y standards.

4. A Burt Solar Compass of the ordinary pattern, made by Gurley.

5. A Theodolite Solar Compass. This was originally an English Cradle Theodolite 5" limb. Mr. Charles Potter, of this city, under directions from its owner, changed it to as now shown. It has compass sights attached to the lower plate made adjustable to the zero line of the solar. Besides the ordinary four levelling screws it has a ball and socket quick levelling motion, and is mounted on a tripod having its legs adjustable for length. The solar is attached to the cross axis in a manner somewhat similar to that known as Pearson's patent, and consists of a bar having a lens of about 6 inches focal length at one end, and a mirror at the focal distance. This bar moves on its declination axis over an arc both sides of zero, with clamp and tangent attachment. The latitude is laid off on the vertical arc of the theodolite, most of its parts are adjustable with striding levels, and when used as a solar the theodolite telescope, with its Y bar holder, may be removed. A 5-inch needle and variation plate is added. The instrument complete weighs about half as much as the Burt solar above.

6. A German Alt-Azimuth, or universal instrument, made by Extel & Sons, of Munich. This instrument has a 10-inch horizontal circle, divided by four verniers to 10", an altitude finding circle reading to single minutes. The instrument has a vernier on each of the standards to read the circle when reversed in its Y bearings. The telescope is of the prismatic form, viz., the object end half is at right angles to the cross axis at its centre, while the other half coincides with the cross axis itself, the incident rays being bent by a prismatic reflector placed in the centre of the cross axis. The axes, all of them, are of steel. The weight of the upper portion being partly borne by a spring attachment at the spindle to prevent wearing of the centres, and give smooth motion in use. The instrument is adjusted by a very sensitive striding cross axis level. The telescope transits and may be reversed in its Y bearings. It is precisely balanced by adjustable counterpoises. The standards being very low the instrument has a very solid and rigid appearance. The instrument stands on three levelling screws with micrometer heads, is of very broad base, and is not intended to attach to a tripod stand, but merely to rest on the same. The workmanship is of the very highest class.

7. A transit made principally of aluminium, having a horizontal circle of about $6\frac{3}{4}$ inches, read to 10" by two double opposite verniers. The instrument is attached to a framed tripod, and shifts for position over a point. The vertical circle of 5 inches is read by two double opposite verniers to 20", and it, with all its attachments, are connected with the cross-axis and entirely disconnected from the standards. The telescope reverses on its Y standards;

micrometer or gradientor attachment to axis of telescope for measuring distances. Alidade level, divided to read 10", is attached to vernier of vertical circle. Striding level to cross-axis, and striding level instead of attached level to tube of telescope, both reading to 10". This arrangement of tube-level gives great convenience in adjustment of horizontal wire of telescope; telescope of about 11 inches focal length, and $1\frac{3}{8}$ inch clear aperture, the whole instrument weighing about eight pounds. There is attachable to this instrument a Lyman Patent Solar, but which the owner has not, for various reasons, found satisfactory. The instrument was made by Young & Sons for the owner. The owner has recently had constructed for him by James Foster a second telescope of similar dimensions to the above for use instead of it, and may be placed in the same Y bearings, and the same vertical circle, gradientor, striding levels may be attached. It consists of the telescope proper, adjustable for focus at the eye end. In front of the object-glass is placed a small mirror, which may be revolved on its axis, placed at right angles to the collimation. To this axis is attached an arm, carrying a vernier moving on an arc attached to the tube of the telescope, and reading to 20'. At the eye end behind the eye-piece, and attached to it, is an excentric disc, having three openings in it; one of these holes is left open, the second one has a dark glass inserted, and the third has a $\frac{1}{4}$ -inch prism attached for right-angled sighting. By revolving this disc either of the three openings may be brought before the eye lens. The telescope has two cylindrical rings on the tube similar to a Y level. A cross-axis was made to fit the standards of the instrument, and this telescope, having a large ring cast in its centre, with bar and Y's like the level attached, the cross-axis with ring and Y bar being cast in one piece, the Y's for the telescope tube being adjustable laterally, so that the telescope may be placed at right angles to the cross-axis and in the centre over the spindle. The telescope, when in place, occupies the centre of the cross-axis, so as to be symmetrical, and eliminate parallax in vertical angles, as well as horizontal angles. The faces of the ring in the cross-axis are graduated for hour angles, and time is read by an index attached to the telescope. This telescope transits at its eye end. It is provided with a long, diagonal eye-piece, and with the aid of this, in connection with the reflector, the telescope may be placed in a vertical position, and most of its adjustments, both ordinary and equatorial, may be effected with the telescope in a vertical position. The number of the solar adjustments is fewer by this arrangement than by any other solar arrangement yet adopted, owing to its being neither an attachment nor a combination instrument. In use the full power of the instrument is obtained, as the sun, for solar observations, is viewed at the principal focus, the cross wires being arranged to observe the centre of the sun's disc always. Two distinct pairs of observations may be taken; the mean of either pair should be the true meridian. The weight of the instrument, when mounted with this equatorial telescope, is not so heavy as an ordinary Burt Solar Compass, and, of course, it may be used for ordinary transit or for solar work. A small guider,

weighing about $\frac{1}{2}$ of an ounce, is attached to the solar part for approximately placing in the meridian.

8. A small telescope of similar construction to that described above, which may be attached to the telescope of any transit, for solar use. It is as simple and light as any other attachment now in use.

9. A Nautical Sextant (8 inches), of best English make.

10. A Box Sextant, with supplementary arc for large angles.

11. A Clinometer, used in slope measurements in the Dominion surveys.

12. A Pocket Lever Chronometer, made by Frodsham, one of the two used by our department on the United States boundary survey, and is a very excellent instrument.

13. A Three-Arm Protractor, or station pointer, for office work.

14. A German silver 12-inch Micrometer scale of equal parts, graduated to 40 to the inch, and read by a vernier to 400 to the inch.

15. A Pocket Barometer for hypsometrical work.

16. A Spirit Pocket Thermometer.

17. A Rod Level.

18. A Lyman Trigonometer or Protractor, made by Heller & Brightly. This instrument is semi-circular, and reads by a vernier to single minutes. It has a steel arm 36 inches long; has clamp and tangent for setting, and an arrangement for setting to zero on any desired line. The instrument may be used as a parallel ruler, a T square or a protractor, and is first-class in each respect. It has a base-bar, square, 12-inch triangular scale of German silver, spring attachments and clamps in connection.

19. A Cleaver Protractor, made by Young & Sons. This is a circular protractor, with a square frame revolving about it. The instrument may be placed on the drawing in any convenient position, then, after adjusting its zero to the zero of the drawing, the centre or circular part is clamped to the drawing by loosening four spring pins. The circle reads by a vernier to single minutes, and courses may be drawn on any part of the plot by aid of a parallel ruler, by simply placing one edge of the ruler in contact with one of the sides of the square frame of the protractor, laying off the desired course on the circle, and transferring the same to its place on the drawing, and so on without removal of the instrument. It is equal to the best English protractor in all respects, and with the advantage of enabling the plotter to transfer each course when laid off at once to its place, instead of having to prick off all the courses first, then remove the protractor and draw in the courses afterwards.

20. An English Circular Protractor on silver, reading to single minutes.

21. And some other instruments.

MR. POTTER'S EXHIBIT.

Mr. Charles Potter, mathematical instrument maker, of this city, exhibited about \$2,000 in value of instruments, consisting of the following :

Two complete Transit Theodolites (6 inches), both circles reading to 20"; striding, cross-axis levels, diagonals, etc.; heavy, strong, and very complete; English pattern.

One complete Transit Theodolite, 5", reading to single minutes.

One Cradle Theodolite, 5 inches.

Y Levels, 14 inches to 20 inches.

Dumpy Levels, 10 inches to 16 inches.

Exploring Levels.

Drainage Levels.

Three Surveyors' Compasses, 4 inches, 5 inches, 6 inches.

Box Sextant, divided, on silver.

Prismatic Compass.

Aneroid Barometers for hypsometrical work.

Levelling Staves, painted divisions; English pattern.

Steel and iron chains, feet and links, of various lengths.

Chesterman's steel bands and tapes—a variety.

Rochon Micrometer Telescope.

Drawing instruments, separate and in cases.

Miner's Dip Compass.

Rolling parallel rulers of German silver, brass and ebony; straight-edges of steel, brass, nickel and wood.

T squares of wood.

Protractors of German silver, brass, rubber, horn, ivory and boxwood.

Mariner's Compass, with telescope.

French curves and set-squares of rubber and wood.

Arnsler Polar Planimeter, similar to the one described in this volume.

Field and marine glasses in variety.

Telescopes, astronomical and others, with other field and office outfit.

MR. FOSTER'S EXHIBIT.

Mr. James Foster, mathematical instrument maker, of this city, exhibited some \$1,600 in value of instruments, consisting of the following:

One complete 5-inch Transit Theodolite, English pattern, with two verniers to horizontal and vertical limbs, reading to single minutes; level on telescope, etc.

One plain 5-inch Transit, American pattern.

One Y Level, 18 inches.

One Dumpy Level, 14 inches.

One " " 12 inches.

One Drainage Level.

One Planimeter of the Butler & Fessenden pattern, and described by Mr. Butler above.

Two Aneroid Barometers, arranged for hypsometrical work.

Four Surveyors' Compasses, with and without verniers, and of different sizes.

Several steel straight-edges, 24 inches, 36 inches, 48 inches, 60 inches, 72 inches.

Parallel rulers of brass, 18 inches and 24 inches, of superior construction.

Stanley's 12-inch divided scales.

Stanley's drawing instruments, separate and in cases.

Miners', or Dip-needle Compass.

Passometer.

Optical Square.

Reading Glasses.

Prismatic Compass.

Two very superior Binocular Field Glasses.

T squares, with steel blades.

Chesterman's steel bands, in links and feet of various lengths.

" tape-lines.

" steel chains, all usual lengths.

Levelling rods of English pattern.

A tripod constructed for the Dominion Government, for use with one of the large class of astronomical instruments now employed in the surveys in British Columbia.

A Mechanical Traverse Table Instrument, made for Mr. Sankey, and a quantity of other outfit for office and field use.

Mr. Timpson, of Toronto, one of the oldest mathematical instrument makers on this continent, and well known a generation ago, exhibited a 6" Ramsden Cradle Theodolite of ancient pattern.

THE MINTO PROVINCIAL DRAINAGE SCHEME.

The following are extracts from a circular issued by the promoters of this scheme to show its objects and the means of attaining them:

“The Local Government shall prepare a bill embodying the following clauses, viz. :

“1. All main leading outlets or discharges to be opened, improved and maintained by the municipalities with money borrowed from the Government at a rate of interest not exceeding $2\frac{1}{2}$ per cent. per annum, principal and interest payable in annual instalments, the time of payment extending over a term of twenty years, the said municipality to have the privilege of paying the amount so borrowed at the expiration of five years.

“2. The Government shall appoint one engineer to each county, whose duty it shall be to report to the Government from time to time the nature and extent of the work required to be done in his municipality, the said engineer to be empowered to employ assistance whenever necessary, all expenses connected with the engineering staff to be paid out of the funds set apart for that purpose by the Government. It shall also be required of the engineer that a quarterly report be prepared by him and presented to the township council, specifying the concession, name of owner and number of lot, from whom applications have been received, and the amount of valuation of the said improvements.

“3. Any landowner being disposed to locate surface or under-drains shall notify the engineer of his intention, who will prepare plans and specification of the proposed improvements, the landowner shall then proceed to execute the work, and upon its completion a final inspection to be made by the engineer who shall then report to the township council the true value of the work.

“4. The landowner shall then make a demand upon the Provincial Treasurer for the amount required, upon a form of application signed by the engineer and countersigned by the Warden of the County, the said loan to extend over a term of twenty years. Interest at $2\frac{1}{2}$ per cent. per annum, payable in annual instalments, with the privilege of liquidating the debt at the expiration of five years, payments to be made to the Township Treasurer each year, along with the other municipal taxes and subject to the same conditions.

“5. A Board of Arbitrators consisting of the engineer, Reeve of Township, and one appointed by the party interested in the improvements.”

The following is a summary of Mr. Dobson's address, referred to in the Minutes:

Mr. Dobson expressed his thanks to the Association for the invitation to be present at the meeting. He stated that there are in Ontario 115,200,000 acres of land, of which only 7,000,000 acres are under cultivation. In Germany the population is 200 to the square mile, in Belgium 440, in Ontario only 9, yet we are obliged to erect poorhouses. The Surveyors should know better than any one else the amounts of land available, and amounts unavailable, for cultivation, and they know the farmers' wants.

In regard to the method of raising the funds to carry on the proposed scheme, he stated that the Ontario Government has a surplus of six millions, of which one and one-half millions will be spent on new Parliament buildings. This will leave four and one-half millions, and it is proposed that this amount be handed over to the Dominion Government, who will authorize them to issue capital to the amount of sixteen millions on the banking system. This amount to be used for drainage purposes only, because agriculture is the root of the trade and commercial prosperity of a country. He then compared the cost of raising wheat in Ontario, India and Manitoba. In India it cost twenty-four cents to raise one bushel of wheat, in Manitoba seventy-two cents, and in Ontario ninety-eight cents.

In the scheme proposed the outlets of mains are to be opened and maintained by the municipality, and shall be under the superintendence of an engineer appointed by the Government. The present Drainage Act is too complicated. Boiled down to the very lowest degree it occupies some eighteen pages. If you place it in the hands of the average farmer he gets muddled in the reading of it.

Our main object is to place the whole matter in the hands of the farmers and the engineers, and take it out of the hands of the lawyers and judges. We propose to ask each of the councils in the counties of Ontario to send delegates, or to send a representative, to a convention to be held. We do not want them to send gentlemen who are officials or members of the councils, because they are generally men in easy circumstances, and would not take the same interest in these matters. But we would ask each township council to appoint a delegate to attend a meeting in Toronto for the purpose of considering this scheme, and of eliminating all errors from it. After the scheme has been revised by the farmers and engineers in the way proposed, a bill will be drafted, and will be sent to the Ontario Government with a petition.

In the financial part of the question we want your assistance. The Government would receive $2\frac{1}{2}$ per cent. for their money, whereas they are now receiving 5 per cent. We say that if you place the Government in the position of bankers, that is, if you regard them as holding the funds as a bank does, to make money out of them, then the 5 per cent. arrangement holds good; but if the Government is to be regarded as the trustees of the public, who hold the public funds for the good of the people, and for the good of the people only, then, we say, drainage will pay for itself in three years, and by adopting

the scheme the Government would be actually realizing 33 $\frac{1}{3}$ per cent. on the investment. It will reduce the financial forces of Ontario, of course, for a few years, but after the system has been freely working for a few years, and the people begin to see the benefit of it, the funds of the Province will assume a firmer tone, and when the land has been thoroughly drained, we have an unlimited field to the north of us where our surplus capital can be invested in mining.

We don't say that this movement is perfect. We are perfectly sensible of its imperfections. Still we hope that you may be able to devise ways and means whereby we can bring into cultivation our waste lands, and bring Ontario up to the standard which she ought to occupy.

The past history of drainage in Ontario is calculated to frighten the farmer from going into it.

If my time permitted me to go more into detail I might make the scheme a little plainer to you. We propose that the borrowers shall have the privilege of paying back the entire loan at the end of five years. We would prevent speculation. If I can borrow money at the rate of 2 $\frac{1}{2}$ per cent., I might be able to take it out and use it for other purposes, this would have to be prevented. The Township of Minto has, say, 500 lots, and say that there is an average of 10 acres on each lot requiring drainage. That would make 5,000 acres. Taking the average of \$30 per acre, that will make \$150,000 to drain it. That would keep 100 men, at a dollar a day, working for three years and four months. In this way the population can be retained in the country. The manufacturing industries are overstocked with labour, and something must be done to give our people employment in order to keep them in the country. I leave the matter in your hands.

DISCUSSION.

Mr. Aylesworth—You said it was your intention to ask the township councils to send delegates to a meeting to be held in Toronto, where a petition will be drafted. Have you any idea of getting that done for this session?

Mr. Dobson—This is a gigantic scheme. I have been engaged for three or four years in it. It will take time to bring it to completion. I hardly think it possible that we should have this convention in time for this session. We propose, in the coming summer, to invite a delegate from each division, along with as many of the engineers as possible, to draft the skeleton of a Bill, which can be circulated among the farmers, so as to let them see what we are asking the Legislature to do. This convention will be held at a time possibly to be determined by yourselves, because the Executive Committee have come to the conclusion that the only way to do is to place it in your hands. We look to you as taking the initiative in the matter. I have already explained the difficulty that we find from these men who hold positions in the township and county councils. We would suggest that the meeting should be held this summer.

Moved by M. J. Butler, seconded by A. Niven, "That this Association does not feel called on at present to express an opinion on

the Minto Provincial Drainage Scheme, as we have not had sufficient time to consider it; and we beg to return our best thanks to Mr. Dobson for the information furnished us."

Mr. Butler remarked, in speaking to the motion, that the subject was of such magnitude as to require years of consideration and thought. It would be premature to take any steps with regard to it now.

Mr. Chipman—I would suggest to the secretary of the scheme that it would be a good idea to have these circulars distributed among members of the Association.

Mr. Aylesworth—I think that the thanks of the meeting are due to the speaker for the ideas he has given us in the direction of placing the agricultural interests of the Province in the position they ought to occupy. There are the interests of the land surveyors also to be considered as well.

Mr. Stewart—I have endeavoured to understand, as far as possible, the ideas that he has presented. He speaks of the present Drainage Act being complicated. I do not know how anything can be made less complicated than the Drainage Act to contain all the necessary points. I cannot understand why the surplus of the Province should be placed in the hands of the Dominion in the way he proposes. It seems to me that the guarantee of the Provincial Government would be all that was necessary, without interfering with the surplus.

Mr. Stephens—I would like to know if we have any means of ascertaining what the surplus really is. (Laughter.)

The Chairman put Mr. Butler's motion, which was carried unanimously.

BOUNDARY COMMISSIONERS.

Moved by William Ogilvie, seconded by G. B. Abrey, "That the draft of the bill attached to this motion, respecting the appointment of Boundary Commissioners, be referred to the Legislative Committee, and a copy of this draft be embodied in the Annual Report for the consideration of the members of the Association, in order to a thorough discussion of the matter at the next annual meeting."—Carried.

March 3, 1887.

G. BELL.

The Lieutenant-Governor shall appoint in each county in the Province a Provincial Land Surveyor, who shall be styled and known as "Boundary Commissioner," for the county to which he has been so appointed.

The duties of these Boundary Commissioners shall be as hereinafter set forth in this Act.

They shall retain office during life, unless they have been guilty of gross inattention to their duties, or of gross partiality in their decisions in cases submitted to them.

When any Boundary Commissioner shall have been guilty of gross inattention to the duties of his office, or of marked partiality in deciding any case submitted to him as hereinafter provided, the party or parties injured by such misconduct may, within three months of the time of the discovery of such misconduct, notify the County Judge of the county in which such misconduct has been committed, and petition him to investigate the charges formulated in such petition against said Boundary Commissioner.

The County Judge shall within three months of the time of receiving such notice, summon before him at a time and place to be plainly set forth in such summons, the Boundary Commissioner so accused, and his accusers, for the trial of such charges, and shall issue summonses for the appearance before him of witnesses to be heard in the trial.

If the County Judge finds that the charges have been sustained, he shall report the fact to the Lieutenant-Governor, who shall at once dismiss such Boundary Commissioner from his office, and appoint another Provincial Land Surveyor to the office thus made vacant.

When the office of Boundary Commissioner in any county becomes vacant by the death of the incumbent of said office, the judge of the county in which such vacancy occurs shall report the fact, duly attested by the certificate of a legally qualified medical practitioner, to the Lieutenant-Governor, who shall, upon the receipt of such

notice and certificate, appoint another Provincial Land Surveyor to the vacant office.

Whenever the parties to any disputed boundary case, where such question is purely a question of survey, shall so agree, they may refer the adjustment of such disputed boundary to a Court of Arbitrators composed of three Boundary Commissioners appointed as aforesaid.

Each of the parties to such dispute shall choose one such Boundary Commissioner, and the County Judge of the county in which the disputed boundary is situate, shall appoint the third.

The arbitrators so chosen and appointed, shall, within days after receiving notice of their appointment to the said duty of arbitration, give ample notice to the parties to such disputed boundary, of their intention to proceed, on the day set forth in such notice, to the place of the boundary in dispute, and to adjudicate upon the case ; and the arbitrators shall, on the day appointed, proceed to the scene of the disputed boundary, and shall then examine all witnesses in the matter on the ground to which their evidence relates, and shall perform any operations, as surveyors which they may deem necessary to a proper understanding of the matter in hand.

Upon the completion of the examination of all evidence submitted to them in the case, and such measurements and operations as they may deem advisable, the arbitrators shall make their award in the case, and such award shall be final and binding on both parties to the dispute, except in the case of gross negligence or gross partiality, as hereinbefore provided for.

The Boundary Commissioners constituting the Court of Arbitration which has tried any case of disputed boundary, shall award the costs of such trial, and the proportion to be paid by each of the disputants, in a manner that shall be deemed just and equitable by the arbitrators.

Each Boundary Commissioner shall be entitled to the sum of dollars per day, together with travelling and living expenses, while engaged in the trial of any disputed boundary case submitted to them as hereinbefore set forth ; such fees and expenses to be a part of the costs of the trial, and to be paid as hereinbefore set forth.

Before proceeding to the trial of any suit or question submitted to them, the Commissioners, as above chosen, shall make an affidavit before the County Judge or before some Justice of the Peace, or Commissioner for taking legal affidavits, that he has not any personal interest in the suit at issue, and that he has not in any way been engaged professionally as a surveyor on it. Such affidavits to be filed along with the rest of the documents connected with the case, with the Clerk of the County Court of the county in which the dispute is located.

(Signed) W. OGILVIE.

NOTES.

The students of the School of Practical Science, attending the meeting of the second day, and, either from the interest taken in the proceedings or from fear of one of their professors, who was present, desisted from "hazing" or other college pastimes. Many of these graduates are now leading members of our Association.

The discussions, Mr. Dobson's address, and much of the article on Exhibit of Instruments are prepared from the stenographer's notes. Mr. Frost, of the *Globe*, was engaged to act as "our reporter" at the last meeting—the same gentleman who accompanied Mr. Bolger on his Rainy River explorations in 1886, and whose popular account of the trip has appeared in the *Globe* this winter.

ATTENDANCE AT THE SCHOOLS OF ENGINEERING IN CANADA—SESSION 1886-1887.

McGill University, Montreal—Department of Practical and Applied Science:—1st year, 19 students; 2nd year, 13 students; 3rd year, 13 students; 4th year, 8 students; partial, 4 students; total, 57.

Royal Military College, Kingston:—1st year, 24 students; 2nd year, 24 students; 3rd year, 15 students; 4th year, 8 students; total, 71.

School of Practical Science, Toronto:—1st year, 20 students; 2nd year, 18 students; 3rd year, 8 students; special students, 10; total, 56.

REPORT OF COMMITTEE ON LEGISLATION: A POSTSCRIPT.

The Committee on Legislation beg to report that at the request of your Association the Honourable the Commissioner of Crown Lands introduced and carried through the House all the amendments asked for in the "Act Respecting Land Surveyors and the Survey of Lands." The thanks of the Association are due to the honourable gentleman for his assistance. With regard to the amendments to the "Ditches and Water Courses Act," asked for by your Association, the three delegates from the Association, Messrs. Burke, Coleman, and Proudfoot, appeared twice before the Municipal Committee of the Legislative Assembly, and explained the proposed amendments. Delegates from the following Counties, on behalf of the Municipal Councils, were also present, viz.: Perth, Kent, Essex, Elgin, Lambton, and Welland, and after hearing the explanation of the engineers, were practically of the

same opinion as to the desirability of the proposed amendments. To Mr. Waters, M.P.P., the thanks of the Association are due for carrying through some of the proposed amendments in his Bill to amend the "Ditches and Water Courses Act, 1883." One important amendment failed to pass the Municipal Committee, viz.: that concerning a proposed Court of Appeal; the members of the Association interested in drainage are recommended to endeavour to devise some scheme which could be easily and inexpensively worked, as nearly all the delegates from municipal corporations were favourable to some such scheme. With regard to the proposed amendments to the Municipal Act, so far as relates to drainage, the arguments of the engineers must have failed to convince the Municipal Committee, as, with the exception of one almost unimportant amendment, none of the proposed changes were inserted in the "Act to Further Amend the Municipal Act," introduced and carried through by the Hon. A. Hardy.

Respectfully submitted,

GEORGE B. KIRKPATRICK,

Chairman of Committee on Legislation.

Toronto, May, 1887.



SAMUEL RIDOUT, DEPUTY SURVEYOR.

BIOGRAPHICAL SKETCH
OF
→❁ SAMUEL RIDOUT, ❁←
DEPUTY SURVEYOR.

By HIS SON, JOHN RIDOUT, Esq.,

TORONTO.

SAMUEL RIDOUT was born in the Town of Hancock, Maryland, on the 7th of September, 1778, and there received his education as land surveyor. In 1798 he came to Toronto, and held several appointments under Government. He was Deputy Clerk of the Crown in 1800, and chief clerk in the office of his father, Thomas Ridout, Surveyor-General from about 1802 until the year 1829. He was appointed Sheriff of the Home District in 1815, and held that office until the year 1827, when he was appointed Registrar of the County of York. He retained the office of Registrar until his death, which occurred in 1855.

He was appointed a Deputy Land Surveyor at an early date; was captain in the militia, and served in the War of 1812, at the close of which he was assigned the duty of conveying prisoners of war to Quebec. He was also appointed, in 1816, agent for the officers of the Land Granting Department, and in this connection received a pension from the year 1834. He owned and occupied for some time a farm on Yonge Street, now known as Summer Hill; also, park lot No. 4, now in the city, where he resided at the time of his death. He was twice married; two sons and one daughter survived him.

LIST OF MEMBERS.

ACTIVE MEMBERS.

NAME.	OCCUPATION.	ADDRESS.
Abrey, George Brockitt.....		31 King Street East, Toronto.
Apsey, John Fletcher.....		35 Elgin Avenue, Toronto.
Aylsworth, Charles Fraser.....		Madoc.
	Engineer for Village of Madoc, and Townships of Madoc and Rawdon.	
Aylsworth, Wm. Robert.....		Deseronto.
Baird, Alexander.....		Leamington
	Chief Engineer Leamington and St. Clair Railway, Engineer for the Townships of Mersea, Tilbury West, South Colchester, and Malden and Village of Leamington.	
Bazett, Edward.....		Midland.
Beatty, David.....		Parry Sound.
Beatty, Walter.....		Delta.
Bell, James Anthony.....		St. Thomas.
	City Engineer, St. Thomas.	
Berryman, Edgar.....		7 Place d'Armes Hill, Montreal.
	Chief Engineer Montreal and Sorel Railway, Engineer South Eastern Railway.	
Biggs, Jas. Morley Mowatt.....		Orillia.
	Sub-Assistant Engineer Welland Canal.	
Blake, Frank Lever.....		Toronto.
	Astronomical Assistant at Observatory.	
Bolger, Thos. Oliver.....		Belleville.
Bolger, Francis.....		Penetanguishene.
Bolton, Jesse Murray.....		Albion.
Bolton, Lewis.....		Listowel.
	Engineer for Townships of Wallace, Elma, Grey, Morris, Town of Listowel and Village of Drayton.	
Booth, Chas. Edward Stuart.....		Kingston.
Bowman, Cleming Derstine, Grad. S.P.Sc. (Toronto).....		West Montrose.
	Engineer for Townships of Woolwich, Peel and Nichol.	
Bowman, Herbert Joseph.....		Berlin.
Bowman, Isaac Lucius.....		Berlin.
	Engineer for Townships of Waterloo, Wilmot and Wellesley.	
Bray, Edgar.....		Oakville.
Browne, Harry John.....		17 Toronto Street, Toronto.
Browne, Wm. Albert.....		“ “ Toronto.
Burke, Wm. Robert.....		Ingersoll.
	Engineer for County of Oxford.	

132 ASSOCIATION OF PROVINCIAL LAND SURVEYORS.

NAME.	OCCUPATION.	ADDRESS.
Burt, Frederick Percy	Artist <i>Engineering News</i> .	New York City.
Butler, Matthew Jos., As. M. Inst. C.E. ; M. Am. Soc. C.E.	Chief Engineer N. T. and Q. Railway.	Napanee.
Byrne, Thomas		Sarnia.
Cadenhead, John Arbuthnot		Morris, Man.
Campbell, Archibald Wm.		St. Thomas.
Campbell, David Suter	Engineer for six Townships.	Mitchell.
Casgrain, Jos. Philip Bakey		198 Spadina Avenue, Toronto.
Cavana, Allan George	Engineer for Townships of and Mara Rama.	Orillia.
Chipman, Willis, B.A.Sc. (McGill)		Brockville.
Coad, Richard		Glencoe.
Coleman, Richard Herbert	Drainage Engineer, Canada Company.	Toronto.
Cooke, Richard P.	Contractor Welland Canal Enlargement.	Brockville.
Cozens, Joseph		Sault Ste. Marie.
Cromwell, Jos. Miller Oliver	Engineer for the County of Lanark and one Township.	Perth.
Davidson, Walter Stanley		Arkona.
Davis, Wm. Mahlon, Grad. Royal Military College	Town Engineer, Woodstock.	Woodstock.
Davis, John	City Engineer Guelph, Chief Engineer Guelph Junction Railway.	Guelph.
DeGursé, Joseph		Windsor
Dickson, James		Fenelon Falls.
Doupe, Joseph, C.E. (McGill)		7 Princess Street, Winnipeg, Man.
Drewry, Wm. Stewart		Belleville.
Duchesnay, E. Juchereau, B.Sc. (Laval)	Division Engineer, Canadian Pacific Railway.	Chapleau via Biscotasing.
Ellis, Henry Disney		74 St. Patrick Street, Toronto.
Esten, Henry Lionel		26 Adelaide Street, Toronto.
Evans, John Dunlop	Chief Engineer Central Ontario Railway.	Trenton.
Fawcett, Thomas, D.T.S.	Surveying Dominion Lands.	Gravenhurst.
Fitton, Chas. Edward		Orillia.
Foster, Frederick Lucas		176 Argyle Street, Toronto.
Fox, Edward	Chief Clerk of Patents, Crown Lands Department.	Toronto.
Furlonge, Wm. H.	Mining Engineer.	Port Arthur.

NAME.	OCCUPATION.	ADDRESS.
Galbraith, John, M.A. ; Assoc. M. Inst. C.E., D.T.S.	Professor of Civil Engineering, School of Practical Science.	Toronto.
Gardiner, Edward	Engineer for the County of Lincoln.	St. Catharines.
Gaviller, Maurice, C.E. (McGill)		Collingwood.
Gibson, Peter Silas, B.Sc., C.E. ; M. Sc. (Univ. of Mich.) . .	Engineer for Townships of York, Scarboro' and Etobicoke.	Willowdale.
Hanning, C. G., C.E. (T. C., Dublin, Ireland),		135 Bloor E., Toronto.
Henderson, Edward Eli		Wardsville.
Johnston, Wm. Oswald		Whitby.
Jones, John Henry	Engineer for the County of Lambton.	Sarnia.
Jones, Thomas Harry, B.A.Sc. (McGill)	Engineer for the Townships of Brantford, Burford and South Dumfries.	Brantford.
Keefer, Tho. Coltrin, M. Inst. C.E. ; Vice.-Pres. A. Soc. C.E. . .		Ottawa.
Kirk, Joseph	Ex-Engineer for the County of Perth, Engineer for the Township of Mornington.	Stratford.
Kirkpatrick, George Brownly	Chief Clerk Survey Branch, Department of Crown Lands.	Toronto.
Klotz, Otto Julius, D.T.S. ; C.E. (University of Michigan) . .	In charge of Astronomical Work British Columbia.	Preston.
Laird, James Stewart	Engineer for County of Essex and Townships of Rochester, Maidstone, Sandwich East, Anderdon, North Colchester and Gosfield.	Essex Centre.
Lawe, Henry		Dunnville.
Lendrum, Robt. Watt	Engineer for Townships of Lochiel and Hawkesbury.	Vankleek Hill.
Lumsden, Hugh David, M. Inst. C.E.	Engineer in charge of construction, Ontario and Quebec Railway.	Montreal.
McAree, John, D.T.S., (Grad. S.P.Sc.)		245 Parliament St., Toronto.
McDonell, Augustine		Chatham.
McGeorge, Wm. Graham	Engineer for County of Kent.	Chatham.
McGrandle, Hugh		Huntsville.
McKenna, John Joseph	Engineer for Township of Hibbert.	Dublin.
McNabb, John Chisholm	Chief Engineer Erie and Huron Railway.	Chatham.
Maddock, Junius Arthur		Lindsay.
Manigault, Wm. Mazyck	Engineer for Townships of Adelaide, Caradoc, East Williams and Town of Strathroy.	Strathroy.
Miles, Charles Falconer	Engineer for the Townships of Minto, Normandy, Carrick, Culross, Greenock, Brant, Arran and Bruce, and Town of Wingham.	Walkerton.

134 ASSOCIATION OF PROVINCIAL LAND SURVEYORS.

NAME.	OCCUPATION.	ADDRESS
Miller, Fred. F., Assoc. M. Inst. C.E., B.A.Sc. (McGill)		Napanee.
Moore, John McKenzie		London.
Murphy, Chas. Joseph	26 Adelaide Street East,	Toronto.
Niven, Alexander	Surveying base lines and meridians near Lake Temiscamingue.	Haliburton.
Ogilvie, William, D.T.S.	Astronomical work, British Columbia.	Ottawa.
Ord, Lewis Redmond	Assistant Engineer Algoma Branch C. P. R.	Thessalon.
Patten, Thadeus James		Little Current.
Proudfoot, Hume Blake, C.E. (University, Toronto)	Engineer for nine Townships.	Clinton.
Purvis, Frank	Engineer for Townships of Wilberforce, North Algoma and Bromley.	Eganville.
Reilly, William Robinson		Regina, N.-W.T.
Russell, Alexander Lord		Port Arthur.
Sanderson, Daniel Leavens		Courtice.
Sankey, Villiers	17 Toronto Street,	Toronto.
Scane, Thomas		Ridgetown.
Selby, Henry Walter	Engineer for Townships of Nottawasaga and Sunnidale.	Stayner.
Sewell, Henry DeQuincey, Assoc. M. Inst. C.E.		Port Arthur.
Smith, George	Engineer for the Townships of Ops, Eldon, Georgina, Thorah and Bexley, and Villages of Woodville, Cannington and Beaverton.	Beaverton.
Smith, Henry	Superintendent of Colonization Roads in Ontario.	Toronto.
Speight, Thomas Bailey		Toronto.
Sproatt, Charles, C.E.	City Engineer.	Toronto.
Stewart, Elihu		Collingwood.
Stephens, Haldane Hincks		Owen Sound.
Traynor, Isaac	Engineer for Townships of Egremont and Preston, and Village of Dundalk.	Dundalk.
Tyrrell, James Williams, Grad. S.P.Sc. (Toronto)	Last year at Meteorological work, Hudson's Strait.	Weston.
Unwin, Charles		Toronto.
Van Nostrand, Arthur Jabez		Toronto.
Vicars, John	Engineer for Township of Brock.	Cannington.

NAME.	OCCUPATION.	ADDRESS.
Warren, James	Engineer for Townships of East Wawanosh, Bruce, Greenock and Huron;	Kincardine.
Weatherald, Thomas	Engineer for the County of Huron.	Goderich.
Webb, Major Adam C.		Brighton.
Wheelock, Charles Richard		Orangeville.
Wickstead, Henry King, B.A.Sc. (McGill)	City Engineer, Port Arthur; Chief Engineer Port Arthur, Duluth and Western Railway.	Port Arthur.
Willson, Alfred	Chief Engineer Canada Company.	Toronto.
Wilson, Hugh		Mount Forest.
Yarnold, William Edward	Engineer for Townships of Reach, Mariposa, Scugog and Georgina.	Port Perry.

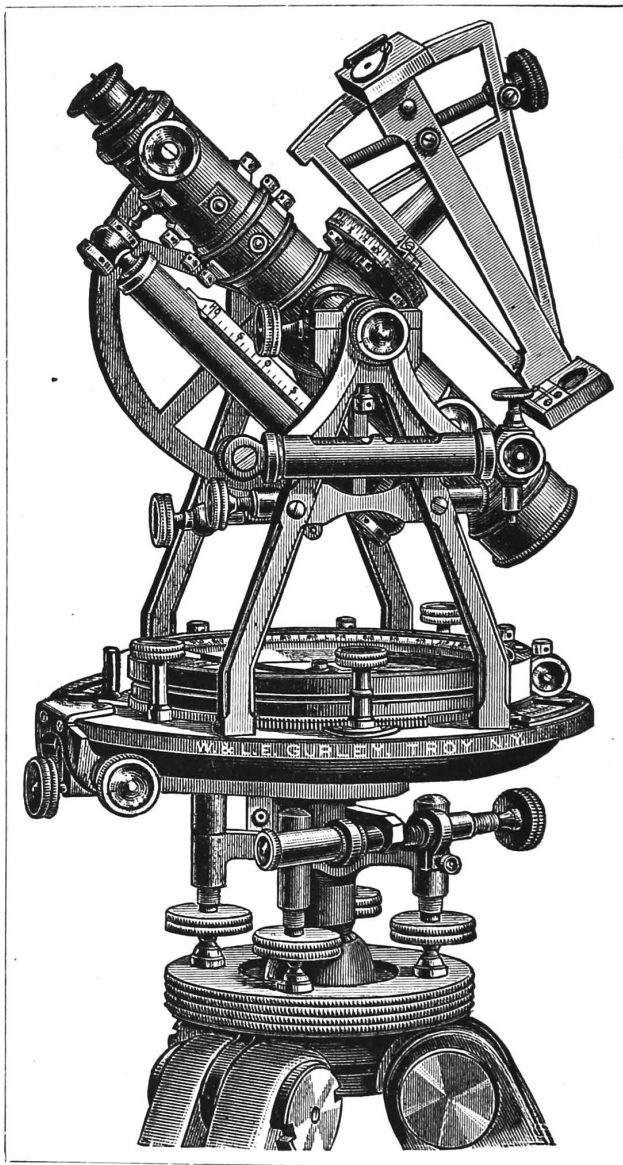
ASSOCIATE MEMBERS.

Rathbun, Edward Walter, jun.	Articled student with M. J. Butler.	Deseronto.
Sherman, Ruyter	Articled student with T. H. Jones.	Brantford.

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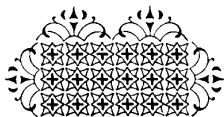
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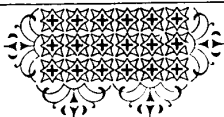
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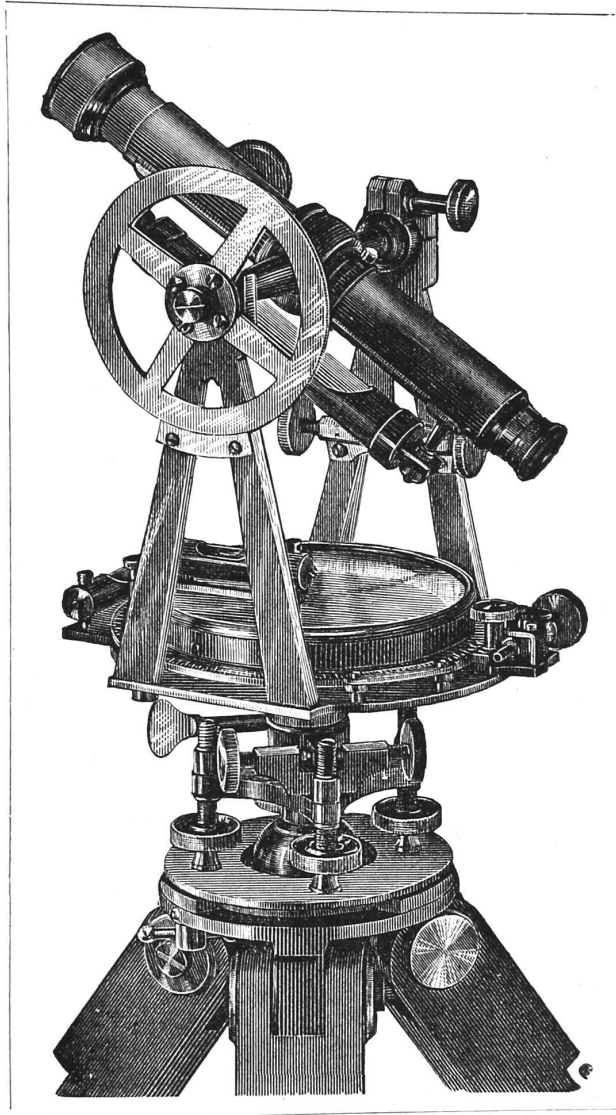
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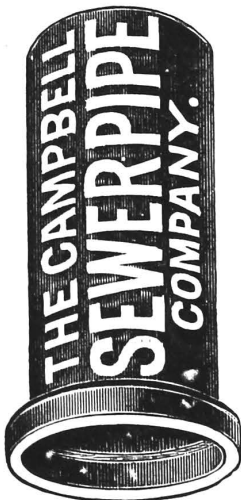
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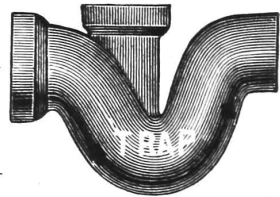
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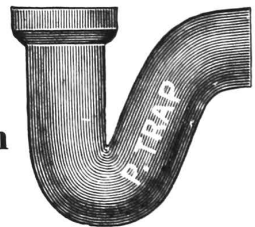
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OF ONTARIO,

AT ITS THIRD ANNUAL MEETING HELD AT TORONTO,
ON FEBRUARY 28TH, 29TH, AND MARCH 1ST,

1888.

*The Fourth Annual Meeting will be held in Toronto, on Tuesday,
26th of February, 1889.*

PRINTED FOR THE ASSOCIATION
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NOTICE.

Members are requested to carefully examine all advertisements, and to place orders for office or field supplies with our advertisers,

The Standing Committees should be assisted by all the members of the Association. These Committees are the life of the Association.

Each member is requested to add to his business card the following: "*Member of the Association of Provincial Land Surveyors of Ontario.*"

PREFACE.

To the Members of the Association of Provincial Land Surveyors of Ontario :

IN presenting the Proceedings of the Association at its Third Annual Meeting, held in Toronto, on February 28th, 29th, and March 1st, 1888, the Executive ventures to hope that it will be as kindly received by our members and our exchanges as the Proceedings of preceding years.

The papers printed will be found to contain much that is interesting and useful to the practical surveyor and the municipal engineer.

The "Question Drawer" is a feature that will, we think, meet with your approval.

Respectfully submitted,

EXECUTIVE COMMITTEE.

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ASSOCIATION OF
PROVINCIAL LAND SURVEYORS
OF ONTARIO.

ORGANIZED 23RD FEBRUARY, 1886.

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**Officers for 1888=89.**

---

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PUBLICATION.—T. B. Speight (Chairman); W. A. Browne, H. L. Esten, Prof. Galbraith, H. D. Ellis.

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---

CONSTITUTION AND BY-LAWS  
OF THE  
Association of Provincial Land Surveyors  
OF ONTARIO.

---

CONSTITUTION.

---

ARTICLE I.

NAME OF THE ASSOCIATION.

This Association shall be known as "The Association of Provincial Land Surveyors of Ontario."

ARTICLE II.

OBJECTS OF THE ASSOCIATION.

The objects of this Association shall be the promotion of the general interests, and elevation of the standard of the profession.

ARTICLE III.

MEMBERS.

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

2. Active Members must be Provincial Land Surveyors, and only such shall hold office and have power to vote.

3. Associate Members shall be those persons not Provincial Land Surveyors who may be elected as hereinafter provided.

4. Articled pupils may become Junior Members.

5. Honorary Members shall be those persons only who are distinguished by professional attainments. They shall be exempt from dues.

ARTICLE IV.

OFFICERS.

1. The Officers of the Association shall consist of a President, a Vice-President, a Secretary-Treasurer, and three Councillors, who shall constitute an Executive Committee, which shall have the direction and management of the affairs of the Association.

2. The meetings of the Executive Committee shall be held at the call of the President or Secretary-Treasurer.
3. The Executive Committee shall, as soon after its election as possible, strike the several Standing Committees.
4. Three members of any Committee shall form a quorum.

## ARTICLE V.

### ELECTION OF MEMBERS.

1. Any Provincial Land Surveyor shall be eligible as an Active Member of this Association upon payment of the necessary fees.
2. Candidates for election as Associate Members and Junior Members must make application in writing, and must be recommended by at least two Active Members.
3. Candidates for election as Honorary Members must be recommended by the Executive Committee.
4. All voting for Honorary, Associate and Junior Members shall be at a General Meeting of the Association.
5. A majority of the votes cast shall decide.

## ARTICLE VI.

### ELECTION OF OFFICERS.

1. The nomination of Officers shall be at the General Annual Meeting.
2. The voting for Officers shall be by letter ballot, which ballot will be issued by the Secretary-Treasurer to all Active Members on or before the 15th day of March in each year.
3. The ballots are to be returned to the Secretary-Treasurer on or before the 1st day of April in each year, and opened by him in the presence of one or more of the Scrutineers on or before the 15th day of April.
4. Candidates and retiring Officers are to be notified by the Secretary-Treasurer of the result of the elections.
5. The Secretary-Treasurer is to vote only in case of a tie.

## ARTICLE VII.

### MEETINGS.

1. The General Annual Meeting shall commence on the Fourth Tuesday in February, in the City of Toronto.
2. Special Meetings of the Association may be called by the President, and shall be called by him at the request, in writing, of ten or more Active Members.
3. The Secretary-Treasurer shall give at least one month's notice to all Members of any Special Meeting to be held.



4. Fifteen Active Members shall form a quorum at any meeting for the transaction of business.

## ARTICLE VIII.

### AMENDMENTS TO CONSTITUTION.

1. This Constitution may be amended by a two-thirds vote of the Active Members present at any General Annual Meeting.

2. Any such amendment must first be brought before the Executive Committee, and must be approved of by such Committee.

3. The Secretary-Treasurer shall give notice to all Members of all such proposed amendments approved of as above as soon as possible before the Annual Meeting.

## ARTICLE IX.

### AUDITORS AND SCRUTINEERS.

1. Two Auditors shall be appointed at each Annual Meeting to audit the accounts of the Association for the preceding year, and present their report of the same to the meeting.

2. Three Scrutineers shall be appointed at each Annual Meeting to examine the ballots for officers returned to the Secretary-Treasurer, and shall report the result of the election to the Association.

## ARTICLE X.

### SUBSCRIPTIONS.

1. The fee for membership for active members, associate members, and junior members, shall be three dollars, payable in advance.

2. The association year shall begin on the first day of April in each year, and annual subscriptions must be paid to Secretary-Treasurer on or before that date.

3. Any member twelve months in arrears shall be struck off the roll, and no member in arrears shall be allowed to vote.

---

# BY - LAWS

---

## ARTICLE I.

### ORDER OF BUSINESS.

1. Reading of minutes of previous meeting.
2. Reading of correspondence and accounts.
3. Reports and papers.
4. Unfinished business.
5. New business.
6. Nomination of officers (if at the General Annual Meeting).
7. Adjournment.

## ARTICLE II.

## RULES.

1. 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.
2. Reports of Committees must be in writing, and signed by the chairman thereof.
3. No member shall speak on any subject more than once, except the introducer of the subject, who shall be entitled to reply; every member, however, shall have the right to explain himself, subject to the discretion of the chair.
4. When a motion has been finally put to the meeting by the chairman all discussion thereon shall be closed.
5. The chairman shall appoint two Scrutineers when a ballot is taken.
6. Every member while speaking shall address the chair.
7. All voting at any General Annual Meeting shall be by standing vote, unless a ballot be demanded by at least two members.
8. Parliamentary rules to govern in all cases not provided for in preceding sections.

## ARTICLE III.

## DUTIES OF OFFICERS.

1. The President shall preside at all meetings at which he is present; in his absence the Vice-President; and in the absence of both the meeting shall appoint a chairman.
2. The presiding officer shall only have the casting vote, but not a deliberative one.
3. The Secretary-Treasurer shall keep an accurate record of all meetings, conduct all correspondence, announce all meetings, receive all fees and subscriptions and other moneys, pay no bills unless sanctioned by the Executive Committee and signed by their chairman, make annual report of all his receipts and disbursements, and shall perform such other duties as may from time to time be assigned him by the Executive Committee.

## ARTICLE IV.

## DUTIES OF STANDING COMMITTEES.

1. Each Standing Committee, appointed by the Executive Committee, shall endeavour to advance the interests of that branch of the profession allotted to it.
2. Meetings of any Standing Committee shall be held at the call of the chairman, three members to form a quorum.
3. Each Standing Committee shall present to the Association or to the Executive an Annual Report on the work done by said Committee.

PROGRAMME OF THE  
Association of Provincial Land Surveyors of Ontario

AT ITS THIRD ANNUAL MEETING, HELD IN TORONTO,  
FEBRUARY 28TH, 29TH, AND MARCH 1ST, 1888.

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PROGRAMME.

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

Meeting of the Executive Committee.  
Meeting of Standing Committees.

*Afternoon, 2 o'clock.*

Reading of minutes of previous meeting.  
Appointment of scrutineers of ballots.  
Reading of correspondence.  
Report of Secretary-Treasurer, Willis Chipman, B.A.Sc.  
Report of Scrutineers.  
President's Address, G. B. Kirkpatrick, P.L.S.  
Report of Committee on Land Surveying, V. Sankey, P.L.S.,  
Chairman.

*Evening, 8 o'clock.*

Paper—"Determination of the Meridian," Chas Carpmael, M.A.,  
F.R.A.S., Supt. Meteor. Observatory, Toronto.  
"Boundary Commissioners"—Discussion, led by G. B. Abrey,  
P.L.S.  
Question Drawer—Land Surveying.

*Wednesday, February 29th—Morning, 9.30 o'clock.*

Report of Committee on Engineering, M. J. Butler, M.A., Soc.  
C.E., Chairman.  
Paper—"Local Improvements," W. M. Davis, C.E.  
Paper—"Highway Bridges," A. W. Campbell, P.L.S.  
Paper—"Notes on Hydraulics," Prof. Galbraith.

*Afternoon, 2 o'clock.*

Election of Associate Members.  
Report of Committee on Drainage, W. R. Burke, P.L.S., Chairman.

Question Drawer—Drainage.

Paper—"Drainage."

Paper—"Practical Surveying," Alex. Niven, P.L.S.

Report of Auditors.

*Evening, 8.30 o'clock.*

Annual dinner at the Walker House.

*Thursday, March 1st—Morning, 10 o'clock.*

Report of Committee on Legislation, E. Stewart, P.L.S., Chairman.

Question Drawer—Legislation.

Report of Committee on Publication, J. McAree, D.T.S., Chairman.

Report of Committee on Instruments. G. B. Abrey, P.L.S., Chairman.

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

Question Drawer—Instruments.

*Afternoon, 2 o'clock.*

Discussion of Papers in former Reports.

Unfinished business.

Nomination of officers.

New business.

Adjournment.

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Full discussion after each paper and each report.

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EXHIBIT.—During the meeting there will be held an exhibition of "*Instruments for taking Linear Measurements*," and also "*Office Instruments and Appliances*," including draughting instruments, drawing papers, field books, field notes, etc., etc.

Each member is requested to add something to this exhibit.

ASSOCIATION OF  
PROVINCIAL LAND SURVEYORS  
OF ONTARIO.

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MINUTES OF THE THIRD ANNUAL MEETING.  
FEBRUARY 28TH, 29TH, AND MARCH 1ST, 1888.

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The Association met at 2 p.m. on February 28th in the Canadian Institute, the rooms at Shaftesbury Hall, where the meeting was first advertised to be held, being engaged for other purposes.

The Association was called to order by the President.

Moved by Willis Chipman, seconded by Thomas Fawcett : That the minutes of the last meeting, as printed in the Proceedings, be taken as read. Carried.

H. D. Ellis and John McAree were appointed Scrutineers to examine the ballots for officers for 1887-88.

The Secretary-Treasurer, Mr. Chipman, then presented his report.

Moved by Mr. Chipman, seconded by Mr. Sankey : That the report of the Secretary-Treasurer be received and adopted, and the statement of accounts be placed in the hands of the auditors. Carried.

Report of Scrutineers was then presented.

The President then read his annual address.

Mr. Sankey presented report of Committee on Land Surveying.

Moved by Mr. Sankey, seconded by Mr. Niven : That the report be adopted. Carried.

Mr. Sankey read letter from J. G. Scott, Esq., Osgoode Hall, respecting registered plans.

The President also read a letter from Jos. Cozens, Esq., P.L.S., of Sault Ste. Marie, on the same subject. (See Appendix.)

Moved by V. Sankey, seconded by A. Niven : That the President nominate a Committee to report on the points referred to in report of Land Surveyor's Committee and Mr. Scott's letter. Carried.

The President, in accordance with the above, nominated Messrs. Sankey, T. H. Jones, and Speight.

Moved by H. W. Selby, seconded by C. F. Miles: That Messrs. Gaviller and Fitton be a Committee to draft necessary resolution respecting death of H. H. Stephens. Carried.

Association adjourned.

#### EVENING SESSION, 8 P.M.

President in the Chair.

Prof. Carpmael read his paper on "Determination of the Meridian."

A vote of thanks was tendered Prof. Carpmael.

Moved by V. Sankey, seconded by A. Niven: That a Committee be appointed to consider the advisability of having such tables as those in Prof. Carpmael's paper made a permanent feature of our Annual Report, together with the cost thereof. Carried.

Moved by Prof. Galbraith, seconded by Mr. Gibson: That a Committee, consisting of Messrs. McAree, Fawcett, Abrey, and Galbraith, with power to add to their number, be appointed to confer with Prof. Carpmael in the preparation of Azimuth Tables; this Committee to continue in office until the publication of the tables. Carried.

President then called on Mr. Abrey to lead discussion in "Boundary Commissioners."

Moved by A. Niven, seconded by V. Sankey: That a Committee be appointed, with power to add to their number, to consider the draft bill of Mr. Ogilvie's, *re* "Boundary Commissioners," and report on bill at the next annual meeting. Carried.

The President nominated Messrs. Sankey, convener, Aylesworth, Niven, Dickson and Stewart.

Association adjourned at 11.30 p.m.

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#### WEDNESDAY, FEBRUARY 29TH, 9.30 A.M.

President in the Chair.

Questions on Land Surveying in Question Drawer were then taken up and discussed.

Moved by W. Chipman, seconded by P. Burnet: That in the opinion of this Association the centre of posts of fence should be placed on the true line between lots. Lost.

Moved by Mr. Sankey, seconded by Mr. McAree: Moved as amendment, that in the opinion of this meeting the line of a fence be the line between the posts and boards. Carried.

President called for report of Committee on Engineering.

Mr. Galbraith explained that concerning the engineers' report Mr. Butler was chairman of the committee last year, and said he had the responsibility of preparing it. I understood that Mr. Davis was bringing in the report, and I gave it no further thought. The report is very much like it was last year. Our real work is contained in the papers, and that is really all that can be expected.

The different exhibits were then described by the exhibitors.

Mr. W. M. Davis being absent, it was moved by Mr. Aylesworth, seconded by Mr. Evans: That the paper of Mr. W. M. Davis, on "Local Improvements," be taken as read, and be printed in the Proceedings. Carried.

Mr. Abrey read paper on the "Planimeter," illustrated by diagrams.

Moved by Mr. Fawcett, seconded by Prof. Galbraith: That a vote of thanks be tendered Mr. Abrey for his paper. Carried.

Mr. A. W. Campbell then read his paper on "Highway Bridges."

Moved by Mr. Galbraith, seconded by Mr. Gibson: That the thanks of the Association be tendered to Mr. Campbell for his valuable paper. Carried.

Prof. Galbraith then read a paper entitled "Notes on Hydraulics," illustrated with diagrams on blackboard.

Moved by Mr. Gibson, seconded by Mr. McAree: That a vote of thanks be tendered Prof. Galbraith for his paper. Carried.

#### AFTERNOON SESSION, 2 P.M.

President in the Chair.

Proposed amendments to the Constitution and By-laws, prepared by the Executive Committee, were read by Secretary.

Moved by Mr. Chipman, seconded by Mr. Burnet: That the Executive Committee be and are hereby empowered to submit a draft of the proposed amendments to the members of the Association, and that members be requested to vote on said amendments when ballot for officers is taken. Carried.

Report of Committee on Drainage was presented by Mr. Proudfoot, in the absence of Mr. Burke.

Moved by Mr. Proudfoot, seconded by Mr. Kirk: That the Report of Committee on Drainage be received and adopted. Carried.

Mr. Proudfoot then presented paper on "Court Decisions," prepared by Mr. Burke and Mr. Proudfoot.

Moved by Mr. Abrey, seconded by Mr. Gibson: That paper on "Court Decisions" be considered as read, and that it be printed in Proceedings. Carried.

Mr. Niven then read his paper on "Practical Surveying."

Vote of thanks was tendered Mr. Niven.

Report of Auditors was then received and adopted.

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THURSDAY, MARCH 1ST, 10 A.M.

President in the Chair.

The President read a letter from the Canadian Institute, signed by David Boyle, desiring to co-operate with this Association for the purpose of procuring specimens for the Archæological Museum. (See Appendix.)

Mr. Dickson remarked as follows: With regard to the letter about this Archæological Institution, he thought the idea a good one. He believed that every surveyor should be ready to contribute relics or collections he may find. He had made several collections in the past thirty years, and had always intended to present them to such an Institution.

Moved by Mr. Dickson, seconded by Mr. Stewart: That the Executive Committee be empowered to send a list of members of this Association to the clerks of the different municipalities in the Province. Carried.

Resolution of condolence respecting death of H. H. Stephens, prepared by Messrs. W. Gaviller and Fitton, was submitted.

Mr. Stewart stated he would not like to let the occasion pass without saying a few words with regard to Mr. Stevens. He had not much personal acquaintance with the deceased, but was very well acquainted with his family from whom he understood his death was caused by reason of his devotion to his profession. He believed the illness from which he died was contracted from hard work on surveys in the North-West. He had much pleasure in supporting the resolution, and would suggest that the Secretary be asked to send copies of this resolution to his widow and father.

Resolution was then adopted, and copies ordered sent to family of deceased.

The Report of Committee on Legislation was read by Mr. Stewart.

Moved by Mr. Stewart, seconded by Mr. McAree: That the Report be received and adopted. Carried.

Questions on Legislation in Question Drawer were then taken up.

Mr. McAree read the Report of the Publication Committee. Moved by Mr. McAree, seconded by Mr. Chipman: That it be adopted. Carried.



Mr. Abrey read a paper on Instruments. He remarked that as all other professions have their libraries, and as the surveying profession has nothing at all in that line some means should be considered with a view to meeting the exigencies of the case.

Mr. McAree moved, seconded by Mr. Niven: That it be referred back to the Committee for revision if necessary with a view to having it published. Carried.

Committee on Entertainment reserved report, but would report to Executive before proceedings were printed.

Mr. Abrey remarked: He thought that some suitable entertainment should be provided for the wives of surveyors when they accompany their husbands to the city, in the nature of a concert or conversazione, and this could take the place or be held in addition to the Annual Supper. The wife of a surveyor is as a rule isolated from the society of her husband a great deal of her time in consequence of his professional duties calling him away from home. He thought in view of this fact that the matter should have every consideration, and those members who had no wives could bring their sisters or friends if they chose.

Mr. Kirkpatrick said: The room upstairs will be opened in afternoon, and I should like all the surveyors to visit and look at the Indian relics to be placed in the proposed new Archæological Museum. I think the collection of specimens for this Institution is a laudable, interesting and instructing object, and I should like all our members to contribute to it.

Questions on Instruments in Question Drawer were then taken up and discussed.

Moved by Mr. Abrey, seconded by Mr. McAree: That answers of Prof. Carpmael and Mr. King to Question 4 be published in the Report. Carried.

#### AFTERNOON SESSION, 2 P.M.

President in the Chair.

Moved by Mr. Gaviller, seconded by B. J. Saunders: That this Association desires to convey to Mr. F. J. Sager, of Marysville, Ohio, their thanks in sending an exhibit of band chains to our meeting. Carried.

Moved by Mr. Abrey, seconded by Mr. Niven: That a committee be appointed with full powers to secure and publish the paper of Mr. Tyrrell on travels of David Thompson, under Mr. Tyrrell's permission. Carried.

Moved by Mr. Sankey, seconded by Mr. McAree: That a copy of the Sub-Committee's report on registered plans be sent to each registrar of the Province to show what this meeting thinks necessary on registered plans.

Moved by Mr. Niven, seconded by Mr. Abrey: That with reference to the communication of Mr. Boyle, the Curator of the Canadian Institute, respecting the formation of an archæological museum, that this Association recommends its members to give all the assistance in its power in furthering the above object. Carried.

Moved by Mr. Abrey, seconded by Mr. Niven: That Professor Carpmael be made an honorary member of the Association. Carried.

Moved by E. Stewart, seconded by Willis Chipman: That R. S. Latimer be elected an associate member upon payment of fees. Carried.

Moved by Thomas Fawcett, seconded by E. Stewart: That the thanks of the Association be tendered to Prof. Galbraith, the retiring Vice-President, for the valuable services rendered by him to further the interests of this Association. Carried.

Moved by Mr. Burnett, seconded by Mr. McAree: That the President leave the chair and Mr. Niven take the same. Carried.

Mr. Stewart: I cannot let this occasion pass without saying a few words relative to Mr. Kirkpatrick, who has so ably presided over the Association since its formation. It would have been very difficult, I might say impossible, for us to have secured the information and devotion to our interests in the person of any one else other than our President, Mr. Kirkpatrick. I have much pleasure in proposing the following resolution:—

Moved by E. Stewart, and seconded by John McAree: That a hearty vote of thanks be tendered our President, Geo. B. Kirkpatrick, Esq., P.L.S., for his able and courteous conduct as chief officer of the Association from the commencement of its existence to the present time. The Association desire to convey to Mr. Kirkpatrick their sense of their obligations to him for the very great labour that he has so freely bestowed for the advancement of the profession, and they value this all the more on account of the disinterestedness of the motives that prompted him in giving his valuable services for such a length of time in furthering the interests of the Association. Carried.

Mr. McAree: I concur in all that has been said, and am glad to support the motion.

Mr. Stewart: I have much pleasure, Mr. Kirkpatrick, in tendering you the hearty thanks of this Association.

Mr. Kirkpatrick: Mr. Chairman and gentlemen—It does not require that resolution as an expression of approval for any services which I may have rendered to you. I can assure you it has been a great pleasure to me to have had the honour in presiding over you, and to study the welfare of this Association. I have long thought that an Association of this kind was just what surveyors wanted, because from observation I concluded that practically the surveyors of this Province were strangers to one another. As secretary of the Board I necessarily came in contact with all the young surveyors, and I was, apparently, the only one who knew all their faces; however, some of

them often outgrow my recollection. What we require is a brotherhood amongst us, to come together and look into each other's faces at least once a year, to try and help each other, and by so doing to advance the welfare of our profession, and anything which tends to benefit us individually must do so as an Association. I am glad that the Association has arrived at its present satisfactory stage. I think we may safely consider it a live institution with no chance of dying. I was rather afraid before the opening of this session that the members would not come together as they have done, at this third annual meeting, but I am now more than satisfied with the result. I thank you, gentlemen, heartily for your attendance and kindly expressions.

Moved by Mr. Abrey, seconded by Mr. Niven: That the thanks of this Association be tendered to the exhibitors to this Association. Carried.

Mr. Abrey moved, seconded by Mr. Sankey: That the sum of \$40 be voted to Mr. Willis Chipman, our worthy secretary, for his services in the past year. I would like to make that sum larger, and in some measure more commensurate with his services to this Association, but I am afraid the Association funds will not bear it.

Mr. Sankey: In seconding that motion I heartily concur with Mr. Abrey's expressions, but I would say it is not the amount voted but the spirit in which it is given, and Mr. Chipman must look upon it rather as a donation than as compensation for the very onerous duties of the office. As chairman of one of the committees I know something of the amount of letters he would require to write from those I received from him.

Mr. Kirkpatrick: I certainly add my testimony to all that has been said regarding Mr. Chipman's services. Motion was then carried.

Mr. Chipman thanked the Association for the grant, and remarked: I hope that next year each surveyor will feel it his duty to prepare some paper, or to do something to help us along. Give us a paper on the work you have done in the past year. If you have any survey which goes to the Court of Appeal bring it before the Association, I think it will be interesting.

#### ELECTION OF OFFICERS.

Mr. Niven: I beg to move that Professor Galbraith be a fit and proper person for President for the ensuing year.

Mr. Chipman said Mr. Galbraith had told him that the latter could not accept the office of the presidency or vice-presidency of this Association.

Mr. Sankey corroborated the above, adding that Professor Galbraith said, in the interests of this society it would be well to have a practical surveyor, and it would not hurt his feelings in the slightest not to be nominated, as he could not accept office.

Mr. Sankey: I beg to propose that Mr. Alexander Niven be made President for the ensuing year. We all know Mr. Niven, and he has been one of our greatest supporters since we started. It is hard to make a speech when the object of your thought is under your eyes, and I don't want to turn this society into a mutual admiration society, but I don't think we could get a more suitable man. At any rate I should like to see his election carried by a unanimous vote.

Mr. Dickson: I think, Mr. Chairman, the best thing to do is to elect him by acclamation. I have known Mr. Niven for about twenty years, and I say, with no disparagement to any other member, that there is not a better qualified member for the position than Mr. Niven. Mr. Niven's nomination made unanimous.

Mr. Niven: Mr. President and Gentlemen—I hardly know how to thank you for your expressions of good feeling and confidence, and I assure you this is quite unexpected, and I feel rather diffident about accepting it; however, as it seems to be the unanimous feeling that I should take that office I will do so, and endeavour to carry on the work that has been so well commenced, and continued, by my predecessor Mr. Kirkpatrick, to the very best of my ability. I thank you.

Mr. Stewart moved, seconded by Mr. Chipman: That Mr. Sankey be Vice-President for the ensuing year. We all know Mr. Sankey, and I think he will be elected without opposition. Carried.

Mr. Sankey: Mr. President and Gentlemen,—I return you my hearty thanks for the honour you have conferred upon me, and let me assure you that anything I have done in the past for this Association has been a labour of love, and I only wish I had had the opportunity of doing more; but I will say that whatever time I have spent in furthering the objects of this Association has been given most willingly, and I have derived great pleasure therefrom. I thank the Association, and I trust your continued esteem will incite me to still greater efforts on behalf of this Association.

Mr. Saunders: I beg leave to nominate W. R. Aylesworth, of Deseronto, as Councillor.

Mr. Sankey moved that H. B. Proudfoot be a Councillor.

Mr. Ellis moved that T. B. Speight be a Councillor.

Mr. McAree moved that Mr. Stewart be a Councillor.

Mr. Burnet moved that Mr. Fawcett be a Councillor.

Mr. Stewart moved that Mr. McAree be a Councillor.

Mr. Stewart moved that Mr. Dickson be a Councillor.

Mr. Dickson: I thank you, gentlemen, but I will ask you to withdraw my name, as there are many more members better entitled to it, having been longer in the Association. I might serve at some other time, but I must ask to have my name withdrawn. Withdrawn.

The President: We will have to keep Mr. Dickson in view for the future as he says he will be willing to serve some time.

Mr. Niven : I beg to move, seconded by Mr. McAree : That Mr. Willis Chipman be Secretary for the ensuing year. It does not require any words of mine to inform this Association of Mr. Chipman's worth. I quite agree with all that has been said about him. I don't know any one who could take his place. I would not undertake it for quite a consideration. I think we ought to elect him without opposition. Elected unanimously.

Mr. Chipman : I thank you, gentlemen, for the nomination and election, and I will in the ensuing year, with good health, do all I can to promote your interests.

Moved by Mr. Chipman, seconded by Mr. Dickson, that any new business, or omissions or corrections, be made by the Executive Committee or the Committee on Publication. Carried.

The President, in closing, said : I thank you all, gentlemen, for the information you have contributed, and to the earnest endeavours of each member to promote the welfare of this Association ; and now that we are about to adjourn to our respective homes I would call your attention to the very valuable papers of this Association, and suggest that they are well worth our subscriptions. I believe our papers will compare favourably with those of a similar institution, and although we have only been in existence about three years we have no reason to feel ashamed of our achievements in that time. We can, however, all of us lend a hand in collecting information, even the most modest. We may not class ourselves among those who think they have nothing to advance for the interest of science and truth ; if we do let us get over our shyness, and keep in mind that in unity there is strength, and by so doing shall be benefited. There is a verse in the Bible which I think applicable, " He that waters shall be watered himself." I believe in temporal, as in spiritual matters, in helping others we help ourselves. I now bid you all good-bye.

Third Annual Meeting adjourned at five o'clock.

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CIRCULAR No. 15.

RESULT OF THE ELECTIONS.

*President*..... Alexander Niven..... (by acclamation).  
*Vice-President* ..... Villiers Sankey..... (by acclamation).  
*Secretary-Treasurer*..... Willis Chipman..... (by acclamation).

*Councillors.*

|                      |    |                     |    |
|----------------------|----|---------------------|----|
| John McAree.....     | 41 | Thomas Fawcett..... | 21 |
| H. B. Proudfoot..... | 38 | G. B. Abrey.....    | 17 |
| W. R. Aylsworth..... | 31 | T. B. Speight.....  | 10 |
| Elihu Stewart.....   | 30 |                     |    |

*Amendment.*

For, 35; did not vote, 14; partial, 14; total votes given, 63.

I therefore declare the following Councillors elected:—John McAree, H. B. Proudfoot, and W. R. Aylsworth. I also declare the Amendments to the Constitution carried.

WILLIS CHIPMAN,  
*Secretary.*

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MEMBERS IN ATTENDANCE AT THE THIRD ANNUAL MEETING.

|                  |                    |                    |
|------------------|--------------------|--------------------|
| Abrey, G. B.     | Esten, H. L.       | Murphy, C. J.      |
| Apsey, J. F.     | Evans, J. D.       | Myles, C. F.       |
| Aylsworth, W. R. | Fawcett, Thomas.   | Niven, Alexander.  |
| Blake, F. L.     | Fitton, C. E.      | Proudfoot, H. B.   |
| Bolton, J. N.    | Foster, F. L.      | Sankey, V.         |
| Bolton, Lewis.   | Galbraith, Prof.   | Saunders, B. J.    |
| Bowman, H. J.    | Gaviller, M.       | Selby, H. W.       |
| Brown, H. J.     | Gibson, P. S.      | Sherman, R.        |
| Burnet, Peter.   | Hanning, C. G.     | Speight, T. B.     |
| Campbell, A. W.  | Jones, T. H.       | Stewart, E.        |
| Campbell, D. S.  | Jones, C. A.       | Unwin, Charles.    |
| Chipman, Willis. | Kirkpatrick, G. B. | VanNostrand, A. J. |
| Coad, Richard.   | Kirk, Joseph.      | Warren, James.     |
| Davis, John.     | McAree, John.      | Wheelock, C. R.    |
| Dickson, James.  | McEvoy, H. R.      | Whitson, J. F.     |
| Ellis, H. D.     | McKay, Owen.       | Wilson, Hugh.      |

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REPORT OF SCRUTINEERS.

Mr. President,—We find the following members elected as officers for 1887-88:—Mr. John Galbraith, Vice-President; Messrs. M. J. Butler, Villiers Sankey and P. S. Gibson for Councillors; and we also find the amendment of the Constitution carried.

H. D. ELLIS,  
JOHN McAREE,  
*Scrutineers.*

## REPORT OF THE SECRETARY-TREASURER.

MR. PRESIDENT,—Your Secretary begs to submit the following report on the business of the Association for the year 1887.

Our paid up membership increased from seventy on January 1st, 1887, to 118 on January 1st, 1888. Only three members whose names appear on the printed "List of Members" have not yet paid their fees, and four members joined since the printing of the Proceedings.

Our Association can congratulate itself on this large increase in the membership. A majority of the active members of the profession are now in our ranks, and it will be but a short time when all P. L. S.'s of standing will be proud of being mentioned with our members.

One hundred and eleven of our members reside in Ontario, two in the Province of Quebec, two in Manitoba, and three in the United States.

The following counties and cities have as yet no representatives on our list:—The counties of Russell, Glengarry, Stormont, Dundas, Grenville, Prince Edward, Peterborough, Wentworth, Welland and Norfolk, and the cities of Hamilton and Peterborough.

Every other county and town of importance in the Province is well represented.

During the year 1887 two meetings of the Executive Committee were held in Toronto, the first meeting on July 29th, the second on December 23rd, both of which were well attended.

The Executive desires to thank those who have volunteered papers for the present meeting.

The Executive and Standing Committees have met with difficulty in securing papers to be read before the Association.

We have endeavoured to get papers from many members whom we considered competent and willing to assist us, but met with many disappointments. We have found greater difficulty this year than last year, and cannot divine the reason.

In soliciting "contributions" from members we have found three classes: (1) the *willing* member; (2) the *modest* member, and (3) the *busy* member. Of these the third class is the most numerous.

The modest member thinks he can write nothing new, or nothing worth mentioning. This may be the result of modesty or of a false pride that prevents him from undertaking anything unless of very great importance.

A busy man is a man to be admired, and should be imitated by all. Surveyors are of necessity busy men, but no surveyor can be so busy as not to prepare a paper for this Association. It is a well known fact that busy people are generally the best able to prepare papers. The fact that a surveyor is busy is the best evidence we can have that he has something to write about, and that he has the necessary ability to economize his time as to spare a few hours' recreation for the benefit of his professional brethren.

Members who make this *excuse* (the word excuse is used advisedly) cast an unjust reflection on those who have prepared papers. Those who have assisted us in the last two years were not idlers in any sense of the word.

Another charge against the *too busy* member is this:—He is getting from the Association more than he puts in. His subscription pays his share of the publishing of Proceedings and necessary expenses connected therewith, and his share of securing legislation that will be to his benefit, *that* is all. Now who makes the most use of our reports and exchanges? Certainly the busy member.

Time and money are to a great extent convertible: the busy member makes the most money and can therefore afford the most time for preparation of a paper.

If a member finds his time too much occupied with his business, the proper and legitimate thing for him to do is to increase his fees—if sufficiently increased the charm will work instantaneously.

The Secretary owes to the members an apology for the errors that appeared in the last Proceedings, the most of them being of a typographical nature. The bad orthography displayed in the list of members is accounted for by the bad penmanship of the Secretary.

This year the usual reduced rates have been extended to the members of the Association by the railway companies.

The financial condition of our Association is good; there being a cash balance in our favour of \$64.90, and \$9.50 due us for advertisements. Last year our Constitution was amended so as to increase yearly subscription to \$3. The decrease of our "surplus" from \$106.05 to \$64.90 shows the wisdom of passing the amendment.

A statement of receipts and expenditure of the Association from January 1st, 1887, to January 1st, 1888, is appended.

All of which is respectfully submitted.

WILLIS CHIPMAN,  
*Secretary-Treasurer.*

STATEMENT OF RECEIPTS AND EXPENDITURES OF THE ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO FOR THE YEAR 1887.

| 1887.                                       |       | RECEIPTS. |
|---------------------------------------------|-------|-----------|
| To Balance from 1886                        | ..... | \$106 05  |
| " Fees, 1886-87—two at \$3                  | ..... | \$6 00    |
| " " 1887-88, Old Members—sixty-eight at \$2 | ....  | 136 00    |
| " " " New " —fifty at \$3                   | ..... | 150 00    |
| " " 1888-89, " " —one at \$3                | ..... | 3 00      |
|                                             |       | <hr/>     |
| " Advertisements                            | ..... | \$295 00  |
| " Proceedings sold                          | ..... | 77 50     |
| " Thirty-nine Dinner Tickets sold at \$1.50 | ..... | 2 25      |
|                                             |       | <hr/>     |
| Total                                       | ..... | \$539 30  |



EXPENDITURE.

|                                                   |          |
|---------------------------------------------------|----------|
| By Postage, Telegrams, etc .....                  | \$33 60  |
| “ Stationery .....                                | 10 95    |
| “ Rental of Rooms .....                           | 24 50    |
| “ Amount granted Stenographer.....                | 25 00    |
| “ “ “ Secretary-Treasurer .....                   | 40 00    |
| “ Printing Circulars, Programmes, etc., etc ..... | 30 25    |
| “ “ 900 Proceedings.....                          | 191 10   |
| “ Lithographing, etc .....                        | 41 20    |
| “ Express, Cartage, Freight, etc., etc .....      | 14 30    |
| “ Annual Dinner .....                             | 63 50    |
| “ Balance December 31st, 1887 .....               | 64 90    |
|                                                   | \$539 30 |

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REPORT OF AUDITORS.

The undersigned Auditors beg to report as follows:—That we have examined the books and accounts of the Secretary-Treasurer, W. Chipman, Esq., and have annexed to this report a statement showing the amount of receipts and expenditures, which shows a balance on hand of \$64.90. We find vouchers for \$384.40, chiefly for printing, engraving, etc., a great portion of the balance being for postage, duties, freight, express. We think that it would probably be more satisfactory to have vouchers—for all accounts save postage.

All of which is respectfully submitted.

G. B. ABREY,  
LEWIS BOLTON,  
*Auditors.*

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REPORT OF COMMITTEE ON LAND SURVEYING.

The Committee on Land Surveying beg to report as follows:—

I. With regard to the working of the “Survey Act,” as amended at the last session of the Provincial Legislature.

The Act embodies all the amendments set forth in the draft as adopted at our last annual meeting with but very few alterations or additions.

As far as your Committee has been able to learn, the Act works satisfactorily. The real test, however, will not be had until some decisions have been given in the courts. Your Committee would here urge the necessity of making arrangements to have reports of all surveying cases made a permanent feature of our Annual Report. As

there are not a great number of cases reported each year the expense would not be great, and a digest of each case would suffice, with proper references as to where the full report is to be found. The reports of all cases, as now published for the legal profession, are the property of the Law Society, but, no doubt, satisfactory arrangements could be made whereby our Association might procure either sufficient copies or permission to publish in our Annual Report.

II. With regard to Registered Plans, your Committee wish to urge the fullest discussion of this most important subject, and would point out the great responsibility which rests with the surveyor in this matter. Who is responsible for the correctness of a registered plan, the Surveyor or the Registrar? The correct answer to this question is the certificate required by law to be signed by the surveyor, which, to bring the point home forcibly is here reproduced :

“I hereby certify that this plan accurately shews the manner in which the land included therein has been surveyed and subdivided by me, and that the said plan is prepared in accordance with the provisions of the Registry Act.”

The first point that presents itself in the above certificate is this: An actual survey is compulsory at least as far as the outlines are concerned. Then comes subdivision. Now is it necessary that the final operation of subdivision that is the staking out be completed before this certificate be signed? Generally speaking, your Committee think not, but are of opinion that the surveyor must exercise his own judgment in each case as to the amount of staking out necessary to enable him conscientiously to sign, having regard to the provisions of the Registry Act which require, among other things, that the plan shall shew the width and length of all lots, and the courses of all division lines between the same (see sec. 63, sub-sec. 1, Surveyors' Act), the nature of the ground, whether level or broken, and the relation which the subdivision bears to the original lot; whether the lines are on the same courses or differ therefrom. Also curved roads, crooked fences, and natural boundaries, such as hill crests and high-water marks, are all important considerations, which must be taken into consideration in forming that judgment. The next point to consider is that of courses or bearings. These may be astronomic or magnetic. With due respect, however, to the time-honoured compass, let magnetic bearings be kept off registered plans. But by doing so, some may say, an observation will have to be taken for every plan. This would not be necessary. Let the course of some original line on the plan, preferably that of the principal road, be selected, and let all the bearings be referred to it. And generally it is not wise to show the bearing of an original line different from that expressed in the patent. The above requirements being exclusively surveyors' work, shew him to be the responsible party, though the registrar, who is responsible for all documents, plans, etc., received by him, is no doubt quite justified in requiring any further information which appear to him to be wanting on a plan. Finally, on this subject, your Committee consider that

all parties interested in the lands should sign the plan, and that some affidavit of execution similar to that on a deed should be attached to each plan.

III. With regard to descriptions, your Committee are of opinion that surveyors should endeavour to prepare, in all cases, careful and accurate descriptions, from the fact that a description is either the cause or result of all surveys, and that years after both the surveyor and the posts planted by him are dead and gone the description still remains, copied perhaps, through a long chain of deeds, mortgages, etc., to bear evidence of the carefulness or carelessness with which it has been prepared. As this is a very large subject, too large to be properly discussed in a report, your Committee, with a view of promoting discussion, would simply point out a few of the different headings under which descriptions may be classed: such as descriptions of aliquot parts of, or fixed areas of, lots either before or after survey; descriptions of lots and parts of lots on registered plans, making due allowance for surplus and shortage; descriptions of lands acquired for railway right of way, for new streets, local improvements, mill sites, water privileges, water lots; descriptions of lands, the boundaries of which are governed by natural or artificial objects; descriptions in which it is necessary to combine the existing conditions with the "former description." And it must not be lost sight of that this "former description" may "commence at the distance of one chain from nowhere; thence all round the compass—chains—links—hundredths more or less to the point of commencement, containing by admeasurement acres, hundredths, be the same more or less, and all the time the lands intended to be conveyed may contain a gold mine producing \$50,000 per ton. Let surveyors bear in mind that they, of all men, are the proper persons to write descriptions, and by carefulness and accuracy convince every one interested, that when he wants a description, no matter for what purpose, he has only to go to the surveyor.

IV. On the subject of Fences, your Committee think it would be well for the Association to give an opinion as to the operation of the ten year limit for possession.

In conclusion, though the subject has not yet been formally relegated to it, your Committee would urge the careful consideration of Mr. Ogilvie's Boundary Commission Scheme. Undoubtedly there is much to be gained by such a scheme, but the establishing of it is surrounded by many difficulties which can only be overcome by careful consideration and cautious foresight, prompted by a thorough knowledge and full appreciation of the points of the case.

All of which is respectfully submitted.

Signed on behalf of Committee,

VILLIERS SANKEY,  
*Chairman.*

## REPORT OF SUB-COMMITTEE ON THE SUBJECT OF REGISTERED PLANS,

As mentioned in the Report of the Land Surveying Committee, and in the letter of J. G. Scott, Esq., Q. C., Master of Titles, Osgoode Hall, hereto appended.

I. Your Committee concur entirely in the statement in the Report and letter above mentioned, that in all cases an outline survey is necessary.

II. With regard to the limits within which paper subdivision after outline survey may be made without subdivision survey, your Committee would lay down the following limits: On level ground having a regularly bounded parcel of land, paper subdivision may be made of areas not exceeding 10 acres; no side of which should exceed 20 chains in length.

III. In cases of irregular boundaries, and rough ground, sufficient subdivision survey is necessary to determine all broken distances and irregular courses.

IV. As to bearings. It should be clearly stated on the Plan which are the governing line or lines; and also state whether the bearings are actual "astronomic" or "magnetic" (in the latter case, giving the date when observation was made) or "assumed."

V. In all cases the Plans for the Registrar and for the Treasurer should be properly drafted plans, and not lithographs, showing the distances on each lot.

VI. The "Owner's Certificate" should clearly state what lands are being subdivided by the Plan, and no roads should be coloured except those dedicated by the Plan.

VII. In cases where monuments have been planted to mark out the lots or blocks this should be stated on the Plan.

VIII. Surveyors should be careful to mark on all proposed Plans of subdivisions that they are such, and thus prevent any other surveyor being misled by them.

Signed on behalf of Committee.

VILLIERS SANKEY,  
*Chairman.*

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VILLIERS SANKEY, Esq., P.L.S.,  
*17 Toronto Street, Toronto:*

MY DEAR SIR,—In reply to yours of 25th inst., I beg to say that I am glad to learn that you propose bringing the subject of registered plans before the Association of Provincial Land Surveyors. I trust the Association will take such steps as are necessary to see that all surveyors are informed that it is alike contrary to professional duty

and the law for any surveyor to certify, under the Registry Act or the Land Titles' Act, to the correctness of any plan where he has not actually surveyed the land on the ground. I cannot understand how any surveyor can have formed a different idea of his duty, as any contrary practice would make the certificates of surveyors attached to plans simply worthless.

Sometimes surveyors are called upon to draw plans showing proposed divisions before survey. It seems to me that it would be correct for the Association to enact a rule requiring that in all such cases the fact that the plan shows an intended subdivision and not an actual survey should appear upon the face of the plan.

How *far* it is necessary in practice to make the subdivisions upon the ground so as to ensure accuracy is a practical matter on which I am unable to give an opinion:

It has been supposed that all plans of sub-division show actual work, but I presume from what I have since learned that this is a mistake, and that in many cases it is not deemed necessary to plant stakes at the corners of each lot before certifying a plan. Of course, if the outline measurements are mathematically correct this can make no difference. As, however, it is practically impossible to make absolutely accurate measurements of any long distances, I think the surveyors might well lay down a rule fixing the limits beyond which paper divisions must not be made.

I have noticed in the Registry Office many plans certified as being in compliance with the Registry Act which ignored many of its provisions. I trust, however, the clearer language of the recent Act will prevent the occurrence of these omissions.

I have, of course, to be more particular than registrars, as the duty is thrown upon me of seeing that a plan is in accordance with the rule, and is consistent with other descriptions of the same land in my office, or, if not, that the discrepancies are properly explained.

It has been the practice of surveyors, when a number of lots have the same width, to content themselves with simply inserting the width of the lots at each end leaving the intervening lots unmarked. The statute requires that the width of each lot should be shown.

Ought not surveyors to adopt the practice showing what is the governing line both in plans and in descriptions wherever the courses are given? According to the present practice it is impossible to tell from most descriptions whether they are magnetic, astronomical or assumed courses. Most, I believe, are assumed courses. That is, it is assumed that a former survey, as, for instance, the old lines of "north 16° west," are correct. I understand surveyors sometimes put these assumed lines within inverted commas, but this is a very unsatisfactory way of stating the governing line, and I think it would be well to adopt the practice of saying "in above description — street is assumed to run on a course north 16° west," or, where the survey is made from actual observation it should be stated "the courses are astronomical by actual observation." My attention has been particularly called to this by two adjoining surveys made by the same surveyor, whose courses, seemingly intended to be a continuation of the same lines,

were given differently. Upon enquiry, I learned that one was made from actual astronomical observation, while the other assumed the old survey line of "north 16° west" to be correct. There was nothing in the descriptions to indicate the cause of the difference. The quotation marks sometimes used do not seem to me to be sufficient for this purpose. One objection is that a clerk ignorant of their object would very naturally in copying leave them out. This is, I think, a matter of very great importance, as, at present, unless we happen to meet with "north 16° west, or the complementary line "south 74° west," or some such similar well-known lines, the absolute direction of courses is a mere surmise until the notes of survey are examined.

Yours truly,

J. G. SCOTT.

*Osgoode Hall, February 27, 1888.*

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### REPORT OF DRAINAGE COMMITTEE.

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MR. PRESIDENT,—As Chairman of the Drainage Committee, I beg to present the following report:—

The Committee met, pursuant to notice, on the 23rd of December, 1887, at the Crown Lands Department, Toronto. Members present: H. B. Proudfoot, Clinton; R. H. Coleman, Toronto; and W. R. Burke, Ingersoll, Chairman.

Correspondence was read from Engineers and Surveyors in answer to letters and circulars sent out by the Chairman, asking for information relating to the Drainage Acts and the changes they thought necessary for their improvement or an explanation of any difficulties they had met with when laying out drains or assessing for drainage. Although a circular, or letter, was sent to every member of the Association who was likely to be engaged in drainage work, very few replies were obtained.

We considered it inadvisable, through this Association, to ask the Legislature for any change or amendments in the Drainage Acts at their coming session. We deemed it beneficial to the Association to distribute circulars to the members of the Association, reeves and clerks of the various townships, asking their opinion and advice regarding the hearing of appeals from the Municipal Drainage Act and the Ditches and Watercourses Act, not to be to the County Judges, but to three competent persons, one of whom shall be a P. L. S., whose duty it shall be to examine the lands, have power to take evidence, etc., or in some way improve the Act in this respect, and it is to be hoped that at this annual meeting it will be fully discussed.

The following is a form of circular that might do to send to the various clerks of municipalities, etc.

W. R. BURKE,  
*Chairman.*

[Circular.]

## ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO.

SIR,—At the meeting of the Local Legislature in 1887 the above Association sent delegates to appear before the Municipal Committee of the Ontario Legislature to be examined on the various changes proposed in the different Drainage Acts of Ontario, the Municipal Act, section 570, etc., and the Ditches and Watercourses Act of 1883 and the Amendments thereto, and were very successful in having nearly all the changes proposed by the Association carried and included in the Statutes of 1887, most of the delegates sent by the municipalities concurring in the changes proposed.

At the meeting of our Association, held in Toronto, on February 28, 29, March 1, 1888, it was decided to have the opinion of the various Municipal Councils and Farmers' Institutes throughout Ontario, and of the Ontario Branch of the Dominion Grange, on the change in the two Acts that were proposed at the above meeting of the Legislature, but which were not sustained by the Municipal Committee, and ask them also to propose any changes they might think would make the Acts more worked. The most important alteration on which we would like to have the opinion of your

is concerning the appeal from the award of the Engineer under the Ditches and Watercourses Act of 1883, which is contained in the following sections of Bill No. 107, 1887, presented by Mr. Waters, which reads as follows:—

6. Section 11 of the said Act is hereby repealed and the following substituted therefor:

11.—(1) Any person dissatisfied with the award and affected thereby, may, within fifteen clear days from the filing thereof, deposit with the clerk of the municipality a written notice of his intention of appealing therefrom (shortly setting forth his grounds of appeal) to the Court of Revision of the municipality of which the lands in respect to which the proceedings are initiated are situated, which Court the Council shall from time to time, as the occasion may require, hold on some day not earlier than twenty, nor later than thirty days from the day on which the time of appeal expired.

(2) The clerk on the receipt of the notice of appeal shall notify the reeve or other head officer (as the case may be) of the same, who shall instruct the clerk to notify the other members of the court of the time and place such court shall be held.

(3) Such court shall be constituted in like manner, and have the same powers as Courts of Revision under the Assessment Act.

(4) The appeal from the Court of Revision shall be to three competent persons (one of whom shall be a Provincial Land Surveyor) whose award shall be final, and who shall be appointed by the judge, junior, or acting judge of the County Court of the county in which

the lands are situated, and the proceedings in such last mentioned appeal shall be as follows:—

(a) The appellant shall serve upon the clerk of the municipality, with whom the award is filed, a notice in writing of his intention to appeal therefrom (which notice must be filed with the clerk within at least ten clear days from the finding of the Court of Revision) shortly setting forth the ground of appeal.

(b) The clerk of the municipality shall, at the expiration of the time of appeal from the Court of Revision, forward by registered letter, or deliver a copy of such notice, or notices of appeal, if there is more than one appeal, to the clerk of the Division Court of the division in which the land of the owner filing the requisition (as provided in section 6 of this Act) is situate, and such Division Court clerk shall immediately notify the judge of said appeal, whereupon the judge shall appoint the three persons named in sub-section 4 of this section, and may, if he thinks fit, order such sum of money to be paid by the applicants to the said clerk as will be sufficient indemnity against costs of appeal.

(c) The three so appointed persons shall examine all the lands and are hereby authorized to examine the parties, and their witnesses on oath, and may administer an oath or affirmation as in courts of law, and may set aside, alter or affirm the award, correcting any errors therein, and may order payment of costs (including the costs as set forth in the award) by the parties or any of them, and fix the amount of such costs, and shall within thirty days from their appointment file with the clerk of the municipality a report, together with the copies of any evidence they might have taken, setting forth their finding in the matter of such appeal.

Also your opinion of the following which was presented by Mr. Waters as an amendment to the Municipal Act:—

Section 570. In case the majority in number of persons *as certified by the County Judge (whose certificate thereto shall be final) at a sitting of the Division Court in County in which the lands or a part of the lands are situated* to be owners, whether resident or non-resident of the property to be benefited in any part of any Township, City, Town, or Incorporated Village, petition the council (*in Form A*) for the deepening or straightening of any stream, creek, or watercourse, or for draining of the property, describing it, or for the removal of any obstruction which prevents the free flow of the water of any stream, creek or watercourse as aforesaid, or for the lowering of the water of any lake or pond for the purpose of reclaiming flooded land, or for more easily draining any land, the council *shall* procure an Engineer or Provincial Land Surveyor to make an examination of the stream, creek or watercourse proposed to be deepened or straightened, or from which it is proposed to remove obstructions, or of the lake or pond the waters of which it is proposed to lower, or of the locality proposed to be drained, and *shall* procure plans and estimates to be



made of the work by such Engineer or Surveyor and an assessment to be made by such Engineer or Surveyor of the real property to be benefited by such work, stating as nearly as may be in the opinion of such Engineer or Surveyor the proportion of benefit to be derived therefrom by every road or lot, or portion of lot, and if the Council is of the opinion that the said work or portion thereof is desirable the Council may pass by-laws.

Instead of S. S. 13, 14 and 15 insert :

S. S. 13. *The appeal from the Court of Revision shall be to three competent disinterested persons (one of whom shall be a Provincial Land Surveyor) appointed by the Judge, junior or acting Judge of the County Court of the County in which the petition originated, who shall constitute a Court to hear the appeal, and who shall examine all the lands assessed, and may vary the assessment of the lands and the roads benefited as aforesaid, without further notice to the parties interested therein, so that the aggregate amount assessed shall be the same as if there had been no appeal, except as to the costs of appeal which may be added thereto as hereinafter provided, and the Court of Appeal, or, in case there is no appeal to the Court of Appeal, the Court of Revision, shall return the roll to the municipal clerk from whom it was received, and the assessors shall prepare and attest a roll in accordance with their original assessment as altered by such revision.*

S. S. 14. *If the assessment be varied in any way by the Court of Appeal, the costs of appeal shall be added to the aggregate assessment, otherwise the costs shall be ordered to be paid by the appellant.*

Sec. 571. Sixth line in form of By-law: strike out "as shown by the last revised assessment roll" and insert *as certified by the County Judge.*

Sub.-Sec. 2. Where word "Judge," occurs insert *Court of Appeal.*

Sub.-Sec. 3. Where word "Judge" occurs insert *Court of Appeal.*

Sec. 572. *Before the final passing of the By-law a printed copy of the same (together with a notice that any one intending to have such By-law or any part thereof quashed must not later than ten days after the final passing thereof serve a notice in writing upon the reeve or other head officer and upon the clerk of the municipality of his intention to make application for that purpose to the High Court of Justice at Toronto during the six weeks next ensuing the final passing of the By-law) shall be served upon each of the several owners, their lessees or occupants, or upon the agent or agents of such owners, or left at their place of residence with some grown up member of the family, or, where the land is unoccupied and the owner or owners, or their agent or agents, do not reside within the municipality, may cause to be sent by registered letter to the last known address of such owner or owners a copy of such By-law and notice, and the said By-law shall not be finally passed until after the expiration of three weeks from the last of such services, and the clerk shall keep on file in his office a statutory declaration or declarations*

*by the party or parties making such service or services, and the manner in which the same were effected.*

Sec. 576 (49 Vic., chap. 37, sec. 27). For the amendment in sec. 27 read *and until he obtains a sufficient outlet for such water so that no lands shall be flooded thereby without the written consent of the owner or owners, and in every such case to charge the lands and roads to the same extent and in the same manner as is provided by the next succeeding section of this Act.*

Farmers in Ontario have now arrived at the conclusion that to make farming pay it is necessary to have their farms well and properly drained, and that must be accomplished in the most inexpensive manner. To do which the drainage laws must be put in such a shape that farmers as well as engineers and lawyers will understand them and know where, when and how they may have any of their grievances alleviated.

We trust that you will make a point of having this circular laid before your \_\_\_\_\_ and have their answer forwarded to any of the following addresses:—

W. R. BURKE, Ingersoll.  
R. H. COLEMAN, Canada Company, Toronto.  
H. B. PROUDFOOT, Clinton.  
I. L. BOWMAN, Berlin.  
WILLIS CHIPMAN, Brockville.

#### DISCUSSION.

Mr. Proudfoot—The amendments to the Act which we proposed to send to the different municipalities were just the same as were proposed last year, but they were not carried through the House as there were too many lawyers there. I think these same clauses were brought up last session. The clause about changing the court of appeal to three competent persons under the Ditches and Watercourses Act or to the County Judges I have always thought would be a good one, as many judges don't care to have to deal with it. If people were appointed right on the ground to examine the cause of complaint it would be much more practical.

Mr. L. Bolton—In reference to changing the court of appeal I think it would be advantageous if you got a judge favourably inclined to the engineer.

Mr. Kirk made a suggestion about amending the Bill and as to conferring more power on engineers as to repairing drains, etc. The Act was framed to provide for drains to be constructed, and to prevent bad feeling between neighbours. It is proposed by this Bill to give them power to discharge the water.

Mr. Gibson—It appears to me that the trouble is this—for any natural flow of water I think the common law is sufficient to make them let it off, but by the proposed Ditches and Watercourse Act it

is not necessary, only for the better improvement of the land. As between individuals they can go and make ditches, but railroad companies may block the natural flow of water.

Mr. Proudfoot—Take the case of the original construction of a railway through a bush or a beaver meadow. Perhaps at the time of construction there was no natural flow, but years afterwards the natural flow came into the railway. Are not the railway company bound to put in the culvert?

Mr. Gibson—Yes, but they won't!

Mr. Proudfoot—But that is just what we want to do by this Bill.

Mr. Gibson—If a railway company draws water from a source that it would not otherwise naturally come from they are amenable, but the trouble is to make them comply with the Act.

Mr. Proudfoot—I had a case in the County Huron against a railway company, where a man wanted to drain a beaver meadow, and they would not let him and would not do it themselves, and the water is there yet.

Mr. T. H. Jones—I had a case against the Grand Trunk Railway Company about a culvert deep enough to carry off the surface water, but which I considered should be two and a half feet deeper to drain the land. The railway company contended through their solicitor that they were not liable under the Ditches and Watercourses Act. It was submitted to arbitration, and the company had not their work done, but they consented to deepen it and make it wider, the counsel consenting that part of the expense of increasing the width should be borne by them.

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## REPORT OF COMMITTEE ON ENGINEERING.

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This Committee had nothing to report.

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## REPORT OF COMMITTEE ON LEGISLATION.

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MR. PRESIDENT AND GENTLEMEN,—Your Committee on Legislation beg to report that they have little to add to the postscript inserted in last year's published report of the proceedings of your Association, in which the amendments to the Surveying Act and the Ditches and Watercourses Act are referred to.

Inasmuch as important amendments have so recently been made to these Acts and as they have been incorporated in the consolidation of the Statutes, your Committee would not deem it wise to urge any further change at present on the Legislature, but they consider that

the time may be profitably employed by the Association in maturing for future legislation any improvements that may be thought desirable in the interest of the public and the profession.

Among these they would mention that of a court or commission to settle disputed boundaries, a notice of which was given at the last meeting of the Association.

All of which is respectfully submitted.

E. STEWART.

PETER S. GIBSON.

Mr. Stewart—Mr. President, this Report has one great merit, viz., brevity. I might say the committee on land surveying, engineering and drainage, have taken up many points on drainage and land surveying, and much ground has been covered thereby that would otherwise be contained in this Report.

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#### REPORT OF COMMITTEE ON PUBLICATION.

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MR. PRESIDENT,—We your Committee on Publication, beg leave to report as follows:—

The contract for printing our second Annual Report of Proceedings was given to C. Blackett Robinson, of Toronto, who, it will be remembered, printed our first report. The cost was \$191, being at the rate of about \$1.26 per page, for the issue of 906 copies. The increased cost over last year was due to the larger number of copies printed, and to the considerable amount of tabular matter and algebraical expressions in several of the papers. In addition to the printing, the lithographing of the plates belonging to the paper on "Highway Bridges," cost \$37.50, and the portrait accompanying the biographical sketch cost \$5.

The account of our exchanges is as follows:—Two hundred copies of our report were sent to the Michigan Society of Engineers and Surveyors, in exchange for 120 copies of their Report; 100 copies were sent to the Illinois Society of Engineers and Surveyors, in exchange for 120 copies of the Report of that Society; 100 copies were sent to the Indiana Society of Engineers and Surveyors, for which we received 120 copies of their Report; 100 copies were sent to the Ohio Society of Engineers and Surveyors; and 50 copies to the School of Practical Science Engineering Society, from each of which societies we received 120 copies of their respective reports.

We recommend that the following prices be charged for single copies of our Reports:—

|                                             |        |
|---------------------------------------------|--------|
| For the Report for A.D. 1886, per copy..... | \$1 00 |
| “ “ “ 1887, “ .....                         | 0 50   |
| “ “ “ 1888, “ .....                         | 0 50   |

For advertising space we charged \$6 per page; \$3.50 for half a page; and for lesser space 25 cents per square inch, and we recommend that these rates be adhered to for our next report.

The revenue from advertisements defrays a considerable portion of the cost of publishing our Proceedings; and we beg leave respectfully to urge upon the members of our Association the duty of a careful perusal of the advertisements, and we hope that in purchasing supplies for the field or for the office, and in placing orders for work of any kind in connection with the pursuit of their profession, our members will not ignore the claims of those who patronize our advertising columns.

Respectfully submitted.

JOHN McAREE,  
*Chairman.*

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#### REPORT OF COMMITTEE ON ENTERTAINMENT.

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

Enquiries were made by us as to cost of rooms for holding annual meetings, price of dinners, etc., previous to the last meeting of the Executive Committee, and a report thereon submitted to said meeting.

In view of a reduction in rent of meeting rooms, it was decided by your Committee to engage the front room in the Shaftesbury Hall building on Queen Street, but when it was subsequently ascertained that continuous occupation during the session of the Association could not be given, and that the Library of the Canadian Institute, where the meeting took place last year, could be got for the same rental as the Shaftesbury Hall room—\$12, it was engaged.

It was decided by your Committee to have the dinner at the Walker House, but as it was learned that we could not be accommodated there on the date fixed we gave the order to the Rossin House. Your Committee would recommend that in future it should be positively ascertained at least two weeks before the Annual Meeting whether the dinner is to be ordered or not, and the number of members taking tickets.

The failure to give entire satisfaction, of the late dinner at the Rossin, was perhaps as much due to the short notice at which it was ordered, as to any want of attention on the part of the proprietor.

All accounts in connection with the transactions of your Committee will be forwarded to the Secretary-Treasurer.

Respectfully submitted.

FRED. L. FOSTER,  
*Chairman.*

*Toronto, March 1, 1888.*

REPORT OF COMMITTEE ON INSTRUMENTS.

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MR. PRESIDENT AND GENTLEMEN,—As chairman of this Committee I would say that the members of it all reside away from the city, excepting myself. Mr. Fawcett, one of them, was away in the mountains of British Columbia until a very few weeks ago, and could well be excused from attendance at a Committee meeting, and perhaps also from getting up a paper upon the subject. From the other members I could learn nothing, though I sent the usual notice and request to attend, as well as to prepare a paper on the subject for the annual meeting; therefore nothing has been done by the Committee in the way of a report, neither has a paper been prepared on the subject of instruments, unless that one describing the Rolling Planimeter be accepted as one.

The subject, I think, might be written upon, and a very interesting and useful paper compiled, showing the improvements made in the instruments used at this day compared with those of the old days, some of which were very evident from the instruments shown in this room at our last annual meeting. In this report I will only mention one or two points that occur to my mind. In the days when I passed my examination (twenty-eight years ago) the English cradle theodolite was the *beau ideal* of the Canadian surveyor, and with it the surveyor could not only produce straight lines and measure angles, but make observations for latitude and take observations on Polaris and establish the meridian. It did not matter what was wrong with the instrument, he had his adjustments by rule to correct all errors. One of the adjustments was to sight to a star, then to its reflection in still water or artificial horizon, and adjust by raising or depressing one of the standards of the horizontal axis. This was said to be equal to a plumb line millions of miles long. Now, of course, most stars that the surveyor would choose for this adjustment would be moving in azimuth to some extent, and this correction could at best be but an approximation. But suppose the surveyor got the corrections fairly well made, he had only succeeded in making the horizontal axis horizontal, while another almost equally important element was ignored, and from the rules given the instrumental errors were supposed to be eliminated (very few instruments indeed were provided with the means for correcting this error). Now, in the above no mention is made of the possibility that the telescope might not be at right angles to its axis, and the rules given do not search for such an error. When requiring the true azimuth of a line surveyors used to be satisfied with a single observation on Polaris at one of its elongations, made with an instrument adjusted as above, and perhaps levelled up by means of plate bubbles, not showing or reading nearer than several minutes of arc, and without of course a striding level or other measure of the inclination of the horizontal axis. Then fix a point in the horizon by depressing the telescope and sighting in a picket.

Suppose the above observation was made for the bearing of a governing line. Next, suppose a similar observation made at a point

where it is required to run a line on the same course as the governing line. We might also suppose that sometimes at the second observation the instrument is reversed, or that the telescope at least may have been reversed in its Y's. Now, gentlemen of the present day, how many would trust or vouch for the correctness of a line the course of which was obtained by an instrument of the above description ?

Then, as to instruments for measuring distances. We all a few years ago used the old Gunter chain, made up of one hundred longer pieces of iron or steel wire and from two hundred to three hundred shorter pieces of wire, so put together as to form the chain. These were all sure to wear and liable to accidents, and in a short time the chain was anything but sixty-six feet long. To-day most of us would not like, for work requiring care, to trust to the old-fashioned chain. For my own part, I may say that I have not used one for any kind of work for nearly ten years, but have used continuous steel bands of various kinds. I have had some of Chesterman's blued steel bands that have measured not less than one thousand miles of line, and some of the lines in new townships amongst the rocks and mountains in the worst portions of Algoma, in both winter and summer.

I would say that I think some better method than that now followed should be adopted for testing and correcting the lengths of chains and tapes. The old pine stick five links long is quite incompetent to correct a steel tape sixty-six feet or more in length.

I understand that the Dominion Lands Department have perfected arrangements for issuing to D.L.S.'s standard steel tapes, one hundred links long, divided and marked at given temperatures. If these could be made available to P.L.S.'s, and a copy of the standard be deposited with the Inspectors of Weights and Measures throughout the Province, this might give all the uniformity desired ; but I think every surveyor should be in possession of a standard of not less than sixty-six feet long himself.

I would make a passing reminder also of some of the instruments common nowadays, used for economy's sake, such as the various telemeter appliances for measuring distances, the different planimeters for mechanically adding the area of any figure, and the equatorially mounted transit, commonly called the solar, for mechanically solving the astronomical triangle. One of our members, Mr. McAree, presented a good paper at our last annual meeting on Solar Azimuths, which reminds us that one of the objections to taking observations on the sun for azimuth is on account of the rapid movement of that body making it difficult to get the exact instant of observations of the limb, and time being a very essential element in the calculation. With the solar this source of error does not apply. The contacts are taken by it with the same ease and precision that the same could be made on Polaris or other slow moving star at its elongation, and if the instrumental error can be eliminated I see no reason why an observation by the solar on the sun should not approximate to the same precision as one on Polaris.

I had intended to substitute my description of the planimeter for my report on instruments, but as that got in yesterday, and as our

indefatigable Secretary insists upon a report also, I had hastily prepared the foregoing during the morning, and I hope that Mr. President and the members will bear with what has been written.

I should have said at the outset that I used my best endeavours to induce a few of the principal American instrument manufacturers to send an exhibit to our meeting, and from the correspondence I believe it is useless to expect them to come and face our Customs regulations. This year I did not ask our Toronto makers to repeat their last year's exhibit. I saw some of the stationers and others, and in response Messrs. Hart & Co., the Map and School Supply Company, and some others, have sent in some lines in which we are interested. These will be found somewhat more in detail in another part of this Report.

Respectfully submitted.

G. B. ABREY,  
*Chairman.*

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#### PRESIDENT'S ADDRESS.

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GENTLEMEN OF THE ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO,—It gives me great pleasure to welcome you to our Third Annual Meeting. Let us, in the first place, render our thanks to the great Architect of the universe for His protecting care during the past year, and invoke the Divine blessing on that on which we have entered. We meet to-day with bright prospects for the future. Our membership now stands at one hundred and twenty-two, an increase of forty-seven over that of our last annual meeting. I trust that before long all the live, active men of our profession will have enrolled themselves in our ranks. It rests with yourselves, gentlemen, to make the Association a success; you all know the old proverb, "God helps those who help themselves." I hope that none of you will allow the well-known timidity and bashfulness of our profession to stand in the way of letting "your light shine" for the benefit of your fellows.

I have to announce the removal by death of one of our number since last we met, Mr. H. H. Stephens, of Owen Sound, who died last year after a short illness.

It was only yesterday when it was my mournful privilege to follow to the grave one who has left his mark on the annals of his country; one, too, who was second to none in his endeavours to advance the status of the surveyor, who, if I mistake not, was the "father of our Survey Act," and the "inaugurator of the Board of Examiners," who was the first Assistant-Commissioner of Crown Lands, and afterwards held an important position in the Dominion Lands Branch of the Department of the Interior. I allude to the late Andrew Russell, who passed away in this city, on Friday last, the twenty-fourth of February, in his eighty-fourth year. I have always looked on Mr. Russell as the connecting link with a bygone generation. It is given



to few men to hold an official position in the public service for fifty years.

At the last session of the Legislature of Ontario the "Act respecting Land Surveyors and the Survey of Lands" was amended. It is perhaps too early to pronounce it an unqualified success, but we must all allow that it is an improvement on the old one. The qualifying examination for admission to practice has been extended to include among others the kindred subjects of railway surveying and drainage work, both of which are likely to engage the attention of an increasing number of our surveyors in the future. It is a matter of satisfaction that provision has been made for the guidance of surveyors when called upon to act in those townships which have been subdivided under the system prevailing for the last thirty years and upwards, as doubts have often arisen in the mind as to the law in such cases. It is now laid down clearly in the fifty-second section of the amended Act. I trust that any doubtful points may be well ventilated in the discussion likely to arise through the "Question Drawer," a new feature, as you will perceive, in our programme this session, and one I venture to think which will commend itself to you. The papers on the agenda are all of practical importance to the surveyor, and I invite free discussion thereon. It does not seem to me as if the public or the profession itself are sufficiently aware of the facilities which our best qualified surveyors have of acquiring valuable information, or why are not their services more frequently called into requisition? Some of our soundest Loan Companies have Provincial Land Surveyors of repute as valuers; why should not more of them follow suit? As a judge of timber our practical surveyors ought to be sound. I know several who are such, and who have found it not unremunerative; why should not many more avail themselves of the unrivalled chances of acquiring this knowledge and fitting themselves for positions of trust and emolument? The mining industry of this Province is as yet in its infancy. Here is a field in which our educated men may have full scope for their talents. Possessing as they must an elementary knowledge of mineralogy and geology at the outset of their career, they enter the field with a fair start. Study and practice must do the rest. I know more than one surveyor whose services as a mining engineer and expert have been eagerly sought, and who have been professionally employed outside the Dominion.

I think I may say that last year has been a busy one with most of our brethren. At least we have found great difficulty in getting "papers" prepared, want of time has been invariably pleaded. I am glad that this should be so, and trust that the good time may continue. In my own case, I have to ask your indulgence for not having prepared something more worthy of your attention, but I think I can truly say that I have not had half a day at my disposal in which I could sit down quietly to devote to the proper preparation of something wherewith to interest you. I am glad to be able to report that very shortly we hope to have the different Acts by which a surveyor has to govern himself printed in a pamphlet form of useful size and shape. During the year a Digest of Survey cases as reported has

been prepared with care by one of our members, which cannot fail to fill a want long felt by us all. Before closing, I would throw out a suggestion whether it would not be advisable to publish a list of the members, with their addresses, for distribution freely among our municipalities. It is but right and due to the public that they should know who are the reliable and go-ahead men of the profession, and whom it will be in their interest to employ. Let us have faith in ourselves and others will do the same.

In retiring from the office of president of your Association, which I have held by your suffrages for the last two years, allow me to thank you, one and all, for your kindness and courtesy to me. It has been a great pleasure to me to think that I have been, even in a small way, useful to my fellow-workers, and I would bespeak for him who will follow me in this chair the same cordial assistance which you have rendered me. The co-operation of one and all is necessary to success; assured of that, I have no fear for the future of our Association.

GEORGE B. KIRKPATRICK,

*President of the Association of Provincial Land Surveyors of Ontario.*

*Toronto, Canada, February 28, 1888.*

Mr. W. R. Aylesworth, in moving a vote of thanks, said that the President had done invaluable work for the Association and to the profession during the two years he had held that office, and that his address was a very valuable one.

Vote of thanks was seconded by Mr. Niven, and then tendered the President.

Mr. Kirkpatrick in reply thanked Association for hearty vote of thanks tendered, and stated he would always endeavour to do all he could for the benefit of the Association. Let each member use a paddle and the canoe will then get along all right. (Applause.)

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# PAPERS.

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

## PRACTICAL SURVEYING.

By A. NIVEN,  
*Provincial Land Surveyor, Haliburton.*

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THE subject upon which I have been requested to read a paper, viz., "Practical Surveying," is too wide to be condensed interestingly into one article, and I shall therefore at present touch upon a few points only, and will first call your attention to that part of it which relates to the preparation of *Descriptions for Deeds* :—

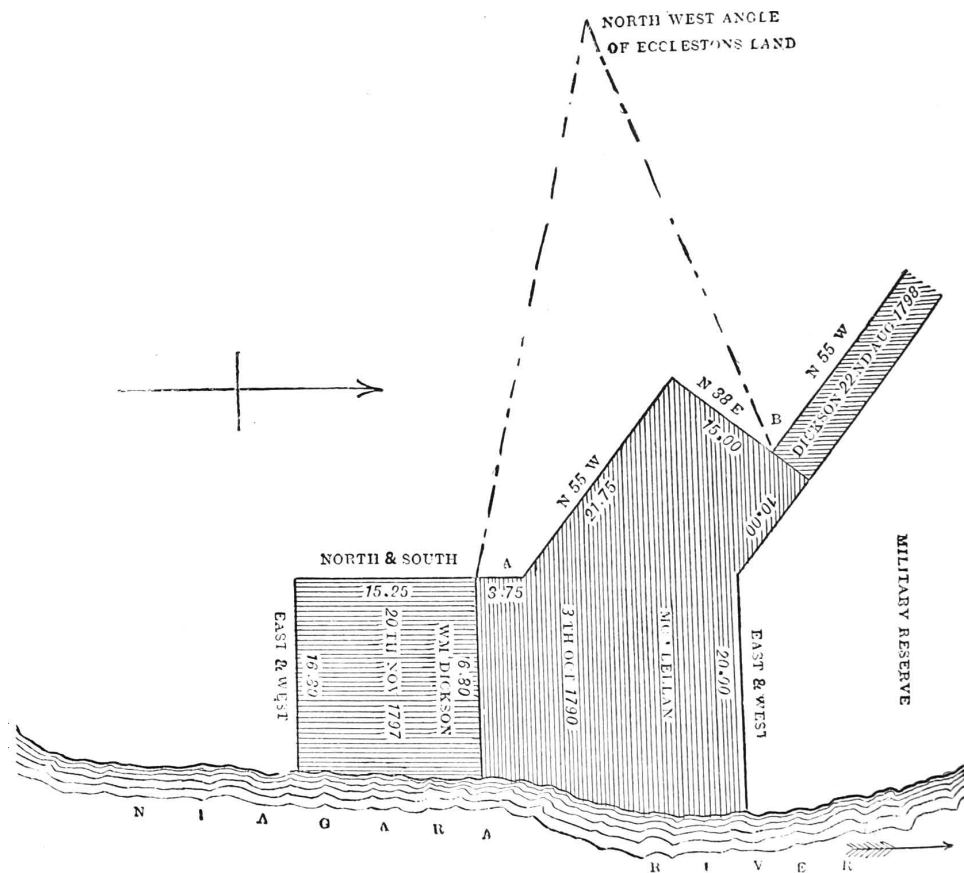
A blazed tree which may have been erroneously marked could soon be cut down. A stake or stone which may have been wrongly planted could soon be removed to its new site, but when a description once passes from our hands and becomes incorporated in a deed and the deed signed, and witnessed and sworn to and sent to the Registry Office it has utterly passed beyond our control.

Very often a township clerk or village schoolmaster, and sometimes the estate agent or the articulated clerk in a lawyer's office, for economy's sake, prepares both description and deed. Any error which may have been made may perhaps not be discovered until all the original parties to the transaction are dead, and when it is discovered I am afraid it is often very ungenerously set down as having been made by a Surveyor when a Surveyor was not called at all. Against such accusations we cannot well protect ourselves, very often we can say after reading a description that it was not prepared by a Surveyor, there is a want of genuineness in the ring of it, just as an expert can detect a counterfeit coin or bank bill. We should therefore aim at making descriptions clear and concise. A very celebrated conveyancer and real estate Surveyor, not now in practice, was accustomed to prepare descriptions but there was such a redundancy of words that it was difficult to understand what was meant, he never seemed to know when he had said enough.

There should be uniformity in our style. The words "more or less" should not be used unless the case actually required it. The phrase is now too often used as if a description could not be properly closed without it. When bearings are given I think it should be mentioned whether or not they are original magnetic bearings or present magnetic bearings or astronomical bearings, as without the addenda suggested courts are, I believe, inclined to say that all bearings are

astronomical. The limits of the old Town of Niagara (the home of my boyhood) may some day be the subject of an expensive lawsuit if ever the "boom" of land speculation should strike it before an error in it is rectified, and it will be caused by the word *easterly* having been used instead of mentioning the exact bearing.

"Commencing at Mississagua point, thence easterly along Lake Ontario to Cookstown; then along the rear or town line of Niagara to the Black Swamp Road; then along the eastern limits of the land



of the late Thomas Butler, and the lands of Garratt Slingerland to the north-west angle of the lands of John Eccleston; thence *easterly* to where the lands of William Dickson and Martin McLellan come in contact; then east along the northern boundary of McLellan's land to the Niagara River," etc., etc.

The difficulty which exists here is in being directed to go *easterly* from Eccleston's land, and the question which will arise is whether or not McLellan's land is in the Town or Township of Niagara, for Dickson owns and did own land on the north side of McLellan's and also on the south side.

There are two points A and B where Dickson's land and McLellan's land come in contact, and both are *easterly*; from the north-west angle of Eccleston's land towards the point, A being *south-east*, and towards the point, B being *north-east*.

It would seem as if the error occurred by saying then east along the *northern boundary of McLellan's land*, instead of along his *southern boundary*, or otherwise along the *northern boundary of Dickson's land*. The effect is either to include or exclude a large tract of land from the Town or Township of Niagara.

Another impracticable description occurred in Niagara, where the radius of a circle of 1,200 yards was to be drawn from a *point in Fort George*.

Fort George enclosed a piece of land of considerable area, and no particular point could be selected. One thought it might have been where the flagstaff stood, another hazarded the conjecture that perhaps it was the centre of the magazine, as it was a very solid structure of brick and iron, but no definite spot could be agreed upon.

A similar description occurs in Toronto, where the western boundary of the city was limited by the periphery of a circle of 1,000 yards radius to be drawn from a point where the east limit of allowance for road between lots 18 and 19 (now Bathurst Street) on being produced  $S.16^{\circ}E.$  would intersect *high water mark of Lake Ontario*.

Now, as there are no tides in our fresh water lakes our predecessors supposed that the water of Lake Ontario always remained at the same height, and considered that they had thus sufficiently well defined the centre of a circle from which at any time the circumference could be marked out; but the south limit of Bathurst Street terminated where the Gore Vale Creek had its outlet into the lake, and a considerable deposit of low alluvial land was formed there. The centre of this circle was fixed at high water mark, but in or about what year it was fixed there is no record; and when it is taken into consideration that the difference between high water and low water every six or seven or eight years is 4ft. 6in., or thereabouts, which would shift the centre from 200 to 300 feet, there is little hope at any time of being able to determine either the centre or circumference of this circle.

Whilst we are now criticising these descriptions, which were made eighty or ninety years ago, we might ask the question whether descriptions, which are made at the present day, of mining tracts, etc., will be free from difficulty to Surveyors who may succeed us eighty or one hundred years hence?

#### *The "Windmill Line" in Toronto Harbour.*

I was very much surprised to hear a Chief Justice interrupt and contradict a Surveyor who was giving his evidence, and who made a statement to the effect that no one could say where the "Windmill Line" was (that is, a line to the south of which no wharves are to be built). The said Chief flatly contradicted the Surveyor, and said that the "Windmill Line" was as well known as King Street.

Judges on the bench and lawyers on a cross-examination have considerable power, but they sometimes exceed their privilege. I

studied in Toronto, and claim to know that the "Windmill Line" was almost a myth. It existed theoretically, but practically I believe that no Surveyor could define it.

It was a line to be drawn from the old French Fort on a course "N.65°E." to an old stone building called "*Gooderham's Windmill*." One would think the old French Fort was a mere point, having neither length nor breadth, and from it you were to draw a line N.65°E. The plans of the Fort were long since carried back to France. Its actual site is, I believe, entirely obliterated by the encroachment of the lake. The old windmill which stood at the east end of the city, 30ft. or 40ft., or perhaps more, in diameter, was torn down about forty years ago. What, then, is there remaining by which a Surveyor can define this line, so as to be able to say that any particular wharf has been built beyond its limits? Nothing but the empty bearing of "N.65°E." Supposing it were possible to make an approximation by evidence as to the site of the old windmill, then comes the difficulty about the bearing. Was the N.65°E., as recorded in those early days, magnetic or astronomical? I cannot believe that it was astronomical, any more than I can believe that the course of King Street as "N.74°E." was astronomical, and yet a court of law would not allow it to be assumed that it was magnetic, for courts have decided that "N.65°E.," or some other similar bearing is an astronomical course. No Surveyor in Toronto will believe otherwise than that "N.16°W." and "N.74°E." are and were original magnetic bearings. If so, it is also most likely that the bearing of the "Windmill Line" was magnetic. If that be granted, then in order to renew the "Windmill Line" I should require that same compass from which was observed that bearing, and require it to be in the same state of magnetic intensity as it was at that date, and so range the line from the site of the old windmill. Any other compass would not do. Take several of such instruments, and set them up on the same straight line and they will give different bearings, Take the same instrument and it will itself give different bearings to the same line on different days, and project a straight line from the open field and glare and heat of a summer sun into the shade of a dense wood and the bearing at each end of the line will be different. Who, then, was right—the Chief Justice or the Surveyor—respecting the existence of the "Windmill Line"? "As true as the needle to the pole," is all very nice in poetry, but it will not do for practical surveying.

In a certain criminal case which occurred in the year 1818 the question arose in the court as to what was the meaning of the expression "northward," for on it depended whether or not the crime of murder was committed within the boundaries of Canada or in the United States; and it may not be uninteresting to submit the discussion on that word at the present time:—

*Mr. Sax*, a witness for the Crown, is being examined, and says: A line, supposing it ran due north, from the junction of the Ohio and Mississippi rivers would leave the River Winnipeg five degrees out of the Province of Upper Canada; not a northward line, but a due north line.

*Attorney-General.*—Do you mean to say that a northward line is not a north line?

*Mr. Sax.*—It is not always; it may be north by east, or north by west, or north north-west, or many other points of the compass. A due north line is one that goes direct to the North Pole without any deviation whatever.

*Attorney-General.*—And does not a northward line go to the North Pole? If you had a northward line to run, would you not run it to the North Pole?

*Mr. Sax.*—Perhaps I might, and perhaps not. I would certainly run it northerly, though I might not run it due north.

*Attorney-General.*—What is to prevent you taking it due north? If you had a line to run from a given point until it struck a river, and thence to continue along the course of that river northward, would you call that drawing a northern line?

*Mr. Sax.*—Undoubtedly it would be a northern line, but not a due north line.

*Attorney-General.*—Would it not? Could it be east or west?

*Mr. Sax.*—It might, according to circumstances, be a north-eastward or north-westwardly line, and yet a northern line; that is a line having a northward course or drawing nearer to the North Pole as it progressed, though not an astronomical north line.

*Attorney-General.*—Is not a north line a line northward?

*Mr. Sax.*—Certainly, a line running due north is undoubtedly a northward line.

*Attorney-General.*—And a line due north-westward you would call a north-westward line?

*Mr. Sax.*—Certainly, a line due north-west is a north-westward line; but a line, for instance, that runs towards the north, notwithstanding it may gain in its course more northing than westing or easting, is not therefore necessarily a due north line, but is a northern or northward line.

*Chief Justice Sewell.*—I do not really comprehend the distinction. To say that a northward line is not a north line, I confess, appears to me to approach the *reductio ad absurdum*. Suppose that we had a compass here, and from a given point I draw a line north-westward, that is to say, terminating at a point north-westward, would not that be a due north-west line?

*Mr. Sax.*—It would, if drawn due north-west, but if in drawing it you gained northerly it would from the course of its deviation be a line northward, though not a north line.

*Chief Justice Sewell.*—Then its course northward must unquestionably be due north, if a line north-westwardly is a north-west line. I want to know whether in point of fact—a fact that any man can tell as well as a surveyor—whether a line from the eastern or western point of the compass, drawn northward, is or is not a north line? Just answer that question, yes or no, and then you may explain that answer in any way you think proper.

*Mr. Sax.*—It certainly must be to a certain extent a north line, but not a due north line.

*Chief Justice Sewell.*—Why not?

*Mr. Sax.*—A line drawn from any point between two cardinal points of the compass direct to any cardinal point is a due north or due west line as the case may be, but a line may be so drawn between two points as to be called by surveyors a northward or a southward line as it may chance to gain in the course of running it upon that point of the compass to which it is approaching; as I might draw a line from a point north-westwardly, but gaining in a northerly direction in its course, so that at its termination it would be a line northward from having more northing there than at the point from which I started.

*Should the private field notes of a Surveyor be received in evidence after his decease?* My own private opinion is that they should not, and for the same reason that affidavits taken by a Surveyor are not received in court, because it is very often the case that a Surveyor is only employed by one party interested in the matter, and his manner in taking the evidence sometimes has a leaning towards his employer, and that the examination is not sufficiently searching. There is no cross-examination; for if so such replies might be made as would perhaps rather more entangle the subject than clear up the difficulty, and the surveyor finding a certain line of evidence easy for himself and also favourable to his employer follows it up and by doing so arrives at an *ex parte* conclusion.

A witness on giving evidence respecting the front limit of two adjoining lots said: "The place which I have this day pointed out is, I verily believe, the exact site of the original post planted in the first survey of the township." At the conclusion of his own voluntary statement on being asked why he believed so said "because there has been a cut stone monument planted there," and could give no other reason, so that if the stone monument had been planted a rod or more either on one side or the other, his assertion would in all probability have been the same. Witnesses are sometimes observed to call "old" stakes "originals" when they do not know what an original stake is; so that unless there is a Surveyor acting for each party interested in the survey, or unless one Surveyor is equally employed by both parties, I think that such evidence is rightly excluded from our courts.

A similar course of objection may be made to the entries made by a Surveyor in his field notes, unless his entries relate to facts, but sometimes his entries are but *his opinions* or the *opinions of others*.

I have however been surprised to hear that the original field notes of some townships which have been retained more by oversight than by any intention in the family of the Surveyor, and because they had not been deposited in the Crown Lands office, would not be allowed to be received in evidence in court. According to strict rules of the law of evidence this may be right enough—nevertheless I do think they should be now—even at this late date, gathered in and deposited in the Crown Lands office subject to the inspection of Surveyors, to be able to glean whatever information was possible from them, and thereafter to be used in court for what they are worth. If any interpolation



occurred anywhere not in the handwriting of the original Surveyor, then such parts of the notes might fairly be rejected.

*The Statute of Limitations*, which prevents a line from being moved to its true position after a lapse of "ten years," is in my opinion a most unjust and absurd law, and should be repealed. A person should never be ousted from his just right by any such frivolous claim.

Two people, wishing to live on adjoining farms peaceably and neighbourly with each other, neglect to enquire whether or not the line fence between their lots is correctly located. After their decease the old rails are so rotten as to be no longer fit for a division line, and in all probability it is mutually agreed to erect a post and board fence, but before doing so one side thinks it advisable to call in the services of a Surveyor, and finds that the position of the old snake fence was wrong, but the other side having the "ten" or even "twenty" years possession to sustain him refuses to allow justice to be done, although there is nothing in the way but a lot of rotten rails which could be moved in twenty-four hours. I admit that where a solid stone wall or brick building is occupying the ground, *that* and *that only* should alter the case, but even then compensation should be made for the land taken and this amount of compensation should be settled by arbitrators of their own choosing.

In former times a similar law existed respecting ancient window lights, where if a person erected a house with windows overlooking his neighbour's lawn or garden or other unoccupied piece of land, and such windows had existed over "twenty years," that then I could not build a house on my own land so close to those windows as to obstruct the light within certain limits. That relic of a feudal law has, I am glad to say, been repealed in Ontario, and the Statute of Limitations respecting the "ten years'" possession should be made to follow it.

Shortly after I commenced practising as a Surveyor in the Town of St. Mary's—now more than a quarter of a century ago,—while walking up the street one day with my instrument on my shoulder, I was accosted by a farmer in this way: "Hello there, Mr. Surveyor! What do you charge for running a line?" I replied, "Six dollars a day." "But," said he, "I don't want you a day; I've got a post at the corner of my lot, and I want you to start there and go ahead; you can do all I want in two hours."

In vain I explained to him that the law compelled me to go to the end of the concession from which the lots numbered, and get my bearing and then angle up to this post, or take an observation before I could start to run his line. "Well," said he, "after you get your bearings at your own expense you can come and run the line at mine." Bidding him good-day, I continued my journey.

This is one of the greatest difficulties a Surveyor has to contend with in a new country where the people are poor and cannot afford to pay for the work necessary to be done to comply with the Act, and it has often occurred to me that it would simplify surveying very much if all lines were run on the astronomical course of the original survey of the township.

In most cases the side roads and concession roads are not cut out, and we all know that this means a good deal more work to get a start than doing what is required to be done—and I throw out the suggestion for consideration: Whether the law should not be so amended that when a Surveyor is called upon to run any line, that he should run it on the astronomical course given on the original plan and field notes of the township on record in the Department of Crown Lands.

It might be said that this would not answer in the older townships where most of the lines have been run: but could this not be applied to the northern townships of this Province? say for instance, all north of a range of townships across the country in the vicinity of the rear of the older counties—such a line would be almost a line from Collingwood to Ottawa. As the section of country north of such a line is mostly surveyed into blocks or sections of 1,000 acres or 640 acres where the side of the block from which the lots number becomes the governing line for the block, the effect would simply be that in the 1,000 acre blocks, where the Surveyor had not run the boundaries on the true course of N. 20° 51' 40" W. astronomically for instance, there would be two lots whose sides would not be parallel, instead of one as under the present law, and in my opinion this evil would be more than counterbalanced by being less troublesome to the Surveyor, and consequently less expensive to those requiring surveys to be made.

I might say a few words with reference to *Bush Surveys* but feel that my paper is perhaps now too long.

The "management and equipment of a surveying party" was admirably treated of in a paper by Mr. Fawcett, D. T. S., read before the Dominion Land Surveyors' Association at Ottawa in 1885, and also in "Crown Surveys," read before this Association last year by Mr. Stewart.

I can endorse all that those gentlemen said of the trials and tribulations of a Surveyor, but anything that can be written descriptive of a "Bush survey" falls short of the reality, and one requires to "go through the mill" as the saying is, to really understand what is required.

In conclusion I would say that the basis of good surveying is accurate measurement, and that the frequent examination of chains and instruments is of the greatest importance. No man can do accurate work unless he has accurate instruments to do it with, and given these he has to exercise the intelligence and care that is necessary to the performance of accurate work, remembering that what is worth doing is worth doing well.

#### DISCUSSION.

Mr. Niven, referring to his paper on Practical Surveying, said:— I would particularly like to ask your opinion, Mr. President, and the opinion of those who are acquainted with practical surveying, to express their views on the suggestions I have thrown out in my paper.

Mr. Fawcett—I came across some very defective descriptions in British Columbia, and if there had been nothing but the description

to guide me as to which way to run I would never have known ; and if I had not had a sketch I would have been entirely at sea. I think it would be a good idea if Surveyors would adopt some uniform method in describing by giving the azimuth of the lines. That is done in making Government surveys for the Dominion Government ; the north point zero, and then around by the east to 360 degrees. Then in giving the azimuth there could be no mistake. I think it is just as convenient to use the complete circle, as you lay off your azimuth at once on the circle, and it would be just as well to adopt that method.

Mr. Dickson—With regard to descriptions I don't think that any deed should be drawn until the description was written by a Surveyor, and not by a lawyer. I had an action where a description was written by a solicitor ; and how do you think he began to describe ? He began at the point of a stump, and said we will call this stump so many rods in one direction, and so many in another. If that stump were removed it would be impossible to find that piece of land. With regard to bearings I think we should have true astronomical bearings.

Mr. Proudfoot—There is a point in the paper that deserves some attention—that with regard to deceased Surveyors' notes being taken in evidence. I have lately had a case in which the whole notes on file in the Crown Lands Department were put in as evidence. It was urged that they should be taken as evidence (perhaps not as substantial evidence) so as to clear up certain points. I thought it unfair that they should be produced, as they were not in ink, shewing that they were copies, but they were sworn to. Now as to the description. I know one that commences at the corner of a house, and that house has since been moved away half a mile. When another deed is to be given, and that mark is gone, what are you to do to correct this description ? If we go on we will have to copy that old description, I suppose.

Mr. Sankey—With regard to Surveyors' notes being taken in evidence, take the case of a Surveyor's private notes ; ought they to be received in court ? I think not ; for as a rule I think the Surveyor who takes them is the only man in the world who can say what is intended by the entries ; and I know some years afterwards one has to rack his own brains to know what they do mean. In regard to correcting descriptions, there is no difficulty about that, and you can easily say in your deed, "At the place where the old pine stump was standing" on such a date. Finally, in regard to the "Old Windmill" in Toronto I would just say, for the information of this Association, that I succeeded in locating it. It was a circular structure of about thirty-nine feet in diameter, and I found the foundation, which was of masonry, the brick superstructure having disappeared. But with regard to the other end of the line, the Old French Fort, I fear that is more difficult to place, and it is probable that it has been washed away altogether, but for all practical purposes the site of the "Windmill" has been established.

Mr. Dickson—I think the fact of the Surveyor's notes having been taken in ink should not preclude their being taken in evidence; all my notes are copied that way, and, under the circumstances, ought to be received in evidence as original notes.

Mr. Chipman—Regarding a deceased Surveyor's notes, I think that comes up before the Legislature on that heading. There is one point I would like to refer to Mr. Niven. He thinks the Statute of Limitations should be done away with. I would like to know how we are to do in the eastern part of the Province if that Statute were done away with, as I have found side-lines varying from one to five degrees from their proper bearings run nearly one hundred years ago. I don't see, if you do away with the Statute of Limitations, under these circumstances, what you would do?

Mr. Esten—I read over a case a short time ago where a judge held that a man could not hold a lot unless he could prove possession for forty years.

Mr. Niven—With regard to ten or twenty years' possession—in Mr. Chipman's case, over one hundred years—I would not, certainly, like to go back as far as that. I would not mind twenty years, but I certainly think ten years is an absurdity.

Mr. Gibson—As to old notes of deceased Surveyors, if not satisfactory evidence the Court has a right to rule them out. Then as to affidavits in Court, they are invariably ruled out because they are not made to conform to the law. A Surveyor who will draw an affidavit improperly destroys his own case. With reference to the ten years' possession you must look after your property in time.

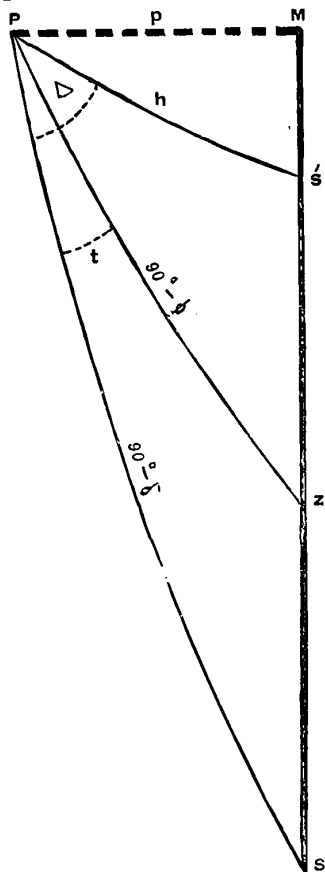
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## FORMULÆ FOR FINDING THE TIME BY OBSERVATIONS IN THE VERTICAL OF POLARIS.

By E. DEVILLE,  
F.R.A.S., F.R.S.C., Surveyor-General, Ottawa.

WHEN a time star is observed on the same vertical as the pole star at a time  $\theta$  before or after the setting on Polaris, the results and computations are the same as if both stars had been observed at the same instant, the right ascension of the pole star being decreased or increased by  $\theta$ . Consequently in the following formulæ we shall suppose both stars observed at the same instant.



$P$  being the pole,  $Z$  the Zenith,  $S$  and  $S'$  the time star and Polaris, let—

$PM = p =$  perpendicular to  $SM$ ,  $\phi =$  latitude  
 $ZPS = t$   $\delta, \delta' =$  declinations  
 $S'PS = \Delta$   $a, a' =$  right ascensions  
 $90^\circ - MPS = x$

In triangle  $ZPM$  we have:

$$(1) \sin(t + x) = \tan p \tan \phi$$

and in  $SPM$ :

$$(2) \sin x = \tan p \tan \delta$$

Therefore,  $p$  being known, the values of  $(t + x)$  and  $x$  might be deduced from the above equations and  $t$  found by subtraction, but considering that  $t$ ,  $x$  and  $p$  are small arcs, we may write, when no great accuracy is required:

$$\begin{aligned} (t + x) &= p \tan \phi \\ x &= p \tan \delta \end{aligned}$$

subtracting

$$(3) t = p (\tan \phi - \tan \delta)$$

which formula is easily calculated with a table of natural functions. If none is at hand, the following form of the same formula will be used:

$$(4) t = p \frac{\sin(\phi - \delta)}{\cos \phi \cos \delta}$$

NOTE.—The above demonstration by E. Deville, F.R.A.S., F.R.S.C., etc., Surveyor-General, of the formulæ for finding the time by observations in the vertical of *Polaris*, given in the Manual of Dominion Land Surveys, will be highly valued by all our surveyors, who will also feel much obliged to their distinguished confrère for the elucidation of this problem.

If the pole star had been observed at a time  $T'$ , and the time star at  $T$ , then:

Expression of  $p$ :

$$\Delta = (d - \alpha') - (T - T')$$

Let  $PS' = 90^\circ - \delta' = n$

In triangle  $S'PM$  we have:

$$\tan p = \sin (\Delta + x) \tan n;$$

using the developments of  $\tan -y$  and  $\tan y'$ , and neglecting the powers of  $p$ ,  $x$ , and  $n$  above the third:

$$(5) \quad p = n \sin (\Delta + x) + \frac{1}{3} n^3 \sin \Delta \cos^2 \Delta.$$

Developing  $\sin (\Delta + x)$  and neglecting the powers of  $x$  above the second:

$$(6) \quad \sin (\Delta + x) = \sin \Delta - \frac{x^2}{2} \sin \Delta + x \cos \Delta$$

In triangle  $MPS$  we have, neglecting the powers of  $p$  and  $x$  above the second,

$$x = p \tan \delta$$

substituting this value of  $x$  in (6):

$\sin (\Delta + x) = \sin \Delta + p \tan \delta \cos \Delta - \frac{p^2}{2} \tan^2 \delta \sin \Delta$  and Eq. (5) will become:

$$p = n \sin \Delta + n p \cos \Delta \tan \delta - \frac{n p^2}{2} \sin \Delta \tan^2 \delta + \frac{1}{3} n^3 \sin \Delta \cos^2 \Delta$$

which is reduced by neglecting the powers of  $n$  and  $p$  above the third to:

$$(7) \quad p = n \sin \Delta + \frac{n^2}{2} \sin 2 \Delta \tan \delta + n^3 \sin \Delta (\cos^2 \Delta \tan^2 \delta + \frac{1}{3} \cos^2 \Delta - \frac{1}{2} \sin^2 \Delta \tan^2 \delta)$$

The table was computed with a mean value of  $\delta'$  equal to  $88^\circ 41'$ . The result must be multiplied by  $\frac{\cos \delta'}{\cos \delta_0}$  for the time of the observation.

When  $\Delta$  is smaller than  $12^h$ , the correction is to be subtracted from the star's right ascension, and to be added when it is larger than  $12^h$ .

The arguments of the table are:

$$\Delta = (\alpha - \alpha') - (T - T') \text{ and} \\ \delta = \text{Declination of time star.}$$

(See Table VII. of the "Manual of Surveys.")

#### EXAMPLE.

On April 29th, 1880, the pole star and  $\alpha$  Columbæ were observed on the same vertical, the times being by a sidereal chronometer  $5^h. 28^m. 37^s.$  for Polaris, and  $5^h. 33^m. 14^s.$  for the time star. Latitude,  $46^\circ 49'$ . Required the chronometer correction,

*Approximate Solution.*

$$\begin{array}{rcl}
 \alpha = 5 & 35 & 18.5 \\
 \alpha' = 1 & 13 & 04.5 \\
 \hline
 \alpha - \alpha' = 4 & 22 & 14 \\
 T - T' = & 4 & 37
 \end{array}
 \qquad
 \begin{array}{rcl}
 T = 5 & 33 & 14 \\
 T' = 5 & 28 & 37 \\
 \hline
 T - T' = & 4 & 37
 \end{array}
 \qquad
 \begin{array}{rcl}
 \delta = -34^\circ & 08' & 30'' \\
 \delta' = & 88 & 40 & 13.8
 \end{array}$$

$$\Delta = 4 \quad 17 \quad 37 = 4 \quad 17.6$$

$$\text{Nat tan } \phi = +1.06551$$

$$\text{Nat tan } \delta = -0.67811$$

$$\tan \phi - \tan \delta = 1.74362$$

(Table VII. of Manual)

$$\begin{array}{r}
 \log = 0.24145 \\
 \log p = 2.45179
 \end{array}$$

$$\log \frac{\cos \delta'}{\cos \delta_0} = 0.00421$$

$$\log t = 2.69745$$

$$t = 8^m \ 18.3s$$

$$\alpha = 5 \ 35 \ 18.5$$

$$5 \ 27 \ 00.2$$

$$T = 5 \ 33 \ 14.0$$

$$\text{Chr. fast} \qquad 6 \ 13.8$$

*Rigorous Solution.*

In the triangle  $SPS'$  we have:

$$\text{Angle } SPS' = 4^h \ 17^m \ 37s = 64^\circ \ 24' \ 15''$$

$$PS' = 1^\circ \ 19' \ 46.2''$$

$$PS = 124^\circ \ 08' \ 30''$$

Whence by spherical trigonometry the angle  $S = 1^\circ \ 26' \ 20.6''$

Then from the triangle  $SPM$  we have  $\sin p = \sin PM = \sin S \cos \delta$

$$\text{Whence } \log \sin p = 8.3177673$$

$$\text{and } \log \tan p = 8.3178512$$

Then by the formulæ for  $t + n$  and  $x$ ,

$$\log \tan p = 8.3178512$$

$$\log \tan \phi = 0.0275587$$

$$\log \tan p \quad 8.3178512$$

$$\log \tan \delta \quad 9.8313014 \ n$$

$$\log \sin (t + x) = 8.3454099$$

$$t + x = 5^m \ 04.6s$$

$$x = -3 \ 13.8$$

$$\log \sin x = 8.1491526 \ n$$

$$x = -3^m \ 13.8s$$

$$t = 8 \ 18.4$$

$$t = 8 \ 18.3 \text{ by the approximate method.}$$

0.1 Error of the approximate method.

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

## COURT DECISIONS ON DRAINAGE CASES.

BY W. R. BURKE, C.E., AND H. B. PROUDFOOT, C.E.

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### WHITE *vs.* TOWNSHIP OF GOSFIELD.

2 O. R. 287; 10 A. R. 555.

GOSFIELD Township in 1865 passed a By-law for the construction of a drain, which went through White's land, and for assessing certain lands, including plaintiff's, for making the drain. The drain was commenced in 1866 and completed. In 1873 they passed another By-law for deepening and widening this drain, which was accordingly done. In 1881 they constructed another drain running into first one below the plaintiff's land. The first drain having become out of repair and choked up, the plaintiff's lands were to some extent flooded in the spring and fall, and the water lay longer than if the drain had been kept properly clear. White, whose lands were injured thereby, notified the Council, calling upon them to repair, which they omitted to do. White brought an action against Council for damages. Trial came before Hagarty, C. J., at the fall assizes, at Sandwich, in 1882, without a jury. The learned Justice decided that defendants were liable to maintain the drain, and that they had not done so, and White should receive \$200 damages. He directed judgment therefor with full costs of suit, and that a mandamus do issue as prayed in the pleadings.

Gosfield appealed to full court of Q. B. D. This court upheld Hagarty, C. J. The Township of Gosfield then appealed to the Court of Appeal. This court affirmed the judgment of the Q. B. D.

### THURLOW TOWNSHIP *vs.* SYDNEY TOWNSHIP.

The Arbitrators appointed by the two Townships on an appeal by the defendants from the report of the Surveyor made an award, pursuant to the Municipal Act, whereby they adjudged that the deepening of a creek, etc., benefited lands in the defendant's municipality, and that the latter pay therefor \$350, but the award did not specify the lands which in their opinion were so benefited, nor charge such lands with a just proportion of the cost of the works.

Held for this reason the award was invalid and of no use.

J. D. Evans, of Belleville, surveyor.



TOWNSHIP OF ROMNEY *vs.* TOWNSHIP OF MERSEA.

Tried at Toronto Court of Appeal. 11 A. R. 712.

A By-law was passed by the Township of Mersea, providing for the drainage of lands in Mersea and Romney, and assessing property owners in both Townships.

Held that the By-law was invalid because the petition therefor did not describe the property to be benefited, and the By-law itself, which did not show the property to be benefited, disclosed that the petitioners were not the majority of the owners of such property.

TOWNSHIP OF WEST NISSOURI *vs.* N. DORCHESTER TOWNSHIP.

Ont. Reports, 1887, Vol. XIV. Pt. 3, p. 294. Mentioned further on.

N. Dorchester, on a petition of 23 out of 39, passed a By-law assessing ten persons in W. Nissouri. Subsequently 17 persons in N. Dorchester withdrew their names from the petition, and N. Dorchester dropped the matter. Afterwards 7 out of the 10 in W. Nissouri petitioned the Council to proceed with the work, which they did, and afterwards brought an action compelling N. Dorchester to pass a By-law to raise the necessary amount. The case was dismissed with costs by Galt, J., who held that it was a case for the County Council under Sec. 598, and that the Township Council had no authority to pass such a by-law. Plaintiffs appealed to the Divisional Court, before Boyd, C.J., and Ferguson, J., who confirmed Galt's ruling, and held that there should always be a majority of the parties interested, whether they are all in one township or not.

MALOTT *vs.* THE CORPORATION OF THE TOWNSHIP OF MERSEA.

9 O. R. 611.

Malott brought action for an injunction against the Township of Mersea. A drain constructed by the Township of Mersea had caused an increased quantity of water to flow into a creek running through his land, which was in an adjoining Township, without making provision for the increased quantity, and his (Malott's) lands had consequently been flooded and damaged, partly from the increased quantity and partly from the increased velocity of water. The case came first before Ferguson, J., at Chatham. He held that Malott was entitled to an injunction restraining the increased flow of water into the creek and also the increased velocity, and that he was entitled to damages. Township of Mersea appealed from this decision to the full Chy. Div. Court, in Toronto, when Ferguson's decision was confirmed by Boyd, C.J., and Proudfoot, J.

SMITH *vs.* TOWNSHIP OF RALEIGH.

Case came before Judge Ferguson at Chatham on May 11, 1882. Then argued at Toronto. 3 O. R. 405.

Raleigh passed a By-law for a drain on the petition of plaintiff and other ratepayers for construction of a drain, and assessed lands

for same, part of which Smith owned. Drain had not been completed, though a reasonable time had elapsed, and portions of the moneys assessed had been applied upon a certain other drain not mentioned in the petition, the report of the Provincial Land Surveyor made pursuant to R. S. O. chap. 529, or in the said By-law, and of no value to the said petitioners,

Held that the plaintiff was entitled to an order compelling the corporation to complete the drain according to by-law, to an injunction to restrain further misapplication of the moneys assessed, and to an account thereof, for that the by-law created a trust which had been violated.

IN RE CLARK ET AL. AND TOWNSHIP OF HOWARD.

14 O. R. 598.

On 21st September, 1868, a By-law was passed by defendants for constructing three several drains in a township, setting forth in separate schedules the land to be benefited according to the engineer's report, and the amount required therefor to be assessed and levied on the said lands. On the 11th December, 1883, a By-law for repairing and clearing one of said drains, the amount required therefor to be assessed and levied on the said lands assessed for the original construction of said drain. On 21st September, 1886, another By-law was passed to change the assessment for the construction of said drain, and to make it more equitable and prevent injustice in levying the same. The engineer was, in making his assessment, limited by the reeve to the lands assessed for the original construction of said drain, and he accordingly limited his assessment thereto, but he reported that great injustice would be done thereby, as a large area of land that would be benefited by the work would escape assessment. The last mentioned By-law declared that the report was adopted, and that, in accordance therewith, the original assessment should be changed and the assessment as made by the engineer adopted, disregarding his protest as to a large area of land benefited being unassessed. There was an appeal to the Court of Revision against the assessment, and the Court, discriminating in favour of some and against others, altered some of the assessments by deducting amounts therefrom and placing the amounts so deducted on others, leaving others undisturbed, thus not making a *pro rata* variation of all the assessments.

Held that the By-law was bad and must be quashed.

In 1886 an application was made to the Chancery Division to quash the By-law passed in 1883, which was heard in December, 1886, and judgment delivered in February, 1887, declaring the By-law to be a void proceeding. The By-law in question was passed on 21st September, 1886.

QUÆRE.—Whether this rendered the By-law in question invalid?

*Notes from Judgment.*

June 25th, 1887, Robertson, J.

By-law of 1868 passed by authority of 29 and 30 Vict. chap. 51, secs. 281 and 282.

On 11th December, 1883, passed a By-law for cleaning out said drain. Augustine McDonell, Esq., C.E., P.L.S., made the examination (and also the original assessment), reported the \$2,000 was required.

On 21st September, 1886, passed By-law now in question, "To change the assessment made for the construction of the McGregor Creek drain," etc., recites passing of the previous By-laws, and declares "that in the opinion of the said council it has become necessary to change the said assessment for the purpose of making it more equitable, and to prevent injustice in levying said assessment," etc.

Mr. McDonell's report in extracts:—

In accordance with your instructions, received from the reeve, etc., requesting me to make an examination of certain lands in your township for the purpose of levying an assessment to defray the expenses of repairing, etc. . . . I beg to say, etc. . . . I find in the first place, that certain lands . . . assessed for the original construction cannot be assessed for the recent improvements, as the said lands drain into the creek below where any improvement was made, etc. . . . as I am limited in my instructions to confine the assessments to the lands originally assessed for the construction of the drain being, etc., . . . the amount required, which is \$2,000, will come very heavily on the above described territory. Again I find that several other drains, such as the Crouch drain, the Harrison drain and the Crawford drain, have been constructed since the McGregor drain, and using the said McGregor drain as an outlet, draining some 9,000 acres of land into the McGregor Creek drain and not paying a cent for the use of the outlet, which is a grievous wrong to the people who paid for the construction and maintenance, etc., . . . inasmuch the above mentioned 9,000 acres should be taxed in fair proportion for both construction and maintenance.

Mr. McDonell made an assessment (Sec. 570) of the lands to be benefited according to his limited instructions. Object of assessment. S.S. 3, sec. 570, sub-section 15. Assessment to be varied *pro rata*. As the Council discriminated in favour of some and against others assessment was not varied *pro rata*.

The assessment as varied cannot be what was intended by the legislature, nor can it be the meaning of the statute.

In the first place, the appointment of a P.L.S., or a C.E., as required by the Act, to be taken preliminary to the consideration of the question of gratuity, the prayer of the petitioners, the object being to ascertain what the costs will be, and to charge each lot or parcel of land benefited according to the benefit to be received by the construction of the work. The legislature therefore declared that a C.E.

or a P.L.S. should be the person employed to do this work, and from the simple reason that from the nature of his profession and his education he is the description of professional man who could make the proper calculation and arrive at the just and most accurate conclusion.

It is held By-law should also be quashed, as it purports to amend or correct a By-law passed in 1883 which has been declared by the Chancery Division to be a void proceeding. In that decision it is held that a By-law based on another By-law which has been declared void must itself be void.

Judgment same as Chancery Division.

The interference of reeve gross and unwarrantable; engineer could not do work under Sec. 570.

It is difficult to find language to express properly the character of this municipal legislation.

Council fly in teeth of Sec. 584, and in direct opposition to what the Surveyor had declared to be just. By-law quashed with costs.

#### MISSOURI *vs.* DORCHESTER.

See *ante*, No. 4, p. 2.

Extracts from Judgment and Report. 14 O. R. 294.

Plaintiffs' By-law was provisionally passed June 10th, 1886—finally July 16th, 1886. Plaintiffs claimed a mandamus to compel defendants to pass a By-law. Defendants said plaintiffs' By-law was invalid. The petition was not signed by the requisite number of owners, and showed on its face that more than those owning lands in West Missouri were interested in said drain, and none of them were parties to the said petition.

Galt, J. (without jury) May 11, 1887 :

“ I find that the work in question proposed to be constructed affects both the Municipalities of Missouri and North Dorchester, and that under Sec. 598 of the Municipal Act, 46 Vic., the County Council is the proper authority to pass By-laws for such a purpose, and that the plaintiffs had no power to pass the By-law now before me. I therefore dismiss this action with costs.”

Boyd, J.—Referring to sections of Municipal Act relating to such questions: “ These sections have been characterized in a late case by the Court of Appeal (as difficult and obscure) and their elucidation has not been aided by diametrically opposite opinions of the Judges of the Superior Court in the same case: *Dover vs. Chatham*, 11 O. R. 248 and 12 S. C. R. 321. The intent of the Statute appears to me is, that if the drain projected in one township is carried into a neighbouring township, it should only be for the purpose of outlet, where that outlet can be found within a reasonable distance of the boundary,” “ would not go so far as Henry, J., who says a majority of the persons to be benefited in both townships is necessary. This construction appears to overlook the provisions of Sec. 581, which directs the Council of

the servient Municipality to pass the By-law 'as if a majority of the owners of the lands to be taxed had petitioned as provided in Sec. 570.'"

Judgment affirmed with costs.

Vol. XII. and XIII. O. R. No drainage cases.

Vol. XI., p. 74.

IN *Re* FUNSTON AND THE CORPORATION OF THE TOWNSHIP OF  
EAST TILBURY.

11 O. R. 74.

In the drainage by-law the assessments as made by the engineer and contained in the schedule to the By-law were revised by the Court of Revision and alterations made, but the By-law was not amended before being finally passed so as to correspond with such alterations as required by Sec. 571 of the Municipal Act of 1883, and it was impossible to discern from such alterations as made the amount of the "total special rate" against each lot or part of lot, and therefore the amount to be annually levied to be ascertained by dividing such total special rate by the number of years the By-law has to run, which in this case was fifteen years.

Held that the defect was fatal to the By-law.

The *locus standi* of the applicant was herein objected to, but on the evidence the objection was overruled.

In moving to quash a By-law the practice has been adopted of applying to a Judge sitting alone, an objection that the application should have been to the Divisional Court was not entertained: but such an application if required to be made to the Divisional Court must be to the Common Law Divisional Courts and not to the Chancery Divisional Court.

Vol. X., no cases reported.

IN *Re* CLARK AND THE MUNICIPALITY OF THE TOWNSHIP OF HOWARD.

9 O. R. 576.

This case relates to the appointment of Inspector of Drains, and is of interest more to Municipal Corporations than to Engineers.

(As the question does not affect Engineers to any extent I will not say anything about it.) By-law quashed.

CORPORATION OF CHATHAM *vs.* CORPORATION OF SOMBRA.

44 Q. B. 305.

The declaration was for money to be paid by the defendants to the plaintiffs according to the award of Robert Fleck, Augustine McDonell and Thomas R. K. Scott, made under submission to arbitra-

tion by plaintiffs and defendants of matters in difference between them. There were also the common counts. The plea was "Never indebted."

The trial took place at the last Fall Assizes at St. Thomas, before Galt, J., without a jury.

The plaintiffs' township desired to effect some works under the drainage clauses of the Municipal Act, and alleged that parts of the defendants' township would be benefited thereby. A report was made by the engineer, and a sum was assessed against certain lands and roads of the defendants by reason of the benefit to them arising from the work in question, all of which was to be executed within the plaintiffs' township.

The defendants appealed and an arbitration was duly arranged, and the above named parties were appointed referees.

By award dated 30th September, 1875, and signed by all three, they awarded "that the Township of Sombra, for benefit of road and lands by the deepening of Otter Creek as recommended by I. W. Shakleton in his report to the Council of Chatham, shall pay to the said Township of Chatham the sum of \$700, instead of the sums named in the report, which said sum of \$700 the said Township of Sombra shall apportion in the same ratio for benefit to roads and lands as is set forth in the said report, or in such other manner as shall be lawful, and shall pay the said sum of \$700 to the said Township of Chatham.

The work was proceeded with and finished two or three years ago. In August, 1887, the defendants were applied to, but did not pay.

At the trial the defendants called witnesses to show that the work was not done well, that the cutting was not deep enough, that it was not of much benefit to Sombra, and that it could be made a good deal better.

For the plaintiffs witnesses said the work was done well, and that it was impossible to ascertain how the work was completed several years ago.

The Judge entered a verdict for the plaintiffs for the amount of the award, with interest from four months after the demand.

May 22nd, 1879, Bethune, Q.C., obtained a rule *nisi* to enter a verdict for the defendants, on the grounds that the plaintiffs had not performed the work for the doing of which the action was brought.

June 2nd, 1879, McMichael, Q.C., showed cause.

Falconbridge contra.

June 28th, 1879, Hagarty, C.J. : If we accept the learned Judge's finding, which we regard as in favour of the plaintiffs on the merits, the objection is at an end. On reference to him, we find he is quite satisfied as to the merits.

On this point alone the defendants fail, unless we take a different view of the merits. But a perusal and consideration of the evidence induce us to think that we cannot safely interfere with the finding. It was also urged for plaintiffs that the doing of the work, or the doing of it in any particular manner, was not a condition precedent to their right to receive the money. Section 538 declares that the report, plans and specifications of the engineers shall be served on the defend-

ants, and unless appealed from shall be binding on them. Section 539 directs the defendants within four months from the delivery to them of the report to pass a by-law to raise such sum as is named in the report, or, in the case of appeal, such sum as may be determined by the arbitrators. In this case it does not appear that the defendants took any steps whatever after the award was made. The work was proceeded with and finished a couple of years before the action was brought. It does not appear to us that they are entitled to refuse payment until the work is done. This award is partly for the benefiting of lands and partly for roads.

In this case the validity of the award was undisputed. It contains an absolute award for payment of a named sum. The statute directs that sum to be raised in a named time. We are not concerned with the question whether the defendants raised the money as directed and then refused to pay it over, or whether they have done nothing whatever in the premises beyond standing by and allowing the plaintiffs, without objection or remonstrance, to carry out the improvements on Otter Creek, which were undertaken clearly on faith of this contribution from defendants' township.

It seems to us that in the case before us the verdict must stand.

Armour and Cameron, JJ., concurred. Rule discharged.

#### IN RE MONTGOMERY ET AL. AND THE TOWNSHIP OF RALEIGH.

C. P. 381.

To a By-law passed under 32 Vict. ch. 43 (Ont.), was annexed a schedule (declared to be part of the By-law) entitled "Schedule showing the benefit to be derived by each lot from the drainage to be performed under the By-law," Held that such a By-law containing such a schedule sufficiently indicated that the lands so assessed were assessed as the only lands within the municipality regarded as benefited by the proposed work; and that it was not necessary that the By-law should specify the mode of ascertaining and determining the property to be benefited under sub-sec. 4 of sec. 2 of the said Act.

Held also that, supposing the question open for the consideration of the Court, whether or not the lands assessed were the only lands benefited, which should have been assessed, lay upon the applicants against the by-law and that in this they had failed. But held, that the objection that all the lands would be benefited had not been assessed, or that the assessments upon the respective lots were overcharges, or that the by-law did not provide properly for determining what lands were benefited, were not grounds for moving to quash the same as by the said 4th sub-section an appellate tribunal is appointed.

Held, also, that an objection, that the petition mentioned in the by-law was not signed by a majority of the resident owners of property assessed, etc., was not open to the applicants upon the motion, but that if it were the onus of proof was upon them, and in this also they had failed.

Held, also, that the 3rd section of the by-law set out below was not open to the objection, that it did not properly provide for a special rate sufficient to include a sinking fund for payment of the debentures therein mentioned, but provided for levying and raising certain instalments with interest.

Held, also, that there was no necessity for the By-law to name a day in the financial year from which it was to take effect, as this was not required by the statute which authorized its passage.

Osler obtained a rule *nisi* why this By-law regarding drainage, passed by the Township of Raleigh, should not be quashed, for the following reasons:—

1. Because the said By-law did not provide for ascertaining and determining what real property would be benefited by the proposed drainage. 2. That no By-law was passed for ascertaining or determining through engineer or other competent persons what lands would be benefited by the proposed drainage, and assessing the same, and that the said By-law itself did not make any provision therefor. 3. That the said By-law did not show that the properties mentioned therein did not show that the properties mentioned therein and assessed thereby were the only lands benefited by the proposed drainage, and that the property and lands mentioned therein and assessed by the said by-laws were not the only lands benefited thereby. 4. That the petition mentioned in the said By-law was not signed by a majority in number of the resident owners of the property mentioned in and assessed by the said by-law or of the property to be benefited by the proposed drainage, nor did a majority in number of the resident owners or of all the owners of property to be benefited petition the council of the said corporation for the deepening of the stream, creek or water-course, or the draining of the property mentioned in said by-law. 10. That the said By-law did not properly provide for a special rate sufficient to include a sinking fund for the payment of the debentures therein mentioned, but provided for the levying and raising of certain instalments with interest, and did not state or provide from what date interest was to be charged. 11. That the said by-law did not name any day in the financial year from which the same was to take effect.

It appeared from the facts stated that a number of residents of the Township of Raleigh petitioned the Council of Raleigh to cause a drain to be opened. The council hired an engineer to go over the proposed drain, and make out a report of it, and he did so, making the different assessments with which each township and each person should be assessed. The estimate amounted to \$4,537, but the heads of the corporations of Harwich and Chatham appealed from this award, and arbitrators were appointed. They decided that Chatham should pay \$475, Harwich \$990, and the balance was to be raised by the Township of Raleigh and other sources. A By-law was passed enacting:—1. That the drain and branch should be made in accordance with the survey and levels of the said engineer. 2. That the township of Raleigh should raise the sum of \$2,606. Debentures were raised by the Township of Raleigh,



and this was divided into three annual payments, which payments were collected along with the taxes, and were placed to form a sinking fund to meet these debentures. This was done on the 29th August, and on the 23rd of September an appeal was put in by Mr. Harris, an attorney for certain parties, moving to have the By-law quashed. The reasons put forward in the appeal were these: 1. That certain lots were too highly assessed in proportion to the benefit they would derive from the drain, and in proportion to other lots taxed. 2. That all the lots and roads that would be benefited by this drain were not taxed. 3. That a majority of the land owners to be benefited had not signed the petition. This appeal was heard but was not entertained, on account of insufficient evidence.

C. Robinson, Q.C., now shewed cause, citing *Re Michie* and the City of Toronto, 11 C. P. 379. Osler contra.

The statutes are referred to in the judgment of the court, which was delivered by Gwynne, J. He ruled that there was no foundation for the 4th objection, and he also ruled that the 10th objection was insurmountable. The 11th objection was also thrown out, as there did not seem to be any grounds for it. Then, in closing, he said: "The municipality has, I conceive, been put to considerable and unnecessary expense in resisting this application. Some of the objections should not have been renewed after the appeal to the council, in accordance with the provisions of the Act and the decision of the council thereon. If the parties were dissatisfied with the decision of the council upon the grounds of appeal, they should have carried their appeal to the Judge of the County Court, as required by the Act. Where municipal councils act, as the council whose conduct is impugned here appears to have done, with an anxious desire to comply with the provisions of the Act and to promote public benefit, I think that application to quash the By-law, if unsuccessful, should be visited with costs, to be paid to the municipality. The rule, therefore, will be discharged with costs. Rule discharged with costs."

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

## THE LOCAL IMPROVEMENT ACT.

By W. M. DAVIS,  
*Town Engineer, Woodstock.*

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WORK may be undertaken under this Act, if initiated in one of the three following methods:—

1st. On a petition of a two-thirds majority of the property owners representing at least one-half the value of the property.

2nd. By the council taking the initiative after due notice being given of the proposed assessment and no petition by a majority of the owners being presented against it within the limited time.

3rd. On a report of the engineer or other sanitary officer, and of a committee of the council, adopted by the council.

Under the second method, if the work be petitioned against by a majority of owners, no second notice of the same kind, for the proposed work, shall be given within two years.

Land on which a place of worship has been erected, and land used in connection therewith, can be assessed when a two-thirds majority of the property owners are in favour of the improvement, or where the frontage system has been adopted by by-law for all improvements.

Sub-section 4, section 617, 1883, provides that any real property specially assessed by the council for any work or improvement under this Act shall be exempted by the council from any general assessment for the like purpose, except cost of works at street intersections, cost of works opposite real property exempt from such special assessments, and cost of maintenance of works constructed under local improvement by-laws.

As much discussion has arisen from the ambiguities of this section, it may be as well to refer to the old Acts on which this Act appears to be based.

Section 551, R. S. O., provides that local improvements be paid for by an annual rate on the dollar.

Section 554, R. S. O.: "Nothing contained in the preceding sections shall be construed to apply to works of ordinary maintenance. All work done under this Act to be kept in repair by the city generally." There is no provision made for exemption up to this point.

Section 11, chap. 27, 1880: "Where property owners petition for a local improvement under section 551-555, R. S. O., the petition may

pray exemption for any named period from any general rate for the like purpose, except that imposed to meet cost of street intersections and work opposite property exempt from special taxation." This is again amended by section 5, chap. 23, 1882, which provides that property shall be exempt by the council from any general rate for the like purpose in same manner and to the same extent as would have been done if petition had been presented as in 1880.

Although the tax was still an annual rate on the dollar, the law must have been highly satisfactory to those who constructed the improvement, for they were exempt from a tax for the like purpose, except cost of street intersections and of works opposite real property not specially taxable, and in addition had the improvements opposite their own property kept in a state of perpetual repair by the unfortunates who had not taken advantage of this Act. The injustice of this was apparently too glaring, and the Act, in 1883, was amended accordingly.

By this amendment the property owners are still exempt from any general tax for the like purpose; there are the same two exceptions, viz., cost of street intersections and of works opposite real property exempt from special taxation; and another exception is added, "Except the general rate which may be imposed to meet the cost of maintenance and repairs on works and improvements constructed under local improvement by-laws." Now let us consider the correct interpretation of "assessment for the like purpose." The most reasonable conclusion appears to be, that a property which has paid for a sidewalk is exempt from any general tax for sidewalks of any material. A property that has built a paved roadway is exempt from general tax for roadways of any kind, and properties constructing both sidewalk and roadway are exempt from any general tax for sidewalks and roadways of any description, outside of course of the exception given above.

The property has also to pay a general rate imposed to meet the cost of maintenance and repairs of works constructed under local improvement by-laws. This clause is no clearer than the "like purpose" clause. If it means (which seems most likely) that the total cost of repairs to all improvements constructed under the Act should be levied as a general rate on all taxable property without regard to the date of construction of an improvement or its life, it is most inequitable, and property owners will be deterred from making permanent improvements, for they would be obliged to assist in keeping in repair the short-lived improvements of their neighbours. A much more equitable plan would be to assess the cost of maintenance of the improvement under each petition against the property which constructed it, according to the frontage.

Recognizing the injustice of this manner of assessment for maintenance one or two cities appointed deputations to wait on the Government to endeavour to get this clause amended. Probably, in accordance with suggestions from those deputations, section 620, 1883, was amended; for section 30, chap. 39, 1885, gives councils the power of dividing the municipality into districts within which streets, or

parts of streets, may be maintained, repaired, lighted, etc.; and a special rate imposed on the property therein according to the frontage thereof. This amendment, however, only applies to cities and towns which have adopted the frontage system as provided for by section 620, 1883.

Section 613, 1883, provides that the *council* may devise an equitable mode of assessing corner lots, triangular and irregular shaped pieces of ground, etc.

Section 614 gives the *council* the power of determining the rate to be paid by lands unfit for building purposes.

Section 615: "In constructing or repairing bridges, culverts, etc.," the *council* determines the property to be assessed.

Each of these might be amended advantageously by the substitution of "engineer" for "council" subject to appeal to court of revision and county judge.

Section 615, as it now stands, virtually places the assessment for a bridge or culvert on the ward in which it is situated; for each member of the council is anxious to get his own ward off as cheaply as possible, and the majority would be very likely to agree that the ward in which the improvement is located derives the whole benefit therefrom.

Section 619 leaves the time over which the exemption shall extend in the hands of the council or an arbitrator. This might be simplified, and justice done to all parties by limiting the time of exemption to the life of the improvement.

In cities in which the frontage system has been adopted cases may arise where it is impossible to construct a necessary improvement. Take the case of a vacant block with no sidewalk opposite, the adjacent blocks having sidewalks, and the owners of the unoccupied property being opposed to the work, it could not be undertaken under any of the three methods provided. The advantages of the frontage system over the ward appropriation, or "ward grab," system are so evident it is surprising that a greater number of cities and towns have not adopted it for maintenance and repairs as well as construction.

Under the old system the appropriation is frittered away by the ward councillors on repairs and petty improvements wherever there are votes to be caught. A councillor who honestly endeavours to construct some lasting improvement uses the bulk of the appropriation in one place, and having no money left to conciliate the electors in other parts of the ward is certain to be defeated the next year by a man who is content to scatter the money in the old-fashioned way.

It is generally conceded that no council has the right to leave a debt to their successors in office, so their hands are practically tied, as they cannot issue debentures without the consent of the electors. Speculators obtain possession of unimproved lots, and hold them for improvements on the adjacent property to enhance their value. Under the frontage system all men are equal or as nearly so as legislation can make them. At any rate each gets what he pays for and pays for what he gets. This system has been adopted by the most progressive of American cities and gives general satisfaction.

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

## HIGHWAY BRIDGES.

BY A. W. CAMPBELL,

*P. L. S. & C. E., A. M. Can. Soc. C. E.*

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A GREAT deal has been written on the subject of bridges and bridge construction, but almost exclusively we find the writer dealing with works of large dimensions, from which the ordinary local or county engineer can abstract but little information relative to common highway bridges with which he has to deal, and it is to be regretted that some of our experienced engineers do not instruct us on this subject, although it may be considered but elementary.

As a general thing the local engineer has to take into consideration the cost as well as the principle on which the bridge is to be built and the kind of material to be used in the structure. Stone substructure with iron superstructure of modern design might be to him very appropriate, but he is, as it were, encircled by a limit of cost, and is therefore thrown upon his own resources to devise some structure whereby the stream may be crossed in safety and the expenditure within the limit. It is here that a word from the experienced man would be of great value. Wooden bridges may be looked upon as the origin of all other constructions for crossing streams, whether of stone or iron, for it seems natural to suppose that in the earliest times the simple method of throwing a plank across a stream may have been adopted. A plank thrown across from one bank of a stream to the other is then the most elementary type of a wooden bridge, and the principle on which it is suspended or kept in its proper position is worthy of consideration.

When a strong plank is thus laid upon two supports, that part of it which lies midway between them has to sustain a certain transverse strain caused by its own weight and that of anything crossing over it, by the cohesion between its particles, that is by the power with which the atoms or fibres of which it is built up cling together, for as that part of the plank has nothing to rest upon, it is clear that it will have a tendency to break somewhere between the supports when the strain upon it exceeds its strength. But owing to the cohesion of the particles which attracts them one to the other, such a plank cannot snap asunder with absolute suddenness, because the cells of which timber is formed are lengthened out into fibres or

hollow threads, and these are so interwoven one with the other that one particle or atom of the material will not readily be separated from its fellow as long as such material remains in a sound state. This being the case the weight upon the plank will cause it to bend or what is technically termed to "sag," and it is to prevent such bending or sagging, extending beyond a safe amount of elasticity, that the efforts of the engineer of wooden bridges are particularly directed.

It will be easily understood that when a timber is laid across from one support to another, and a load is placed on any part of it, it bends, because the particles of which it is formed are pressed close together upon the upper side, whilst on the under side they are drawn out. Thus we understand that two forces are acting upon the beam at the same moment, for the upper portion is subjected to a compressive force whilst a tensile or stretching force is acting upon the lower side. It is the strength with which these two forces counteract each other that constitutes the rigidity of timber, and it is evident that there must be some intermediate plane between the upper and lower surfaces of the beam in which the two opposite contending forces will meet, in which, of course, neither will preponderate. This is denominated the neutral axis, and is differently situated according to the thickness of the beam and the power of cohesion which is possessed by the fibres of the various kinds of timber. The upper and the lower parallel chords of the truss of a bridge are in the same condition as the upper and lower fibres of the beams. It is, as it were, removing the neutral axis without the beam (or lower chord) and leaving all its fibres in tension while another beam (or upper chord) is substituted for the fibres in compression.

The truss of a bridge as well as a timber has a neutral axis, with its position somewhere between the said chords. If the upper and lower chords are of the same size and shape, its axis will be at the centre of the height of the truss. If the dimensions of the upper and lower chords are not similar, it will be half way between the centres of gravity of their cross-sections. The other members of the truss such as the posts, braces, counters, ties, etc., serve to keep the two chords asunder and to prevent them from bending, also to transform the transverse strains produced by the weight of the truss and its load into other strains acting longitudinally along the different members, and conduct said strains along the truss to the abutments. A load placed at any one of these members is of course partly supported by each abutment; one part of it travels up and down alternately between the chords and along the successive members until it reaches one abutment, and the other part in like manner until it reaches the other abutment.

The point chiefly to be aimed at in designing a bridge truss is to dispose its various parts so as to form a series of properly connected triangles, because in that shape they present more resistance to disarrangement of form than in figures of a greater number of sides, for in the case of a polygon, if each joint was like a hinge incapable of

offering any resistance to alteration of the relative angular position of the members connected by it, it would be necessary, in order to fulfil the condition of rigidity, that every polygonal frame should be divided by the lines of resistances of stays and braces into triangles and other polygons so arranged that every polygon of four or more sides should be surrounded by triangles on all but two sides and the included angles at farthest; for every unstayed polygon of four sides or more with flexible joints is flexible unless all the angles but one be fixed by being connected with triangles.

All bridges should be calculated to carry a dead load, or the weight of the structure, and a moving or live load, which is composed of teams, persons, or other loads which may at any time come on the bridge, and to resist a certain wind pressure. The live load may be assumed, or is given in the original data, but the dead load must be assumed, and can be accurately determined only by successive approximations, for it is dependent upon that which we seek, namely the dimensions of the parts of the bridge. We, therefore, at first should assume such a value of the total weight as is indicated by other similar structures, and, after the dimensions of all the other parts have been computed the weight is calculated from these dimensions, and if the assumed weight does not largely exceed the computed weight it may not be necessary to review the calculation. The live load should be assumed to equal or slightly exceed the greatest load which we think will ever be placed upon the bridge. The structure should not be so heavily loaded as to damage the elasticity of the materials which compose it. It is impossible to tell the exact load which the structure can sustain without passing this limit, but considerations of safety and durability demand that we should keep upon the safe side, and it is often the case in practice, that bridges are made about twice as strong as would be absolutely necessary if the materials were all of a known standard quality and the workmanship practically perfect. In order to make the structure safe against all these contingencies a factor of safety is employed and the bridge is made several times as strong as is necessary for sustaining the load at the crushing limit. There is no absolute rule for determining the correct value of the factor which is the ratio of the computed strain to the actual strain, but its value is assumed arbitrarily by the engineer. Observation in this particular, in my opinion, is a good rule. Let the engineer observe the margin of safety that has been used in various structures, and it will serve as a guide in designing new ones. If the margin of safety is so small that the structure appears to be insecure, and gives indications of failure, it evidently should not be followed. If the margin is evidently excessively large, demanding several times the amount of material that is necessary for stability and durability, such factor is too great. Any engineer, without scientific skill or economy in the use of materials, may err in his direction to any extent; but, if the margin appears reasonably safe, and the structure has remained stable for a long time, it serves as a valuable guide, and one which may safely be followed under similar circumstances. All bridges should be made to sustain a live load of not less than one hundred pounds per square

foot of floor, where they are on main roads subjected to heavy travel, and not less than eighty pounds per square foot of floor on those roads not subjected to special or excessive loads.

A wind pressure of not less than thirty pounds per square foot of the total area of the side of the truss should be provided for; this, together with the sway caused by passing loads, should be resisted by horizontal lateral bracing, one-half of said pressure to be treated as a moving load. Timber, in tension, should not be strained more than eight hundred pounds per square inch.

In calculating the compressive strain on timber it is necessary to consider that the breaking and the safe load per square inch are not constant quantities but diminish as the piece becomes longer in proportion to its diameter. If a very long piece be so braced at intervals as to prevent its bending at those points, then its length becomes virtually diminished and its strength increased; therefore, long horizontal or inclined pieces exposed to compression in the form of upper chords and braces in bridges are thus braced. Mistakes are sometimes made by assuming one thousand pounds as the safe compressive load for timber without any regard to the length of the piece. The strength of timber also depends on the degree of seasoning; well seasoned timber will resist about twice the crushing load of green timber. In finding the breaking load of timber, the following formula of C. Shaler Smith may be used:

$$\frac{5,000}{1 + \left( \frac{\text{square of length in inches}}{\text{square of breadth in inches}} \times .004 \right)} = \text{breaking load in pounds per square inch of area.}$$

Not more than one-sixth of the breaking load should be taken as the safe load.

The timber used in a truss should be of first quality of their several kinds, straight in grain, free from large loose knots, shakes, sap or decayed wood, or other defects that would impair the strength or durability of the same.

The strength of timber subjected to transverse strain may be determined as follows:

$$\frac{W \times X^2}{Y} \times 450$$

$W$  = breadth of beam in inches.

$X$  = depth of beam in inches.

$Y$  = length of beam in feet.

450 = coef. for centre quiescent breaking load.

For safety in practice not more than one-sixth of the quiescent breaking load should be employed. This margin is left for jars, jolts, irregularities in timber, vibration, etc.



Timber should be sawn so as to leave its sides parallel and its angles right angles. Care should be taken to have all wind taken out before put in the structure so as to have perfect joints; this is necessary in order to secure equal bearings. It should be well seasoned, as this is of great importance, not only to its durability but also to the stability of the structure, as a very slight shrinkage of some of the pieces arising from the seasoning of the wood might cause material injury if not complete destruction to the structure. I consider timber sufficiently seasoned for bridge work when it has lost one-fifth of its weight when in a green state. Natural seasoning is preferable to any other, as timber seasoned in this way is stronger and more durable than when prepared by any artificial process.

In order to assist the timber in a bridge to withstand the effects of exposure to the weather it should be thoroughly coated with paint, but as this substance is of a perishable nature it should be renewed from time to time.

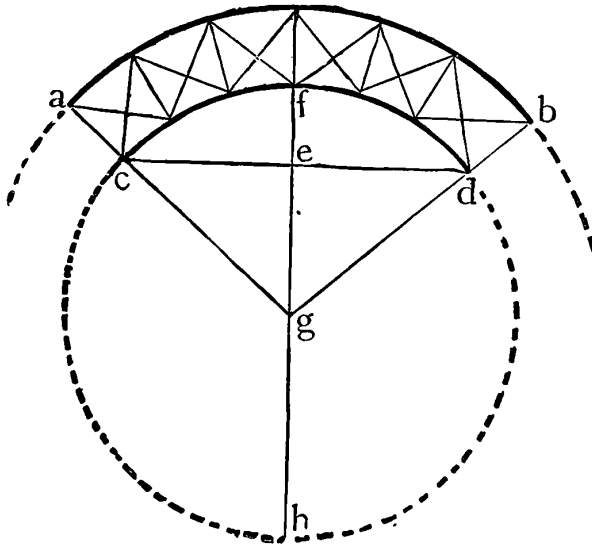
All joints of chords or braces, bearings, ends of posts and braces, ends of chords, keys and packing pieces, and wherever there is a bearing end grain, seat or joint, should be thoroughly coated with thick white lead before being put together, this adds greatly to the preservation of the joints and ends of the timber.

Where the chords and braces of a truss are packed or built, that is, formed of a number of separate members, it assists preservation to cover the same with galvanized iron extending about two inches down the sides of the chord or brace and securely fastened with metal nails, this prevents the water from entering the joints, while a free circulation of air enters from below.

The iron used in the structure for panel or main straining rods should be upset at the screw ends, so that the diameter at the bottom of the threads will be  $\frac{1}{16}$ th inch larger than any part of the body of the rods, and should not be strained more than ten thousand pounds per square inch, and that for horizontal lateral bracing should not be strained more than fifteen thousand pounds per square inch, and should be tough, fibrous and uniform in character. The angle blocks on the chords at the ends of the braces should have their faces at right angles to the line of such brace, and have a rib on the under side about half an inch in depth, to be let into the chord.

There is no rule for determining the amount of camber for a bridge, but it should certainly be such that the heaviest load placed upon it will not bring the chords horizontal, but in practice  $\frac{1}{30}$ th of the span in feet, measured from centre to centre of the outer panel points, is considered sufficient to represent the camber in inches. When the chords are cambered they become the concentric arcs of two circles, with the upper one longer than the lower, and the vertical become radii of said circles, and although their length remains the same the space between them at the upper chord becomes greater than at the lower, and this renders it necessary to lengthen the diagonal braces. Therefore in practice the importance of ascertaining how great this

increase in length is cannot be overlooked; for if so, the different parts, of the truss will not fit accurately together. I determine this increase in the following manner:—



Let  $ab$  in the accompanying figure represent the upper chord in camber;  $efd$ , the lower chord;  $cd$ , length of span;  $ef$ , camber;  $x$ , number of panels. Then,  $efd$  is an arc of the circle  $cdh$ . Produce  $fe$  to meet the circle  $cdh$  at  $h$ .  $ce$  will equal  $\frac{1}{2}$  of span.

$$\therefore \text{Rect. } ce \times ed = \text{rect. } fe \times eh.$$

$$\therefore \frac{ce \times ed}{fe} = eh.$$

$$\therefore fe + eh = \text{diameter of the circle } cdh.$$

$$\therefore \frac{1}{2}fh = fg, \text{ or radius.}$$

$$\therefore cg = fg.$$

$$\therefore fh \times 3.1417 = \text{circumference of circle } cdh.$$

Then, in the triangle  $ceg$  we have the sides  $cg$   $ce$ , and the right-angle  $ceg$ .

$$\therefore cg : ce :: ceg : egc.$$

$$\therefore \text{Log. } cg : \text{Log. } ce :: \sin. ceg : \sin. egc.$$

Then, twice the angle  $egc = \text{angle } cdg$ .

$$\therefore 360^\circ = \text{circumference } cdh.$$

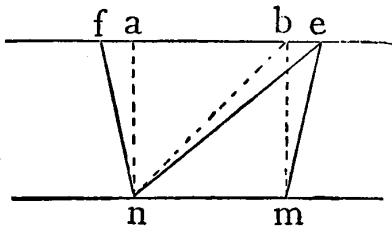
$$\therefore 1^\circ = cdh \div 360^\circ.$$

$$\therefore cgd = \frac{cdh}{360^\circ} \times cgd = \text{arc } cfd, \text{ or lower chord.}$$

Then,  $cfd \div x = \text{length of panel on lower chord.}$

And in a similar manner by adding the height of the truss to the radius of the circle the length of the panel on the upper chord may be found.

When the increased length of the panel at the upper chord is found, the length of the diagonal brace may readily be determined thus:—



Let  $abmn$  in the accompanying figure represent a panel without camber, and  $fem n$  represent a panel with camber.

Let  $x = \text{width of panel on lower chord.}$

Let  $y = \text{depth of truss.}$

Then  $fx$  and  $be$  together = increase to panel.

$\therefore$  to find  $ne$ , or length of diagonal with camber, we have the right-angled triangle  $ane$  with  $an = y$ , and  $ae = x + \frac{1}{2}$ , increase.

$$\therefore ne = \sqrt{x^2 + y^2}.$$

It is not my intention in this paper to deal with the manner of finding strains on the different members of a bridge, as a large number of the members of the profession have gone fully into this in works easily procured.

The general practice in building wooden bridges is to use the King truss up to thirty-five feet span, the Queen or trapezoidal truss up to eighty feet span, and the Howe or Pratt truss up to one hundred and sixty feet span.

The most important branch of carpentry to the engineer is that which relates to the method of joining or connecting timbers together. The joints or surfaces at which the pieces of timber in a structure touch each other, and the fastenings which connect these pieces together, are of various kinds, according to the relative positions of the pieces and the forces which they exert on each other. Lengthening ties are made by fishing or by scarfing. In a fished joint the two pieces of the tie butt end to end, and are connected together by means of fish pieces of wood or iron which are bolted to them. In a scarf the ends of the two pieces of the tie overlap each other. Ties are often fished with iron as well as scarfed. In a plain fish joint the fish pieces have plane surfaces next the tie, so that the connection between them and the tie for the transmission of tension depends wholly on the strength of the bolts together with the friction which they may cause by pressing the fish pieces against the sides of the tie. The tie is only weakened, so far as its effective sectional area is diminished, by the bolt holes. The joint sectional area of the fish pieces should be equal to that of the ties. The bolt holes should be so distributed and placed at such distances from the end of the two parts of the tie that the joint area of both sides of the layer of fibres, which must be sheared out of one piece of the tie before the bolts can be torn out of its end, shall be as much greater than the effective area of the tie as the tenacity of the wood is greater than its resistance to shearing. The joint sectional area of the bolts should be at least one-fifth of that of the timber left after cutting bolt holes, and the bolts should be square rather than round. The fish pieces and the parts of the tie may also be connected by indents or keys; in either case the effective area of the tie is reduced by the cutting of the indents or of the key seats. The area of the abutting surface of the indents or key seats should be such as to resist safely the greatest force to be exerted along the tie, and their distances from the ends of the fish pieces and of the parts of the tie should be sufficient to resist safely the tendency of the same force to shear off two layers of fibres. A timber tie may be fished with plates of iron, due regard being paid to the greater tenacity of the iron in fixing the proportion of the parts. The iron fish plates may be indented into the wood. When a joist or floor beam has to be supported on another beam, the method which least impairs the strength of that beam is simply to place the said joist or floor beam above it, a shallow notch being cut on the lower side of the joist or floor beam so as to fit on the support.

In selecting the site for a bridge, in many cases, very little room is left for the exercise of the engineer's judgment in the matter, the

position of the bridge being determined by other circumstances, such as the necessity of joining two existing roads, but in all cases it becomes necessary for him to make a careful personal inspection of the locality, to have the banks of the stream accurately surveyed, as well as soundings taken of the depths of the stream at uniform distances apart, and borings of the nature of the strata composing its bed. The velocity of the water, and its height at all times and seasons of the year. Prepared with these data, he will be in a position to properly consider the subject and arrive at correct conclusions.

The bridge should, if possible, be built at right angles to the course of the stream, and, if this be prevented by circumstances, the piers and abutments should still be placed parallel to the stream and making an angle with the direction of the bridge.

The most important point claiming the attention of the engineer, as far as the stability of the bridge is concerned, is to obtain a secure and unyielding foundation for the piers and abutments, such as will safely support the superincumbent weight of the bridge and its load, and is not likely to be affected or disturbed by the changes in the bed of the stream or other circumstances.

There is a variety of ways in which piers and abutments may be made. Those for common bridges are usually either built of masonry on the solid foundation of the ground or on a platform constructed upon piles driven into the earth, or they are built of timber framed together in the form of a crib, or of one or more rows of piles driven into the ground in line and extending to the required height of the pier or abutment, and braced diagonally to secure stability, and capped at the top to receive the structure. It is usual in forming the aforesaid foundation to drive the piles about three feet apart from centre to centre and saw them off to the required level, then bolt capping pieces to the top of such piles and plank the same in, and either fill up the space with broken stone laid dry or grouted with mortar. On this the masonry should be placed, or timber framing if desired. In selecting the timber for piles, care should be taken to select that which is straight grained and free from large knots and ring shakes. Rock elm, red beech, blue oak and cedar are the timbers mostly used. In my opinion piles squared are more lasting than round timber, as removing the sap wood renders it less liable to decay. In general practice the timber is left round and the bark removed, in this way they drive easier and are less liable to split. They should be from eight to ten inches in diameter at the small end. In driving the piles a hammer properly concaved and of not less weight than two thousand pounds, with an average fall of from twenty to twenty-four feet should be used. The advantage derived from using a heavy hammer with a moderate fall is that the piles are driven with much less injury or liability to splitting. Every one who has had the management of pile driving is fully alive to the anxiety, delay and expense attendant on replacing injured piles.

Piles which have to be driven through hard ground should be ringed before being raised into the leaders, that is, they should have an iron hoop tightly fixed on their heads to prevent splitting, and also be shod

with iron shoes; these shoes may be of wrought-iron or cast-iron. The shoe should be placed truly in the centre of the pile. Great care is required in shoeing a pile to ensure that the shoe is driven perfectly home. The advantage of a cast-iron shoe is that the inside can be formed with a square butment on which the pile rests, whilst a wrought-iron shoe has to be driven up until the toe of the pile is wedged tight; and as the force with which the pile is driven into the ground greatly exceeds that with which the shoe is driven on the pile, it will often happen that the shoe will burst open and allow the point of the pile to be crushed before it is down to the required depth. When driving a pile into the earth very often it happens that before it is to the required depth a hard strata is reached in which the pile pierces it very slowly. In such case, after about half-a-dozen repeated blows from such a hammer and fall as described above the pile moves almost imperceptibly, the driving of such pile should be abandoned, as further pounding only shatters the pile and loosens the hold it already has in the earth. When driving piles for submerged foundations they should be cut off so as to leave the timber platform about two feet below the low water mark to prevent decay.

It behoves the engineer at all times to associate his energies with those of the builder or manufacturer of bridges in ferreting into the actions of material of all kinds. The suggestion that the engineer and builder or manufacturer of bridge structures go hand in hand in extending a common research into the behaviour of materials is a good one. Theory is very good, but it must be tested by practice to be valuable, and the practical knowledge of the builder or manufacturer can be made of utmost use to the engineer. The practical man may meet with difficulties or stumble on combinations that the purely theoretical man would never dream of with all his philosophy.

I have appended to this paper a side elevation of a wooden highway bridge of the Howe truss principle.

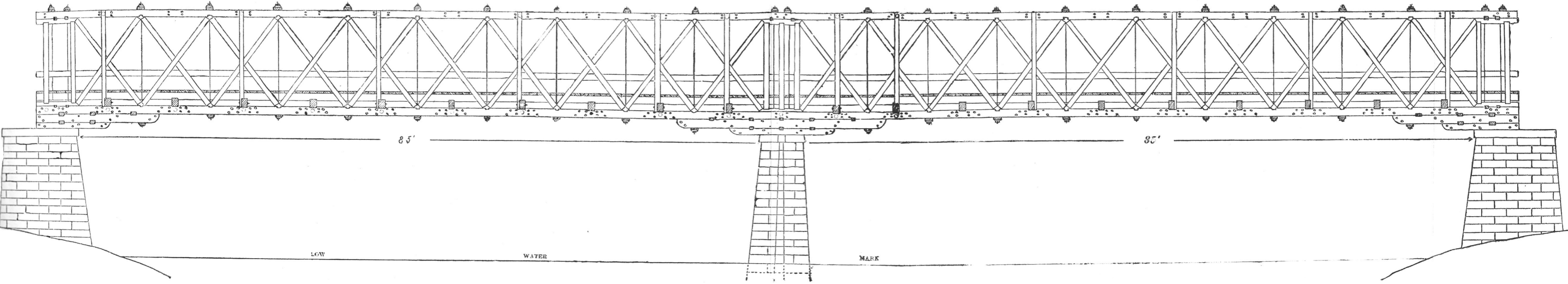
#### DISCUSSION.

Prof. Galbraith—I must compliment Mr. Campbell upon his plain and practical paper; it is somewhat different from Mr. Butler's of last year. And I felt at the time that a paper of this kind would meet with more acceptance from Surveyors, for the reason that they have a great deal to do with county engineering. Upon enquiry I have not found where a book upon wooden highway bridges can be got. I have never been able to find any book of the kind. Books that treat on bridges are principally confined to calculations of forces, etc. They treat also of the strength of material, and all engineers should make themselves acquainted with both of these subjects. Of course that is all very well, but at the same time it would be a good thing if a short treatise on bridges of this character were gotten up, giving in the introduction the relative strength of materials and calculation of forces, etc., and this could be followed by a great many practical details. I think a great deal is to be learned with regard to the connections both as to strength and durability. The way we manage that in the School

of Science is to get the students to take notes during the summer from their own experience. The connections are one of the things rather hard to calculate. A great deal of their strength must depend upon the circumstances generally. So, I think if we had some information of this kind brought together it would afford the engineer of ordinary practice great assistance. I think Mr. Campbell is working in the right direction, and I should like to see him go ahead with it. I think from his paper he is well qualified to go on and get up information of this kind. We might have it in such a shape as to be incorporated in the Proceedings.

Mr. Gibson—I am very much pleased with this paper from the fact that it does not go into mathematics. It is not necessary to go into formulas; what we want are *practical hints*. I think a book giving this information would be very useful, as there are none in existence on wooden bridges that I am aware of. There are works on iron bridges. I think any bridge over sixty feet in length or thirty feet in height should be built of iron. I have built a great many bridges twenty-four feet span, and these can be built very cheaply, and the matter of cost is everything, but if an iron structure is put in, even in the case of a small bridge, it is a financial benefit in the end. Iron bridges are not so liable to be carried away by wind or water as are wooden bridges. But in the U. S. stone is being largely used for bridge building, being considered preferable to iron on account of the discoloration of the latter from exposure to the weather.

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## HYDRAULICS.

By J. GALBRAITH,

*Professor of Engineering, School of Practical Science, Toronto.*

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THE flow of water in treatises on hydraulics is generally considered under the following heads, viz. : flow through orifices and notches, through mouth pieces or short pipes, through long pipes, and through open channels. The driving force is the force of gravity, or the pressure of pumps. The resistances are due to friction, bends, contractions and eddies, to gravity where water is raised, and to the machinery driven where it is used as a source of power. The principal applications of hydraulics are to waterworks, sewerage, drainage, irrigation improvement, and water power. Such being the case, the importance to the engineer of correct hydraulic formulas can hardly be over-rated.

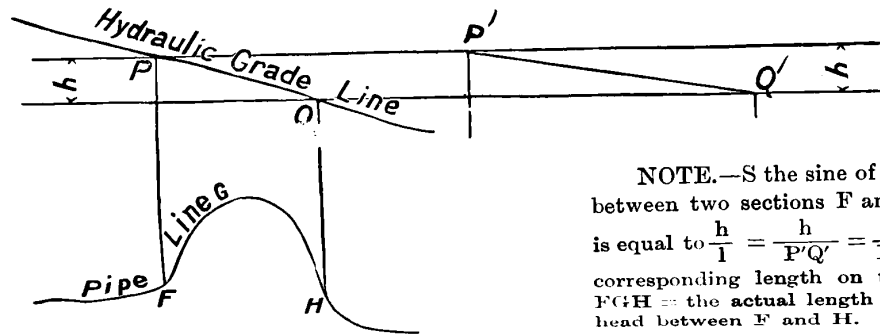
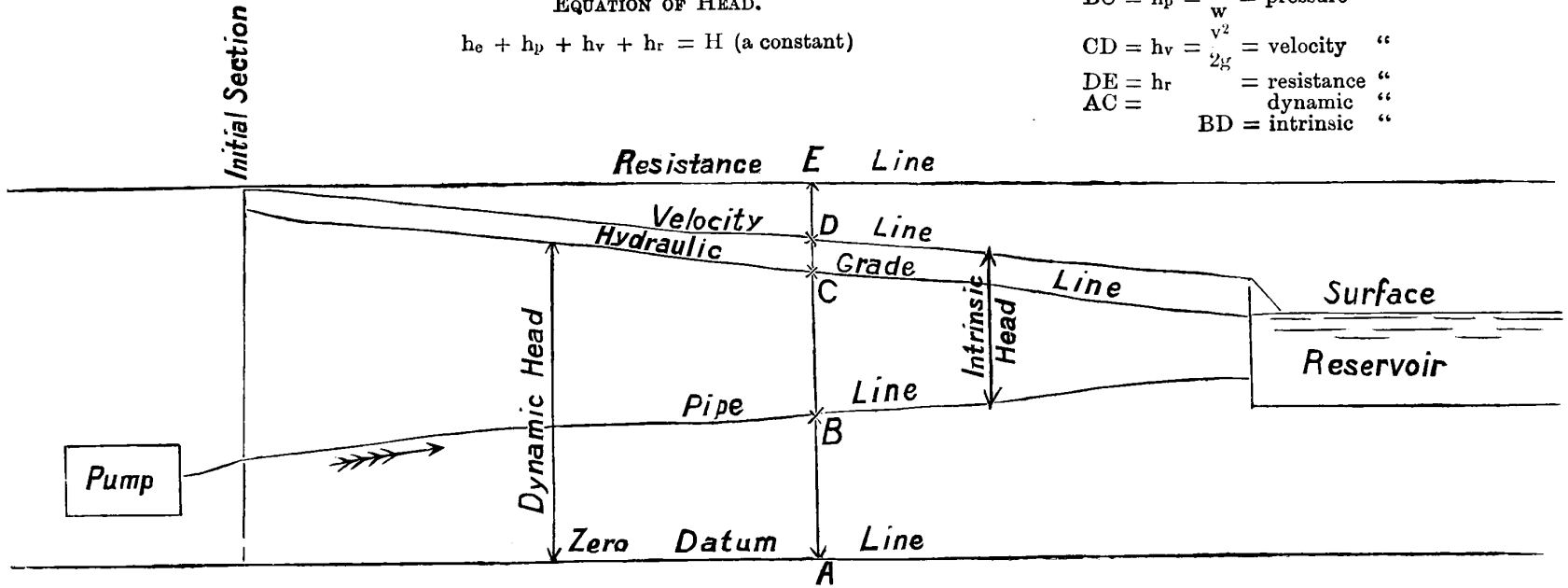
The main object of the great mass of experiments which have been made from the earliest times down to the present is the determining of the resistances due to friction. These are of two kinds, viz. : the friction of the water against the channel in which it flows, and the friction of one portion of the current against another, which causes eddies and all sorts of curious modifications of the flow; the resistance caused by bends and sudden changes of cross-section is probably due to the latter kind of friction. If frictional resistances could only be properly formulated and measured, hydraulics would become as exact a science as astronomy. It is manifestly impossible to trace every particle of water in a stream or pipe through its erratic path. It therefore becomes necessary to consider the motion by the method of averages. A cross-section of the flow is imagined, and the velocity found by dividing the discharge per second through this cross-section by its area is made the subject of investigation. This velocity is called the average velocity of the given cross-section. In the case of open channels a large number of experiments have been made by floats and current meters to determine the various velocities at different points in the cross-section, and various formulas constructed therefrom to enable the average velocity at the cross-section to be calculated from the greatest surface velocity, or from a small number of velocity observations in different parts of the section. Other velocity formulas give the velocity at a cross-section in terms of the dimensions of the cross-section and slope of the surface, and others again include the roughness of the channel. Even float experiments give very little idea of the actual motions of the water particles. Masses of water in a flowing stream are continually sinking from the surface to the bed and rising from the bed to the surface, and floats

# I.—HYDRAULICS.—CLOSED PIPE UNDER PRESSURE.

EQUATION OF HEAD.

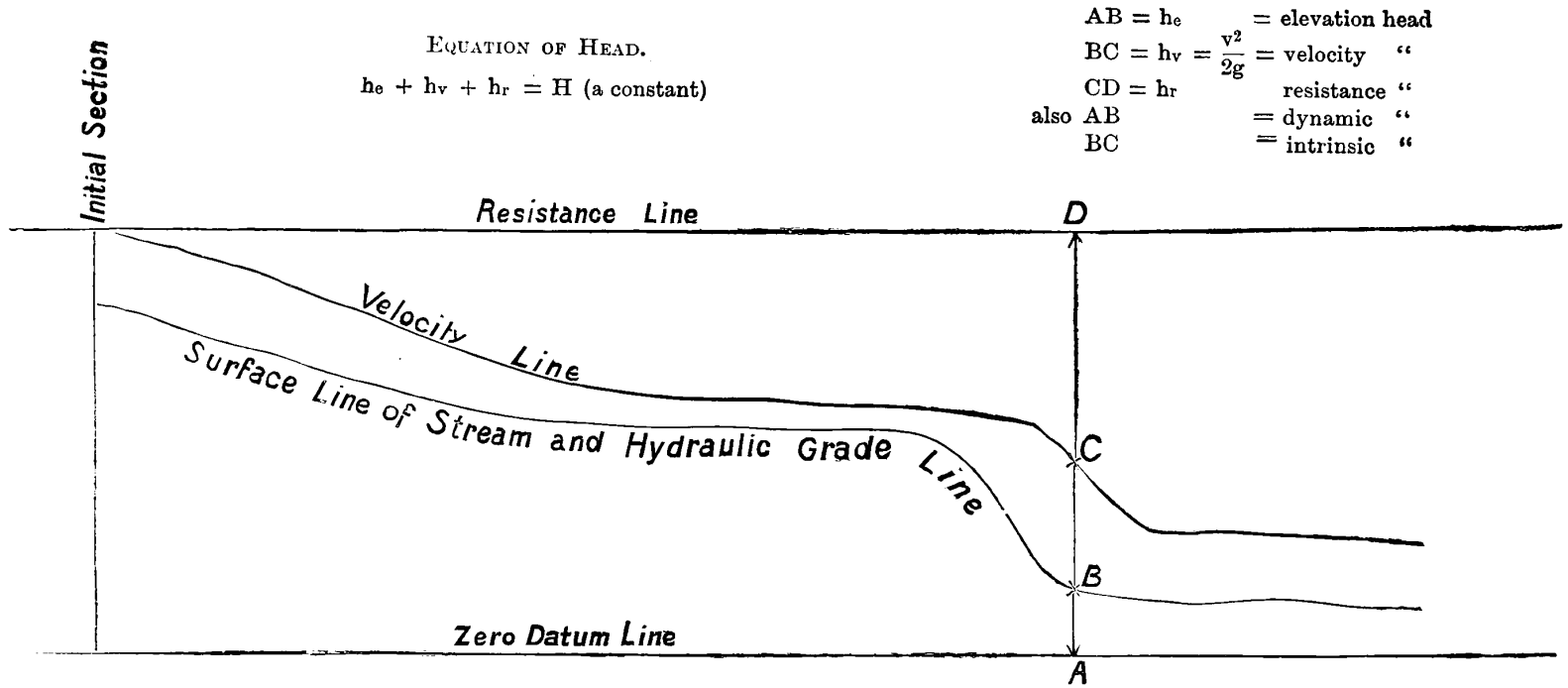
$$h_e + h_p + h_v + h_r = H \text{ (a constant)}$$

- AB =  $h_e$  = elevation head
- BC =  $h_p = \frac{P}{w}$  = pressure “
- CD =  $h_v = \frac{v^2}{2g}$  = velocity “
- DE =  $h_r$  = resistance “
- AC = dynamic “
- BD = intrinsic “



NOTE.—S the sine of the hydraulic gradient or inclination between two sections F and H in a closed pipe under pressure is equal to  $\frac{h}{l} = \frac{h}{P'Q'} = \frac{h}{FGH}$  and not to  $\frac{h}{PQ}$  where PQ is the corresponding length on the hydraulic grade line,  $l = P'Q' = FGH$  = the actual length of the pipe and  $h$  = loss of dynamic head between F and H.

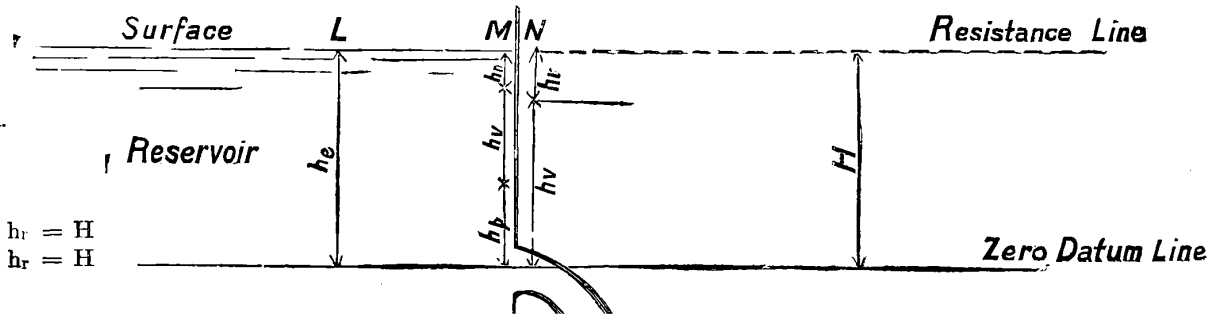
## II.—HYDRAULICS.—OPEN STREAM.



### FLOW FROM RESERVOIR.

#### HEAD EQUATIONS.

- Hor'l Section at surface (L)  $h_e = H$
- Vert'l " orifice (M)  $h_p + h_v + h_r = H$
- " " vena cont'a (N)  $h_v + h_r = H$



give no idea of these vertical movements. The motion of water in artificial channels and pipes is less complex than in natural channels, owing to the absence of disturbing irregularities. In spite of this, however, there is a considerable margin of uncertainty in the accepted formulas. In designing new works the engineer is forced to use formulas for average velocity and discharge, and must therefore provide a margin in his design sufficient in his judgment to cover the uncertainty of the formulas. In examining actual flows he may use appliances for measuring velocities and discharge which will give much closer results than the formulas.

The simplest and at the same time most useful case of flow which demands the attention of the engineer is that known as steady flow. The flow at a given cross-section of the stream is called steady when no alteration takes place in it with the lapse of time. When this is the case at all the cross-sections of the stream under consideration it follows that no accumulation or deficit of water can take place between the cross-sections; in other words, the same quantity of water must be discharging through all the cross-sections of the stream or pipe at the same instant. Hence the average velocity at a cross-section will be inversely as the area.

Perhaps the best way of obtaining a clear view of the generally accepted principles governing the flow of water is to study them as illustrations of the law of conservation of energy. Consider a case of steady flow in an open channel. Let  $Q$  cubic feet be the discharge past a fixed cross-section per second,  $w$  the weight of a cubic foot ( $=62.3$  lbs. nearly),  $v$  the velocity at the cross-section in feet per second,  $g=32.2$ , then the energy of the discharge per second at the given cross-section in virtue of its velocity is  $\frac{Q w v^2}{2g}$  ft. lbs. Let there be a second cross-section taken further down the stream, the difference of level of the surface at the two cross-sections being  $h$  feet, and let the velocity at the latter cross-section be  $u$  feet per second, then the velocity energy of the discharge per second at the second cross-section is  $\frac{Q w u^2}{2g}$  ft. lbs. The increase of energy of the discharge per second between the two cross-sections due to the attraction of the earth through the difference of level  $h$  is  $Q w h$  ft. lbs. Let the loss of energy between the two cross-sections of the quantity discharged per second due to all causes, such as resistances of the channel, friction of the air, etc., be  $Q w h_r$  ft. lbs. We thus arrive at this equation,

$$Q w \frac{v^2}{2g} + Q w h - Q w h_r = Q w \frac{u^2}{2g}$$

which is simply the law of conservation of energy. Dividing out by the common factor  $Q w$ , or the weight of the discharge per second, we have

$$\frac{v^2}{2g} + h - h_r = \frac{u^2}{2g}$$

which is the equation referring to a discharge of one lb. per second:

Writing  $h_v$  for  $\frac{v^2}{2g}$  and  $h_u$  for  $\frac{u^2}{2g}$  we obtain the equation in the following shape—

$$h_v + h - h_r = h_u$$

which is known as the head or height equation. Put into words this equation may be read: The height due to the velocity at the first cross-section + the difference of level between the first and second cross-section – a difference of level due to the energy lost by resistances = the height due to the velocity at the second cross-section.

When the head equation is multiplied by 1 lb. it becomes the energy equation for a discharge of 1 lb. per second; when multiplied by  $Q w$  lbs., the weight of the discharge per second, it becomes the energy equation for the discharge per second for that portion of the stream between the given cross-sections.

The simplest case of the application of the head equation is to a straight stream of uniform cross-section and inclination. In this case  $u = v$ , hence  $h_r = h$ , or the difference of level between any two cross-sections is equal to the difference of level due to the resistances. In other words all the energy acquired by falling through the height  $h$  has been removed by the resistances. Certain mechanical considerations have led hydraulicians to the belief that there is a relation between  $h_v$  and  $h_r$ , in this case expressed by the equation—

$$h_r = f \frac{l}{R} \times h_v$$

where  $l$  is the length of stream between the given cross-sections  $R$ , the hydraulic mean depth (obtained by dividing the area of the cross-section by the length of that portion of its boundary under water), and  $f$  a numerical coefficient. Now  $\frac{h}{l} = S$  is the sine of the inclination of the water surface. Hence we have

$$S = \frac{h}{l} = \frac{h_r}{l} = \frac{f}{R} h_v = \frac{f}{R} \frac{v^2}{2g}$$

$$\text{Whence } v = \sqrt{\frac{2g}{f}} \sqrt{RS}$$

$$\text{Or } v = c \sqrt{RS} \quad \text{where } c = \sqrt{\frac{2g}{f}}$$

This formula is due to Chezy, and is the basis of all formulas for the flow of water in open channels.

The formula which seems now to have the greatest claims upon the acceptance of hydraulicians is the above formula combined with Kutter's formula for variable values of the coefficient  $c$ .

The Chezy and Kutter formulas seem also to be the most rational formulas for determining the velocity of flow in long pipes under pressure.

The question will naturally arise,—How is the value of  $S$  in such cases to be determined? Analogously to the suppositions upon which the Chezy formula was based, imagine two cross-sections of a straight

pipe of uniform calibre, the distance between them being  $l$ . Evidently the velocity in the pipe will be uniform between the cross-sections. Now  $h$ , in the case of the open channel, was the difference in level of the water surfaces exposed to the atmosphere at the given cross-sections. We have therefore to imagine a long open-topped vertical tube, to be attached to the pipe at each of the cross-sections chosen. The water will then rise to fixed heights in each of these tubes, the heights depending upon the amount of pressure in the pipes at the points of attachment, the value of  $h$  will then be the difference of level of the upper surfaces of the water in the two tubes. By the same reasoning as above  $h_r = h$ , also  $S = \frac{h}{l}$ , and the Chezy formula thus becomes applicable to long pipes with proper values of the coefficient  $c$  deduced from Kutter's formula.

The inclination whose sine is  $\frac{h}{l}$  is termed the hydraulic inclination or gradient, and is synonymous with the actual inclination of the surface in open channels. In closed pipes, however, it is evident that the hydraulic gradient between two cross-sections may differ to any extent from the actual inclination of the axis of the pipe. If we define it as the ratio of the difference in level between the water surfaces when exposed to the atmosphere to the length of the channel between the given cross-sections, we have a definition which covers both cases.

The term dynamic head is a useful one in treating of the flow of water. By the dynamic head at a given cross-section of a stream is simply meant the height of the water surface above any arbitrary horizontal plane assumed as a zero datum of levels. Similarly the dynamic head at a cross-section of a pipe in which water is flowing under pressure is simply the height of the free surface of the water in a vertical tube attached to the pipe at the given cross-section above an assumed datum plane.

Thus the hydraulic gradient of any stream, whether in an open channel or close pipe, under pressure between two given cross-sections, is simply the ratio of the difference of dynamic head to the length of the pipe or channel between the cross-sections.

In order to draw the hydraulic grade line accurately for a pipe under pressure the sections should be taken at every point on the line of pipe where there is a decided difference of sectional area; at the beginning and end of horizontal and vertical bends; at both sides of valves or other obstructions to flow; and at all junctions with branch pipes. Vertical ordinates are then drawn at each cross-section, whose tops are at the heights of the dynamic heads above the assumed zero datum. The line joining the tops of these ordinates is the hydraulic grade line.

The definitions above given of hydraulic gradient, hydraulic grade line, and dynamic head hold in the case when the flow is not steady, and when the cross-sections and velocities vary whatever be the physical causes. Thus in the same channels or pipes the dynamic

heads and hydraulic inclinations may vary from instant to instant, as well as from cross-section to cross-section.

The general flow of water is in the direction towards which the dynamic heads decrease but for short distances, owing to acquired velocity, it may flow up a hydraulic grade line.

In fact the hydraulic grade line bears to water the same relation that the slide does to a toboggan. The descent of the toboggan is, on the whole, downwards; but, for short distances, it may rise over humps in the path.

The height above the axis of the pipe to which water would rise in a vertical tube attached to a pipe at any section is called the pressure-head at that section. The height of the axis of the pipe at the section above the assumed datum plane may be called the elevation head. Thus the dynamic head at any section is the sum of the elevation and pressure-heads, and the hydraulic grade line is the line joining the tops of all the pressure-heads of the pipe.

The height due to the velocity at any cross-section is called the velocity-head for that section. If now the ordinates representing the pressure-heads be extended by amounts equal to the velocity-heads, and the tops of these ordinates joined, we shall have a line above the hydraulic grade line, which may be called the velocity line, the vertical distance between these two lines at any point indicating the velocity-head at that point. The sum of the pressure and velocity-heads may be called the intrinsic head, as the energy of the discharge per second due to this head may be called the intrinsic energy. If we again imagine a horizontal line drawn from any point on the velocity line towards the direction in which the water is flowing, the vertical distance between the velocity line and this horizontal line at any point represents the resistance-head for the portion of the pipe between this point and the point in the pipe vertically below the point on the velocity line from which the horizontal line is drawn. Imagine now, all the ordinates produced to meet this horizontal line. We have thus five lines, namely, the horizontal datum line, the axis of the pipe, the hydraulic grade line, the velocity line, and the upper horizontal line, which may be called the resistance line. Any vertical ordinate is divided into four parts by these five lines, the first and lowest part is the elevation head; the second, the pressure head; the third, the velocity head at the cross-section of the pipe in question; and the fourth, or highest part, is the resistance head for the above described portion of the pipe.

Let  $H$  = whole length of ordinate between the horizontal lines— $H$  is therefore constant.

$h_e$  = elevation head.

$h_p$  = pressure head =  $\frac{p}{w}$  where  $p$  is the pressure per sq. foot and  $w$  is the wt. of a cubic foot of water.

$h_v$  = velocity-head =  $\frac{v^2}{2g}$  where  $v$  is the velocity at the cross-section in question.

$h_r$  = resistance head.

We may then represent the above results by the equation :

$$h_e + h_p + h_v + h_r = H \text{ (a constant)}$$

for all cross-sections of the pipe below the arbitrary cross-section corresponding to the upper horizontal line.

In the case of flow in open channels  $h_p$  the pressure head is zero, and the hydraulic grade line coincides with the surface of the water in the channel, the distance of which above the assumed datum line is  $h_e$ . The corresponding equation in this case will be :

$$h_e + h_v + h_r = H \text{ (a constant).}$$

It will be easily seen that the head equation for an open stream in the early part of this paper is a particular example of the general equation ; thus let the zero datum be at the level of the lower cross-section, and let the upper cross-section be the initial section. Then  $h$  is the  $h_e$  of the upper cross-section, the  $h_r$  of the upper cross-section is  $o$ , the  $h_e$  of the lower cross-section is also  $o$ , and the equation  $h_v + h - h_r = h_u$ , becomes  $h_v + h_e + o = h_u + o + h_r = H$  (a constant).

These imaginary lines are of great assistance in studying the flow of water. The same system may be applied in studying the discharge from reservoirs through orifices. For instance, let the datum line be drawn through the centre of the *vena contracta* and the upper horizontal line coincident with the still surface in the reservoir. Then for the section at the *vena contracta*  $h_p = o$   $h_e = o$  and the equation becomes :  $h_v + h_r = H$ . In other words, the whole fall  $H$  is partly employed in producing the velocity at the *vena contracta*, and partly in overcoming the resistance. At the horizontal section at surface of reservoir,  $h_p = o$ ,  $h_v = o$ ,  $h_r = o$ ,  $h_e = H$  ; and the equation becomes  $h_e = H$  simply. Again, if we consider the section at the orifice,  $h_e = o$ , and we have  $h_v + h_p + h_r = H$ . In other words, the velocity in the orifice is less than in the *vena contracta*, because there is pressure in the orifice. In other words, the pressure that exists within the reservoir does not suddenly vanish at the orifice.

It must be remembered that the pressure that we speak of is not the absolute pressure at a point in the fluid, but the difference between the absolute pressure and the pressure of the atmosphere. It is in fact the pressure that would be indicated by a pressure gauge of ordinary construction. It must also be borne in mind that  $h_r$  depends upon  $h_v$ , and becomes zero when  $h_v$  becomes zero.

For illustrations of this method, the reader is referred to Plates I. and II. accompanying this paper.

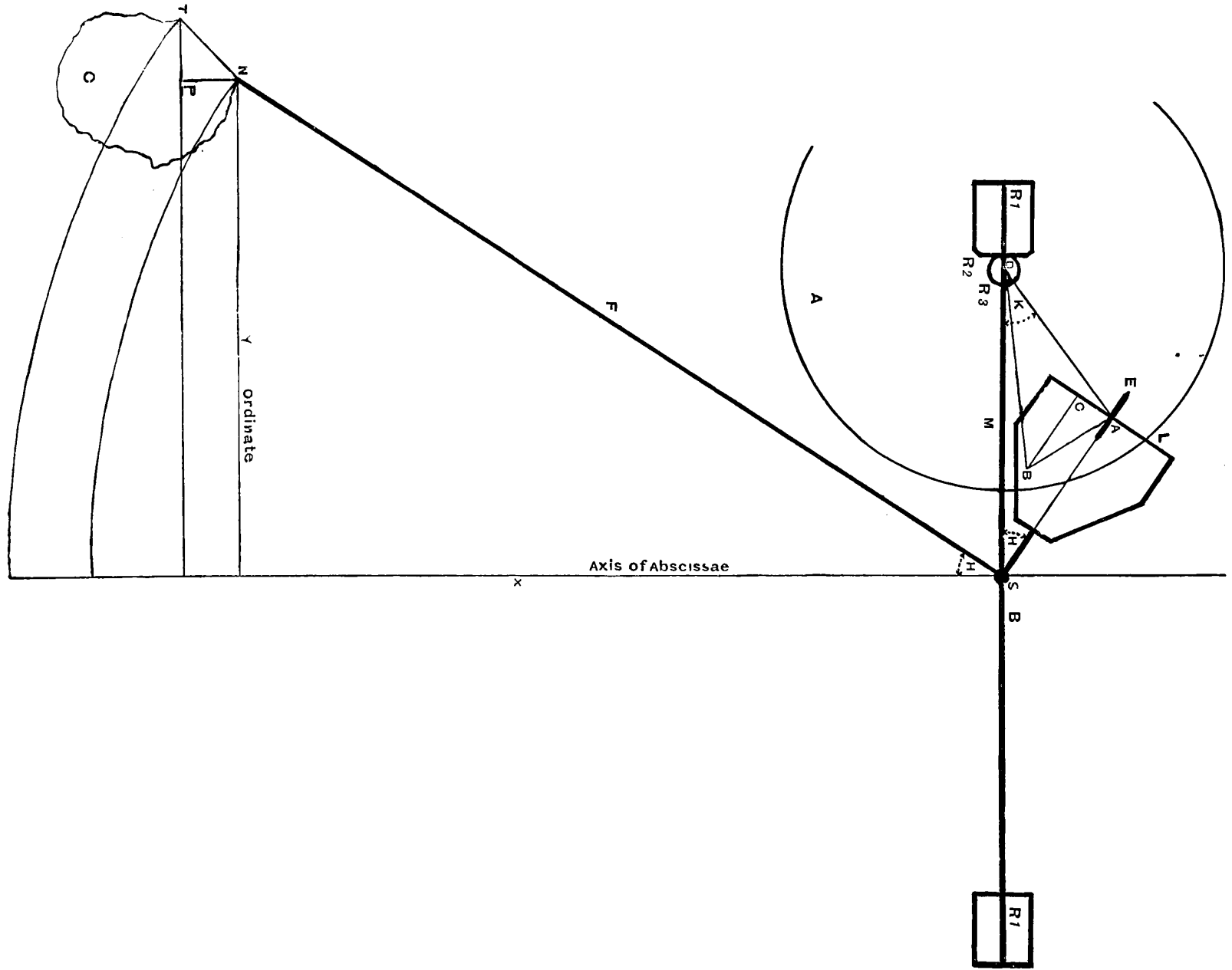
#### DISCUSSION.

Mr. Gibson—I am very well pleased with the method of illustrating this intricate and somewhat awkward subject adopted by Professor Galbraith. I have always been very much pleased with this subject, but my experiment have always been conducted on too small a scale to be useful.





# ROLLING PLANIMETER.



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## ROLLING PLANIMETER.

By G. B. ABREY,  
*P. L. S. and D. L. S., Toronto.*

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MECHANICAL integrators are constructed on the assumption that if a wheel is moved over a smooth surface in the direction of its axis it will slide without revolving, and if moved at right angles to its axis it will revolve without sliding, and if moved in any other direction it will both slide and revolve.

In the instrument here exhibited and represented in outline on diagram, it is mounted on rollers of equal size and equally weighted, and when moved over a figure the fulcrum of the tracing arm moves over a straight line, and it differs from those shown at our last meeting in the principle that they were anchored at a point termed the pole; this then, as you will see, cannot be called a Polar instrument. It possesses great advantages over all Polar planimeters, inasmuch as it will cover and measure at one operation a figure of considerable width and of unlimited length. It is also more easily manipulated than a Polar. In moving the instrument around a figure the arm is always nearly in a line at right angles with the axis of the rollers, and very little difference in force is required to move the tracer over one part than another, whereas with the Polar it is required over some parts to move nearly in line with the anchor point, and then from the greater force required the tracer goes by a more or less jerking motion.

The instrument is also what is called suspended, and possesses greater precision than any yet constructed; and although a large instrument it is very precise in measuring small figures. Of course, like all planimeters, it requires great care, and every part must go smoothly, and yet no shake in any place.

In describing the theory of this rolling planimeter it is convenient to develop it by a system of rectangular coördinates (see sketch). The tracing arm  $F$  is at right angles to the plane of the recording wheel  $E$ , and the axis of  $E$  parallel to  $F$ . In moving the instrument it will be observed that the speed of the recording wheel increases as the tracing arm moves away from the line  $X$ , drawn through its fulcrum  $g$ , at right angles to the axis  $B$  of the rollers, and reverses its motion in passing the line  $X$ , therefore with tracer on the line  $X$  the recording wheel generates no motion. We will call the line  $X$ , which is the path of the fulcrum of the tracing arm, the axis of abscissæ, and all lines perpendicular thereto ordinates. It will also be seen that if the rollers  $R$  remain still, that moving the tracer to either side does not cause the recording wheel to revolve, as it simply slides on the disc  $A$  in the direction of its own axis.

Let  $c$  be any figure to be measured, and  $tn$  be an element of its perimeter. In moving the tracer over  $tn$  its path may be considered as made up of two motions, one parallel to the axis  $X$ , and the other at right angles thereto. Now as the latter of these motions in the direction of the axis of ordinates is but an alternate motion of the tracer, which takes place in an equal ratio, by the time the tracer returns to the spot it started from the plus and minus motions of the recording wheel balance each other, and we conclude that all components of motion of the tracer at right angles to the axis of abscissæ have no influence on the result, we will therefore only discuss a differential motion of the tracer in the direction of the axis of abscissæ. Now, it is to be shown that the motion of the wheel  $E$ , caused by moving the tracer over the path  $pn$ , is equal to the corresponding area  $y.pn$  multiplied by some constant, which is a function of the dimensions of the instrument. Now, it will be seen that if the tracer is moved over the elementary path  $pn$  the entire instrument is moved on the rollers the same amount. This causes a movement of the pitch circle  $R_2 = pn \frac{R_2}{R_1}$

This is conveyed to the disc  $A$ , through  $R_3$ , so that any point on the disc, as  $a$ , distant  $ad$  from its centre, moves through a distance =  $pn \frac{R_2}{R_1} \times \frac{ad}{R_3}$ . The motion of that part of the disc on which the recording wheel rests =  $ab$  causes the circumference of the wheel  $E$  to revolve an amount = the component of  $ab$  at right angles to the axis  $R$  of  $E$ . This distance is  $bc$  and is the measure of  $E$ 's motion. It is now only necessary to show that  $bc = y.pn$  multiplied by the instrumental constant. Now,  $bc = ab \sin bac$ , but  $bac = k + h$ , = supplement of  $dag$ , because  $dab$  and  $gac$  are both right angles. Also from  $dag$  we have  $\sin dag$  to  $\sin agd$ , as  $M$  to  $ad$ . That is  $\sin (h + k) = \frac{m \sin h}{ad}$ .  $Fga$  is also a right angle,

and  $Fax = h$ , therefore  $\sin h = \frac{Y}{F}$ , and we may write  $bc = ab \sin (h + k)$   
 $= ab \frac{m \sin h}{ad} = ab \frac{my}{F.ad}$  and by substitution of values of  $ab$  from (1).

We have  $bc = y.pn \frac{m R_2}{F R_1 R_3}$ , and as  $M, R_1, R_2, R_3$  and  $F$  are all constants for any one instrument. We see that the wheel record is a junction of the area generated by the tracer and the instrumental constant, and that the sum of all the elementary areas included between the path of the tracer, the limiting ordinates and the axis of abscissæ is represented by the total wheel movement, or the difference between its initial and final readings. Now if the area to be measured be bounded by one right line and limiting equal ordinates, it would not be necessary to move the tracer over the entire perimeter provided the instrument could be adjusted with the point  $g$  exactly over the base of the figure, and with the axis  $B$  at right angles to it, so that in rolling the instrument along, the point  $g$  would remain over the base line. Then, for motion of the tracer over this line, the recording

wheel would not revolve, and for equal end ordinates  $\pm$  recordings would balance, so that for the portion of the figure bounded by the base and the equal end ordinates no area would be generated. This is explained a little differently in Professor Johnston's Surveying, and if I have understood what is there stated his explanation is not exact. He uses the expression end ordinates, whereas it should be equal end ordinates. To simply pass the tracer over the irregular part of the boundary would give the area of the figure shown in curved outlines on the diagram, and not that bounded by the y ordinates. In practice, we have to trace the whole figure, as it would generally be impossible to so place the instrument that the fulcrum would travel the path of the figure's base.

From the theory it will be seen that the distance  $ga$  of the wheel  $E$  from the tracing arm is immaterial and is not a function of the area, but the axis of  $E$  must be parallel to the axis of the tracing arm, else the area generated by the tracer on one side of the axis will be greater than on the other. This suggests a test for the adjustment—for suppose we draw two figures, say of equal areas, one on each side of the axis of abscissæ, it will be seen that if the axis of the recording wheel is not parallel to that of the tracer the measured areas will not agree. The instrument is fitted fully for making this test, and with an eccentric socket at one end of the axis  $L$ , which may be adjusted until the areas of equal figures will agree. Also from the same figures, if we know their areas in any desired unit, we may test the corrections, of the length of the tracing arm, and adjust it by the clamp and tangent provided. If the known area reads  $\frac{1}{n}$  too great or small, adjust the arm by  $\frac{1}{n}$ . This same principle enables the instrument to be adjusted to correctly measure an area of which the plot may have shrunk. Of course the instrument measures the area of the plotted figure drawn to scale. This record then requires a suitable multiplier to get the area of the field, or cross section, of which the plot is the diagram, and it is immaterial whether the horizontal and vertical scales are alike or not. In practice it is desirable that the point from which we start to trace be as near the axis of abscissæ as possible, as a small error in bringing the tracer back to same point is then a minimum. Also, if possible, an approximately equal area should lie on each side of the axis of abscissæ, to eliminate any remaining error in the axis of  $E$ . The figure should be traced slowly and by an easy motion forward. Too great a speed, or a jerky motion, may cause the recording wheel to slip.

The accuracy and precision of this instrument may be seen from the published tests. In repeating the tracing of a figure the difference should not be more than about 0.002 of each other. With an Amsler Polar, I found the difference of two readings might be about .02 on the vernier, and was not satisfied with anything greater than that. This error would be about the same independent of the size of the figure. With this instrument the error is more nearly some per cent. of the size of the figure.

In this instrument there is a counting wheel having a differential motion, counting revolutions of the recording wheel up to 420 circum-

ferences. The vernier of the recording wheel subdivides its circumference into 1,000 equal parts. The tracing arm is divided into half millimeters. For English measures index marks are given by the makers for  $0.001\text{''}$ ,  $0.0001\text{'}$ , and  $0.002\text{''}$ , thus corresponding to a length of arm of 346.9, 499.3, 692.3 half millimeters, or in English 6.829, 9.837, 13.681 inches. With care in tracing, the instrument should give the true area of the figure to within the  $\frac{1}{1000}$  to the  $\frac{1}{10000}$ , depending upon its size. The instrument may be arranged to give cubical contents as well as surfaces.

#### DISCUSSION.

Mr. Gibson explained his method of finding areas by traverse table and scaled offsets.

Mr. Abrey—Your method is only guessing at it. I have used the Planimeter on Government work for fifteen years and have always been checked by the Department, and have never found any error.

Mr. Gibson—I think that the Planimeter would work very well for ordinary work, but the traverse table will do for calculating land areas, etc.

Mr. Abrey—The United States Coast Surveyors use this instrument altogether. There is another principle, that of repetition; you can give the figures as often as you please and take the mean. If you are not satisfied you change your base and go around again and you eliminate all errors.

Mr. Fawcett—It is pretty hard for us to fully understand Mr. Abrey's mathematics. Of course that paper gives us the theory of the work, but what we are more particularly interested in is the practical application of it. If Mr. Abrey takes the instrument, and measures a figure, so that we can see the working and facility with which it can be done, I think it will be very interesting.

# QUESTION DRAWER.

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## LAND SURVEYING.

QUES. 1.—When a post and board fence constitutes the boundary between two lots, what is the precise location of the division line? Is it the line through the centres of the posts, or the line between the posts and the board, or the centre line of the fence considered as a whole?

ANS.—The discussion on this question is too lengthy to be given in detail. Some members held that the line was between the posts and boards, others that the line through the centres of the posts was the true line, and others again that it was the line midway between the outside limits of the fence. A member pointed out that the desideratum was to secure uniformity of practice throughout the country, especially when new fences are being erected. Another member informed the meeting that in Toronto the judges had held that the line between the post and board was the correct one, but that this decision was founded upon custom. Finally it was moved by Mr. Chipman, seconded by Mr. Burnet, That the centre of the posts should be placed on the line. Moved in amendment by Mr. Sankey, seconded by Mr. McAree, That the line between the posts and the boards be the true division line.

The amendment was carried.

QUES. 2.—In chaining a boundary line crossing a river I note the abrupt descent to the river valley at 14.84 chains, the edge of vegetation as 16.95 chains, and the edge of the water of the stream at 17.30 chains; between the edge of the vegetation and the edge of the stream is bare gravel, being in fact a part of the bed of the stream when the water was higher than it is at the time when my notes were taken; at 14.84 chains is what might be called the top of the river bank. Which of these three numbers is to be *written on the plan* as giving the length of this boundary between the corner where the chaining was started and the river?

ANS.—Messrs. Aylesworth, Niven, Campbell and McAree considered that the measurement should be taken to the edge of vegetation.

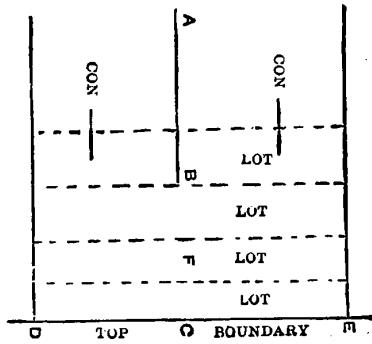
Mr. Sankey—I understand that legally high water-mark is the proper mark; a person can legally extend his boundary to high water-mark, and protect himself from any encroachment within that limit.

Mr. Jones—It is pretty hard to give a rule that would cover every case.

Mr. Niven—I think these questions can best be settled by the surveyor on the ground.

QUES. 3.—In following a concession line it becomes obliterated or lost within half a mile of the Township boundary: How do you establish the line when no post is to be found on the boundary?

ANS.—Mr. Chipman—That appears to me rather vague, and I think there is but one solution, viz., by chaining from *E* to *D*: divide up and connect *C* and *B*. This would be according to the Act.



Mr. Kirkpatrick—Suppose you find a marked tree at *F*?

Mr. Chipman—Join *B* and *F*, and *F* and *C*.

Mr. Kirkpatrick—A case in point occurred in the Township of Enniskillen, where a Surveyor having to run a line, ran a straight line from *B* to *C* as it were, but contrary to law I fancy, for instead of defining the boundary between the two concessions by the straight line from *B* to *C*, he should have established the corners of the lots along the missing boundary by dividing proportionately the total depth of the two concessions at the various corners, and then joining the corners so found: thus *B C* might be a broken line instead of a straight one. As it happened, there were several oil wells, which by the straight line theory would have been placed in a different concession from the one they were always supposed to be in, and it was going to raise a terrible row. In that case it was a blind line I think.

## LEGISLATION.

QUES. I.—Does subsection 2, sec. 63, chap. 25, 50 Vic., apply to compiled plans?

ANS.—A Member—Looking at the Act as to certificates of Surveyors as amended at the last session of the Legislature I cannot see how a Surveyor can certify to a plan of which he does not make a survey, that is to file and certify to a plan which is nothing but a compilation of old plans, and the Surveyor may never have stretched a chain across the land. Therefore I cannot see how a Surveyor can sign that certificate.

Mr. Stewart—I entertain the same idea, because you are certifying to a plan to be filed in the Registry Office that may have been compiled from a number of other plans. Before such could be registered I think an actual survey must be made. I suppose the question is whether I can attach that certificate to a compiled plan?

Mr. McAree—I think the Surveyor should state on the plan the source from which he derives his information, and merely certify to what he did himself, and not make himself responsible for the work of other people.

Mr. Kirk—A person came to me a few days ago and wanted some original lots (three or four) subdivided, and wanted to have the plan registered so that he could make sales of it, but he did not want to



have it surveyed. I showed him the Act, and pointed out the difficulty. I said I could not do it and certify to the plan for registration, as required by the Act, without first making a survey of the ground. He said, "Oh, you are too particular about trifles." He admitted himself that it was not right for him to do so, and the consequence was that he got me to survey the ground.

Mr. Chipman—I ask if a Surveyor can conscientiously sign that certificate?

Mr. Dickson—He would want an elastic conscience.

Mr. Kirkpatrick—Does not the 4th section of the Act meet it?

Mr. Chipman—I think the whole Act respecting the compiling of plans is very defective.

Mr. Dickson—It would entail a large amount of expense for a Surveyor to have to make a new survey in every case.

Mr. Chipman—I suggest that the Legislative Committee be hereby instructed to examine into the Act referring to the compiling of plans, and get the necessary legal assistance, and draft such amendments to the Act as may be considered necessary, and submit them to the next meeting.

Q<sup>UES.</sup> 2.—Is it not compulsory for a P. L. S. to file evidence in Registry Office of county in which lands affected are situated? Sec. 72, chap. 25, 50 Vic. If P. L. S. refuses to file evidence can he be compelled to do so? If so, how?

ANS.—Mr. Dickson—I was a witness in a case tried before Mr. Justice Patterson, and I had filed notes of evidence in the Registry Office, and the other party had not, although the Surveyor had taken his field notes; the judge decided against him, as he had not complied with the law in filing his notes. The case was appealed, and Judge Morrison concurred in the decision of the former judge. My opinion is that every one of a Surveyor's notes should be registered. I register them as soon as I can after taking them, and put an entry in the field book of the date of registration of such notes.

Mr. Chipman—But suppose a Surveyor does not do it, how are you going to make him?

Mr. Stewart—If the Act says he shall he can be proceeded against for not doing so.

Mr. Gaviller—In sec. 72 of the Act it reads "may be filed." I have heard the opinion that "may be" means "shall."

Mr. Kirkpatrick—The question is quite clear that the evidence shall be filed, and the plan or other documents may be filed.

Mr. Warren—I once applied to a registrar to register some affidavits that I had taken in regard to posts and monuments, and he would not do it. I pointed out to him that we had to do it in compliance with the Act; he said he would not do it, but would keep them in his office, and they were filed in that way, without being actually registered.

Mr. Kirkpatrick—I think that the evidence should be filed with the plan and other documents relating thereto, and if the Surveyor refuse to do so I suppose you can get an order from the County Court Judge to compel him.

Mr. Stewart—I think where there is an Act providing that certain things be done, and a person infringes that Act, there is a penalty for any such infringement under the common law.

Mr. Dickson—Don't you think from the reading of the Act it compels us to file the evidence ?

Mr. Kirkpatrick—I think so, certainly. [Section of the Act read.] That section evidently presupposes that the Surveyor must decide what the expenses will be, and he is empowered to determine the same without going to the Registry Office to find out, and having done so to put the charge on both parties.

QUES. 3.—In preparing compiled plans of villages and towns are errors in old plans to be perpetuated or corrected ?

Mr. Burnett—I have made sales where I had to change the description in the deed as described in the old plan.

Mr. Chipman—I would like to ask Mr. Burnett what he would do in a case where one lot too many was registered. This case occurred to me. I could not make it fit in the plan.

Mr. Burnett—Was it shown on the registered plan ?

Mr. Chipman—Yes, it was made up of fifteen or twenty different plans, but it would not fit, as there was no room for it. What would you do in that case ?

Mr. Burnett—Were you copying an original plan ?

Mr. Chipman—I was compiling a plan, and this particular plan was made up of several parcels ; but this particular lot would not fit in, although all the others did.

Mr. Burnett—That was a special case.

Mr. Stewart—That, Mr. President, no doubt occurred in consequence of the land not having been surveyed, and this kind of thing we are trying to avoid. That lot was to be put in but there was no room for it ; that is the way it was dropped out of the original.

QUES. 4.—To what extent are the field notes of a deceased Surveyor admissible as evidence in court ?

ANS.—Mr. Stewart—I heard a case tried before the County Judge in Barrie, in which a square fight was made about the admission of Charles Rankin's notes ; copies of the plan were produced, which showed that a certain side road was not run as stated in the original, and they wished to introduce his personal notes in support of their contention, and we succeeded in keeping them out on the ground that they were merely copied from the book used in the field. Another objection that we took was that we had not his full notes. The judge

ruled that he could not admit them as evidence. They were notes of the original survey, but were not signed by Charles Rankin. Another Surveyor swore that they were in his handwriting.

Mr. Kirkpatrick—I have no doubt that ruling was correct regarding an original survey, but suppose a Surveyor made a survey thirty years ago, and I have his field book stating what he did; it is not signed, and the only connection is that his name is in it; I go on to the ground to make a re-survey, and find the posts and monuments as stated in his field book. Can I not bring his notes and book into Court to support my position? I have done so. I think the notes of a deceased Surveyor should be taken for just what they are worth.

QUES. 5.—Is there a section in the "Survey Act" for making re-surveys of township lots in those townships in the districts of Algoma and Nipissing laid out into lots containing 320 acres? If so, which?

QUES. 6.—What is the difference between a section block and an alternate concession survey?

QUES. 7.—What is the governing line in a section block and in an alternate concession with the side lines run in the original survey?

ANS.—Mr. Kirkpatrick—This case seems to be thoroughly settled in the case of the Corporation of Stafford *v.* Bell. This was a case in which a sideroad had to be re-established, the governing line for which was the sideroad on the opposite side of the block or *section*. This governing sideroad had an original post still standing on the "blind line," but said post was about a chain and a half off the straight line joining the adjacent corners of the section. The line through these corners and the original post at the "blind line" was thus a broken line, and the various Surveyors who attempted to establish the sideroad in question committed the error of taking this broken line for their governing line, instead of making the straight line between the section corners their governing line, as required by the Act; in so far as taking their bearing was concerned they should have ignored altogether the post on the "blind line."

Mr. Burnett—Were not the posts on the "blind line" planted in the original survey under instructions? If so, I think those Surveyors would be quite correct in taking their bearing from that post.

Mr. Kirkpatrick—I think not, because you cannot override the Statute. These posts were only to govern as defining the angle of the lots.

Mr. Burnett—I suppose, then, if these posts were not planted under instructions they could not be recognized.

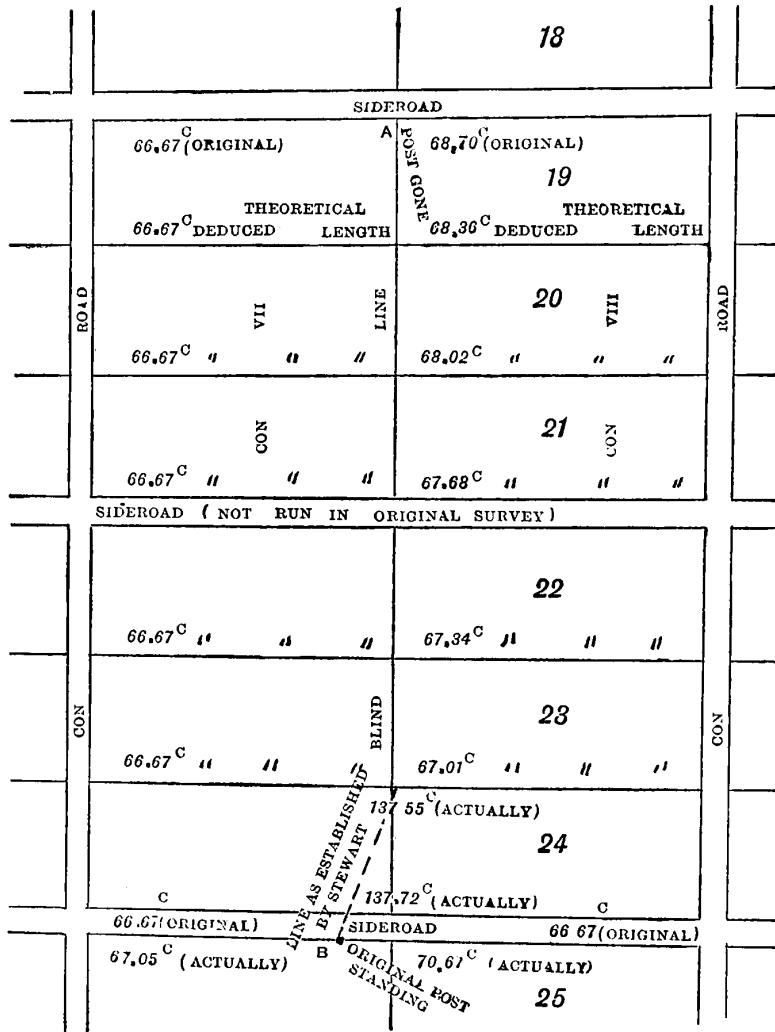
Mr. Kirkpatrick—Unless planted under instructions from the Department they would not be binding even as measuring points, although planted in the original survey.

Mr. Burnett—Suppose that the field notes show that these posts were planted in the original survey, but there is no evidence that they

were planted *under instructions*; would you, in that case, recognise them as governing the bearing?

Mr. Kirkpatrick—There has not been, so far as I know, any decision on that point.

Mr. Stewart—The annexed diagram represents a case that occurred in my practice in the Township of Nottawasaga.



It was required to run the "blind line" between concessions 7 and 8, across lot 24. The post at *A* had disappeared, but the post at *B* was standing. The only depths of lots given on the original plan are the depths marked on sideroads between lots 18 and 19, and 24 and 25 respectively. Since the sideroad between lots 21 and 22 was not run, we must consider the twelve lots in question as one block or section. The points to be established are the corners of lot 24 on

the "blind line, and this is how I established them. I adhered to the old post which I found at *B*. I considered that it was the true corner on this sideroad (24 and 25), between the adjacent concessions. The other corner on the "blind line" of lot 24 I established by ascertaining the actual total depth of the two concessions along the line between lots 23 and 24, and dividing that distance in the ratio of 66.67 to 67.01, which ratio I obtained as follows:—According to the original plan the concessions should have an equal depth on sideroad between lots 24 and 25, while on sideroad between lots 18 and 19, the depth of concession 8 exceeds the depth of concession 7 by 2.03 chains, *i.e.*, the difference in the depths increases from zero to 2.03 chains, *i.e.*, the difference in the depths increases from zero to 2.03 chains, in crossing the six lots, or at the rate of 34 links nearly per lot; therefore the ratio of the depths between lots 24 and 23 will be as 66.67 to  $(66.67 + .34) = \frac{66.67}{67.01}$

Mr. McAree—The question is whether that post at *B* should be recognized.

Mr. Burnett—Was it the intention in the original survey that the depth should be equally divided?

Mr. Stewart—Yes, but they were not so divided.

Mr. Kirkpatrick—I think you will find that it was the intention that they should all be 200 acres.

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## DRAINAGE.

QUES. 1.—Does the Act respecting Ditches and Watercourses apply in the case where owners who have in consequence of some digging on the part of those living above them, had their lands overrun by water, or must they gain redress in some other court?

ANS.—Mr. Proudfoot—I think the Ditches and Watercourses Act applies in this case. If a man has a lot of land which is flooded from above he can call on an engineer to make an order to have it removed.

Mr. Gibson—What section applies to that?

Mr. Proudfoot—It is generally provided by the Act.

Mr. Gibson—Do I understand that if a person from above turns water from him, that a person below can call on an engineer.

Mr. Proudfoot—He can within fifty rods above him, but you cannot exceed that distance. But a party cannot get anything like the amount of damage under the Ditches and Watercourses Act as he can under the Common Law.

QUES. 2.—*Re* sec. 1, sub. sec. 4 of Amend. 1887. It says, "Any one of the owners who is liable for maintaining and keeping in repair any portion of such ditch or drain may in writing notify, etc." How shall they proceed where it has been the allotted portion of only one party to maintain and keep the ditch in repair?

ANS.—Mr. Abrey—When one man has the whole ditch to keep in repair, and does not do so, it is likely the engineer would call upon some other party to keep it in repair. The same way when there are more than one party.

Mr. Gibson—Suppose you and I have property adjoining, yet I have to keep the whole ditch in repair, yet I understand that the party who has to do the work is the one who has to give the notice.

Mr. Proudfoot—If a man has a whole drain to keep in repair and he does not do it properly, then I think the next man can keep it in repair.

Mr. Jones—I understand that when there is only one man to do the work, he is the one who has the benefit; as the people through whose land it may pass cannot notify him, as they are not the ones who originally had to keep the ditch in repair. The Act says any one is liable to maintain any portion of this ditch; and there is no provision to call upon the engineer supposing the person himself refuses to do it: he is the only one who can call upon the engineer.

Mr. Proudfoot—In cases where ditches are dug by other parties they are liable to keep them in repair.

QUES. 3.—*Re* sec. 1, sub. sec. 7, 3rd line, "him." Does this refer to the engineer or inspector, or either?

ANS.—Mr. Jones—I think that might be got over by inserting "Or any person through whose lands such ditches pass."

QUES. 4.—See 46 Vic., cap. 27, sec. 3, 14th line. After the words "or widened" would it not be well to make the following change, so as to make it clear that the engineer has the power to order one person to make a portion of drain and another person to maintain said portion?—"Unless the engineer hereinafter named otherwise direct, either in the award in respect of the original opening, deepening or widening, or subsequently, in consequence of altered circumstances, upon application of any party interested in the same form and manner, etc., etc., as in this Act provided."

QUES. 5.—See 46 Vic., cap. 27, sec. 6, 8th line, as amended by 50 Vic., cap. 37, sec. 3. After the word "purpose" reads as follows: ". . . Be asked to appoint a day in which he will attend at *the time* and place named in the requisition, etc." The words in *italic* should be left out; also in "Form C," after the word "drain" in the 15th line leave out all the words to the word "noon" in the 17th line. As matters now stand the engineer has not the appointing of the day.

ANS.—Mr. Proudfoot—I don't think it is necessary to strike out the words "at the time," as the engineer receives a letter beforehand asking him if he go out, etc.

Mr. Jones—The only trouble is that the Act already provides that they shall name a time and place, and this is already fixed.

QUES. 6.—Sec. 8 of 46 Vic., cap. 27, will need some amendment, such as the following 4th line; "At the time appointed by himself and at the place named in the requisition."

ANS.—Mr. Chipman—This goes right back to the same thing as the other.

QUES. 7.—See 46 Vic., cap. 27, sec. 18, 6th line. After the words "original proceedings," what is the meaning of the following sentence?—"But no person shall make use of such ditch or drain constructed under the provisions of this Act, unless under agreement or award pursuant to its provisions as to the use of the lands of others."

ANS.—Mr. Proudfoot—The way the Act stands we cannot assess a man's land more than 60 rods from the drain, but in the award there may be something provided for paying the other parties for the use of the drain they have dug. We could not bring him in if he is 60 rods from the drain.

QUES. 8.—In sec. 1, c. 43, 47 Vic., amending sec. 3, c. 27, 46 Vic., who is to decide where a proper outlet is reached?

ANS.—Mr. Chipman—I know of a case where the engineer thought he had decided all right, but the Court decided that he did not know anything about it.

QUES. 9.—If the lower owner will not give his consent to construction of ditch on to his land, must the ditch be carried across his land?

ANS.—A Member—You would just have to follow the provisions of the Act.

Mr. Abrey—I happened accidentally last week to see a letter to the Attorney-General by a member of the Association of Civil Engineers, asking that no person can act as civil engineer except a civil engineer under that Act.

Mr. Galbraith—I hope this Association don't think I have any hand in it.

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## INSTRUMENTS.

QUES. 1.—What is the best method of illuminating the telescope crosshairs at night, and what is the best lamp for night observations generally?

ANS.—Mr. Abrey—I think that for illuminating the crosshairs at night the method of illuminating the cross axis is the best.

Mr. Chipman—I think that it would be better not to illuminate the cross axis, as this mode heats it up too much. I believe in lighting through the object glass when the star is not less than the third magnitude, but if smaller than that some other method of illuminating would be necessary.

Mr. Dickson—I have been in the habit of having the light held by an assistant at a distance from the instrument. I never yet failed in taking an observation even with a reflector; and if an assistant cannot be obtained to hold the light you can put it upon a pole.

Mr. Burnett—If you simply take the object glass off the telescope, and put in a piece of white paper around the inside of the telescope tube, this will act as a capital reflector.

Mr. Sankey—If you take a brick and soak it in coal oil, and have it held at a distance of three or four feet from the instrument, this will answer the purpose. It will burn half an hour or an hour.

Mr. Dickson—At a distance of ten or twelve rods I have never had any trouble with a flambeau.

Mr. C. A. Jones—I have sometimes used a reflector, but did not use the ordinary lamp that goes with the instrument. I had the light held at two or three feet so as to throw the light into the reflector, then the instrument is not affected either by heat or extra weight.

QUES. 2.—Has any one experienced difficulty on account of the spindle of his theodolite working too stiffly in very cold weather? Is there any remedy?

ANS.—Mr. Abrey—Use little or no oil in cold weather. I have used instruments at fifty or sixty degrees below zero, and there is a difficulty when using oil. It is recommended to wipe the axis perfectly dry for winter work, but it is also recommended to use black lead, but there is an objection to this latter method, as it is not easily distributed on the spindle. I may say that I rubbed the spindle of the instrument with the oil of a badger, and my instrument never bothered me again. I suppose the oil of any other animal would be as good.

QUES. 3.—How do you prevent the telescope axis from climbing in the Y's while the vertical arc is being moved by its tangent screw?

ANS.—Mr. Chipman—This motion may be caused by opposing screws at lower end of clamp arm to vertical circle not moving in same straight line.

QUES. 4.—Required formula for errors in azimuth caused by the following errors (supposed to be small) of adjustment in the Surveyor's solar instrument (Equatorially Mounted, Transit or other instrument), with their effects in surveying in changes of hour angle both forenoon and afternoon, and in different latitudes and declinations:

- (a) Error due to error of the latitude zero.
- (b) Error due to error of the declination zero.
- (c) Error due to inclination of latitude axis, viz.: Latitude axis not horizontal or perpendicular to spindle of instrument.
- (d) Error due to the inclination of polar axis, viz.: Polar axis not perpendicular to latitude axis.
- (e) Error due to inclination of declination axis, viz.: Declination axis not perpendicular to polar axis.
- (f) Error due to error of collimation, viz.: Collimation not perpendicular to the declination axis.

ANS.—Mr. Abrey—I may say these are all very difficult questions. I know the effect of the errors, however. I took trouble to ask those whom I thought could answer them. Professor Galbraith said they were very difficult, but his time was too much taken up with the School of Practical Science to allow him to go into the matter. I also asked Mr. Carpmael, and he has not yet given his answers. I also asked Mr. King, of Ottawa, and I have his answers to the whole of them, and I would like to have them published in our Report. I should like also to have Mr. Carpmael's answers (when received) published. It is really necessary for us to know what these are, for all the instruments. Mr. King's answers are not lengthy.



## BOUNDARY COMMISSIONERS.

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### DISCUSSION.

Mr. Abrey—I will have to make an apology in reference to this matter, as I have made no preparation for it, and I don't like saying anything at all, still I believe it would be a good thing if we could get it accomplished—one commissioner I think would be enough. We should I think have some legal advice on the matter; it might be done I think by taking some lawyer on the Committee.

Mr. Niven—I have given this matter some little consideration, but I think this proposed act of Mr. Ogilvie's will be too expensive, as it I think would necessitate having three arbitrators appointed. Our people should have the privilege of accepting one; in many cases one might settle the disputes that arise on boundary lines. They should have the option of having two, and if these two could not agree, then they might choose a third. I am not prepared to submit any particular scheme, but I think it would be well to appoint a committee to look into this matter and report before our meeting dissolves. I would move that a committee be appointed to consider this question and report at a future meeting.

Mr. Abrey—Of this session or another season?

Mr. Niven—I think we might have it this session.

Mr. Sankey—The motion has not been seconded, and I will be pleased to second it. I would like to say that I have had the opportunity of discussing it with some members of the legal profession, and I think we have got to admit the legal profession into the discussion. One of the amendments proposed was this: If two Surveyors are appointed by the parties interested then the County Judge is the third. In a case where you could establish a court there could be no reason why the parties interested might not select counsel to represent them at that court. I think two Surveyors can tackle two lawyers and keep them in bounds. The question that bothers Surveyors at court is, what is evidence and what is not, therefore this court requires to know what is evidence and what is applicable. There is another point—a court established in this way would have no power—because the County Judge has no jurisdiction over boundaries. These powers are all vested in the High Court of Justice. These are points I would like to bring before the meeting. No doubt all admit that Mr. Ogilvie's scheme is a wise and useful one because the evidence can be got on the ground, and if the court sees it on the spot it has great weight. Then the difficulty again, that the witnesses may be all posted as to their answers. Then with regard to having Surveyors appointed;

questions may come before the court that nobody but a Surveyor can answer. But the principal difficulty we have to contend with and the real difficulty, is the construction of such a court with such powers as they would have. Unless you bind both parties pretty tight they kick the whole thing over. Then another difficulty may occur; this court would have a president, then three or four decisions may run one after the other, some fellow goes wrong and says the chances are the decision will go against you. But supposing you don't take it to this court at all, and go to the High Court of Justice then the decision is likely to be kicked over. If we are going to make this a practical thing we want to do it with the assistance of some legal mind. I think we should get a good lawyer to try to help us; personally I am very much in favour of it, and if a court were once got into good working order it would save a lot of trouble, but if we don't establish it on a proper basis on the start it will fail at once. Surveyors themselves have not knowledge enough to frame rules without further assistance, and it would be well for this committee to add legal assistance to their numbers. I have spoken to one or two legal gentlemen about it and they all seem to think that a Judge in a higher court always makes a reference to the Master, and then the Court makes the award.

Mr. Stewart—Mr. President, I have not given this matter much attention since last year, but I was led to consider that something of the kind might be done by the arbitrators similar to those who are appointed to settle railway matters, and I think we might settle this in much the same way, viz., that the two parties each appoint an arbitrator, and the County Judge be the third, or some one appointed by the County Judge. With regard to the last speaker's suggestion that the County Judge be a third party, I think that was mentioned too. But I think it would be almost impossible to get the Judge to take hold of it, for the reason that I think an appointment made by a Judge would be preferable. I have spoken to a legal gentleman and he thought you should have a court for establishing matters of this kind, that he had noticed the need of such a court, and suggested our establishing one at once. I asked him if it would be subject to appeal; he thought not, that we could make the thing final. There is one clause in this motion that I think would be difficult for a Surveyor to subscribe to. [Reads clause.] I don't think that a Surveyor should attempt to arbitrate on his own work. Now he may not be interested in that way, but he might be interested in some other survey of a similar nature, and he cannot help being prejudiced in favour of his own fees. I approve of Mr. Sankey's idea of appointing a committee and I will second the motion.

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# APPENDIX.

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## LIST OF EXHIBITS.

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List of Stationery Exhibited by Hart & Company, 31 and 33 King Street West :—

Whatman's hand-made drawing papers, rough, medium or smooth, imperial tracing linen, in rolls 36 and 42 inches wide, tracing paper, in rolls, cross section paper, in rolls, profile paper, in sheets, Faber's Siberian graphic pencils, all grades, Indian ink, finest quality, in sticks, rubber and steel erasers, drawing pins, vulcanite rulers, level books, transit books, record books, cross section books, field books, specification papers, samples of printed note heads and envelopes, specimens of finely engraved steel dies, for professional and private note paper and envelopes.

SYSTEM OF DRAINAGE TABLES. Calculated for the use of Township Officers, Contractors, Land-owners, and all persons interested in drainage works. By J. H. Jones, D.L.S. & C.E., of Sarnia, Ont. Price \$1.50 cloth, and \$2.00 limp morocco.

The Map and School Supply Company, 31 King St. East, exhibited some specimens of Map-mounting, including plans on tracing cloth, mounted on cloth and on card board ; also some of the same varnished and mounted. They also sent in some folded for pocket use and for filing in cases, some of which showed a good degree of skill in the arrangement for mounting and folding a really large map to fit a small case. This Company are reliable and will give satisfaction in their line.

Fred. J. Sager of Columbus, Ohio, exhibited some patent band chains done up in patent self-winding reels which attracted attention.

Messrs. Unwin, Brown & Sankey, Surveyors, showed some maps and plans of the old times, which showed a large amount of draughting compared with what is now done upon plans of equal importance.

Mr. Chipman exhibited form of Field Book for Crown Surveys ; also General Index Book for Township and Town Surveys.

Mr. G. B. Abrey exhibited a Rolling Planimeter.

## COMMUNICATIONS.

*President Prov. Land Surveyors' Association :*

DEAR SIR,—For some time the Canadian Institute has been putting forth efforts to form an Archæological Museum, illustrative of all that pertains to the aborigines of Canada in general, but of Ontario more particularly.

Situated as are most of the gentlemen connected with your Association in various parts of the Province, and having to perform duties that bring before them the topographical features of the country, they are very favourably circumstanced with relation to the procuring of just such information as the Institute requires.

It may also be that many of the members are already in possession of facts bearing upon matters archæological.

In any case, the Council of the Canadian Institute would take it as a great favour if they can in any way enlist the co-operation of your Association for the purpose of locating old Indian village sites, temporary camping-grounds, battle-grounds, mounds, ossuaries, trails, etc.

The council would also be pleased to receive from members of the Provincial Land Surveyors' Association any specimens of Indian relics for preservation in the Provincial Archæological Museum.

Our collection, yet in its infancy, is open for the inspection of your members, all of whom are cordially invited to examine it before they leave the city.

I have the honour to be yours respectfully,

Toronto, March 1, 1888.

DAVID BOYLE,  
*Curator.*

*G. B. Kirkpatrick, Esq. :*

MY DEAR SIR,—Will you, at the Association meeting next week, bring up the question of Surveyors signing plans of subdivision which have no existence ?

I made outline survey of a 75-acre block. The owner sends me an elaborate plan of subdivision and requests me to register the same. I refuse to do so unless I make subdivision. His solicitor then writes me : " We do not intend placing any subdivision posts, or having any such survey made. The law does not require more than a certificate by a P.L.S." I, *of course*, refuse to certify, and say that under the circumstances " no Surveyor of any standing would do so." In reply I receive a letter saying, " The plans are registered by this time, so"—etc., etc.

Now, is it according to the ethics of the profession for a Surveyor to certify to plans of a survey of a block of land nearly a thousand miles away, *which he has never seen*, and plans of subdivision of which have been got up in an architect's office? Pray have this question ventilated. Pardon my troubling you, and believe me always,

Yours most sincerely,

*Sault Ste. Marie, February 18, 1888.*

JOS. COZENS.

[Read and laid over till Report on Surveying received.]

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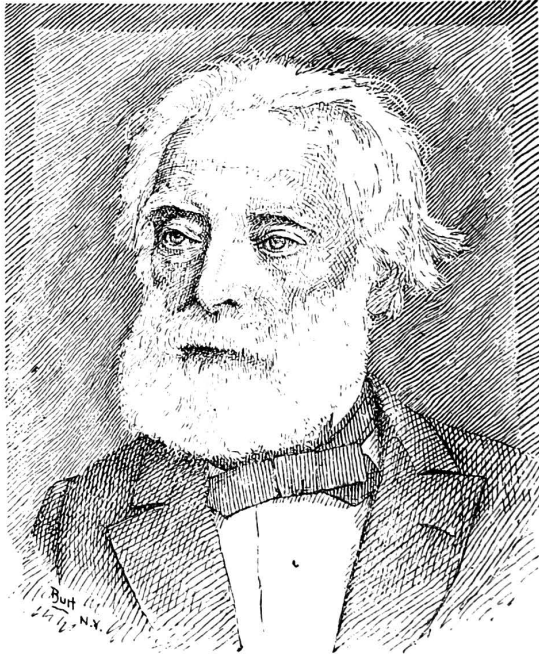
RESOLUTION ON THE DEATH OF H. H. STEPHENS,  
OF OWEN SOUND, ONT.

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Resolved, as it has pleased the Great Architect of the universe to remove from amongst us by death our professional brother, Mr. Haldane Hincks Stephens, that at this, the first meeting of our Association since the sad event, we wish to put on record our sympathy with the family of our departed comrade, of whom it can be said, as when the time of our departure comes may it be said of all of us, "He strove to do his duty."

Carried.

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Miss Russell

BIOGRAPHICAL SKETCH  
OF  
ANDREW RUSSELL, ESQ.

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THE following obituary notice of the late Mr. Russell from the *Evening Journal*, of Ottawa, and the sketch of his life and career, taken from Rose's *Cyclopedia of Canadian Biography*, make up a concise history of this eminent public servant, whose name is respected and beloved throughout the length and breadth of our Dominion, by all who had the privilege of knowing or coming in contact with him.

To make the sketch complete, it is only necessary to add that since Mr. Russell's withdrawal from the public service in 1883, he has lived in quiet retirement at his home in Ottawa, and was on a visit to his daughter, Mrs. A. K. Roy, in Toronto, when he received the summons to depart this life.

*(From the Evening Journal, Ottawa, Feb. 25, 1888.)*

Andrew Russell, of Glasgow, Scotland, whose name was well known throughout Ontario and Quebec, as Assistant Commissioner of Crown Lands, and who served his adopted country faithfully from the time of his first appointment as Superintendent of Government Roads in June, 1829, to the time of his well-earned retirement from the Department of the Interior in January, 1885, died last night at the residence of his son-in-law, 40 Cecil Street, Toronto, aged eighty-five years. His exemplary, unswerving constancy to the cause of Temperance has been fruitful of much good, and the following testimonial (see address from Association of Dominion Land Surveyors, below) is a monument of which a large number of relatives are justly proud: A consistent Christian. His end was peace.

*(From Rose's Cyclopedia of Canadian Biography.)*

Andrew Russell was born in Glasgow, Scotland, on the 29th June, 1804. He is a son of Alexander Russell and Janet Jamieson. He received his education at Glasgow, in the Common and Grammar Schools, leaving Glasgow with his parents, sister and brother for Quebec in May, 1822. The family settled in the Township of Leeds, County of Megantic, in June, 1822. Our subject was appointed Superintendent of Colonization Roads and Settlements in Megantic by the Governor General, Sir James Kempt, in June, 1829. On the union of Upper and Lower Canada he was placed in charge of the Surveys

Branch of the Crown Lands Department for Canada West ; and in 1857 he was appointed Assistant Commissioner of Crown Lands for the Province of Ontario. In 1870 he returned to the Capital to assist in the Census service. In 1874 he received the appointment of Chief Clerk in the Department of the Interior ; and in 1883 retired, after fifty-four years of public service.

Confining his attention purely to official duties, our subject never meddled in politics. He married in May, 1834, Lucy Chandler Lord, eldest daughter of Lieutenant-Colonel P. C. Lord, senior J.P. for the County of Megantic. During Mr. Russell's term of office he faithfully devoted his professional abilities to raising the standard of the surveying profession, and what he accomplished may be gathered somewhat from the following copy of an address presented to him by the Dominion Land Surveyors :—

*To Andrew Russell, Esq. :*

The Surveyors throughout the Dominion of Canada embrace this opportune time, on your retirement from active service, of presenting you with this Address, expressing, as it does, in but a feeble manner the esteem in which you are held by the profession.

During your fifty-four years of public service in the departments of the old Province of Canada and of the Dominion of Canada, you have preserved throughout that high standard of public morality, integrity and faultless character so worthy of emulation.

In the Crown Lands Department, as well as in the Department of the Interior, you have left your ineffaceable mark ; ever prompted by the sense of duty, regardless of personal ends.

A generation has seen you in harness, unassuming, but treading the path of honour.

But our gratitude centres especially upon your professional career. It was you who introduced into Canada the use of the transit theodolite upon public surveys, displacing the less accurate and variable compass. It was you who pointed to the stars for a sure guide, instead of the fickle magnetic pole.

Through your unceasing efforts surveying has attained its present high standard, ever aiming higher, and now is an honourable profession. Rightly may we style you the father of astronomic surveying in Canada, and proud are we of so worthy a progenitor.

May the laurel wreath you have won, resting on its snowy bed, brighten your remaining days in your quiet retreat.

And posterity will record, " His work is well done."

Signed, on behalf of the Surveyors, by

OTTO J. KLOTZ,

*President of Association Dominion Land Surveyors.*

A. F. COTTON,

*Secretary-Treasurer.*

*Ottawa, March 20, 1884.*



Mr. Russell's surviving family are his widow, Mrs. Russell; his three sons: Alexander L. Russell, P.L.S., D.L.S., etc., of Port Arthur, Ont.; Wm. L. Russell, associated with his brother Alexander L. in the same profession at Port Arthur; Andrew Russell, who lives in Ottawa; his four daughters: his eldest, Lucy, married to Wm. R. Ross, wholesale grocer, Montréal; Kate, married to Rev. O. R. Lambly, M.A., Methodist minister, of Madoc, Ont.; Jenny, married to Jno. B. Simpson, of the Dominion Government Audit Office, Ottawa; Annie E., married to Alex. K. Roy, of the firm of Hart & Co., booksellers and stationers, Toronto, Ontario. Mr. Russell died 24th February, 1888, at the residence of his son-in-law, A. K. Roy, 40 Cecil Street, Toronto.

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# LIST OF MEMBERS.



## ACTIVE MEMBERS.

| NAME.                                                       | OCCUPATION.                                                                                         | ADDRESS.                                                           |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Abrey, George Brockitt . . . . .                            | 17 Arcade,                                                                                          | Yonge Street, Toronto.                                             |
| Apsey, John Fletcher . . . . .                              | 47 Gloucester Street,                                                                               | Toronto.                                                           |
| Aylsworth, Wm. Robert . . . . .                             | Deseronto.<br>Engineer for Tyendinaga, Engineer for Bay of Quinte Railway, etc.                     |                                                                    |
| Baird, Alexander . . . . .                                  | Leamington.                                                                                         |                                                                    |
| Bazett, Edward . . . . .                                    | Midland.                                                                                            |                                                                    |
| Beatty, David . . . . .                                     | Parry Sound.                                                                                        |                                                                    |
| Bell, James Anthony . . . . .                               | St. Thomas.<br>City Engineer.                                                                       |                                                                    |
| Berryman, Edgar, M. Can. Soc. C.E. . . . .                  | 17 Place d'Armes Hill,                                                                              | Montreal.<br>Engineer Great Eastern and Montreal & Sorel Railways. |
| Blake, Frank Lever . . . . .                                | Toronto.<br>Astronomical Assistant at Observatory.                                                  |                                                                    |
| Bolger, Francis . . . . .                                   | Penetanguishene.                                                                                    |                                                                    |
| Bolton, Jesse Nunn . . . . .                                | Albion.                                                                                             |                                                                    |
| Bolton, Lewis . . . . .                                     | Listowel.<br>Engineer for Townships of Elma, Grey, Morris, Town of Listowel and Village of Drayton. |                                                                    |
| Booth, Charles Edward Stuart, A. M. Can. Soc. C.E.,         | 393 Division Street, Kingston.                                                                      |                                                                    |
| Bowman, Clemens Dersteine . . . . .                         | West Montrose.                                                                                      |                                                                    |
| Bowman, Herbert Joseph, Grad. S. P. Sc. (Toronto) . . . . . | Berlin.                                                                                             |                                                                    |
| Bowman, Isaac Lucius . . . . .                              | Berlin.                                                                                             |                                                                    |
| Bray, Edgar . . . . .                                       | Oakville.                                                                                           |                                                                    |
| Browne, Harry John . . . . .                                | 17 Toronto Street,                                                                                  | Toronto.                                                           |
| Browne, Wm. Albert . . . . .                                | 17 Toronto Street,                                                                                  | Toronto.                                                           |

112 ASSOCIATION OF PROVINCIAL LAND SURVEYORS.

| NAME.                                                                             | OCCUPATION.                                      | ADDRESS.                                                                            |
|-----------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------|
| Burke, Wm. Robert . . . . .                                                       | Engineer for County of Oxford.                   | Ingersoll.                                                                          |
| Burnet, Peter . . . . .                                                           |                                                  | Orillia.                                                                            |
| Burt, Frederick Percy . . . . .                                                   | Artist "Engineering News."                       | New York City.                                                                      |
| Campbell, Archibald Wm. . . . .                                                   |                                                  | St. Thomas.                                                                         |
| Campbell, David Suter . . . . .                                                   | Engineer for five Townships.                     | Mitchell.                                                                           |
| Casgrain, Joseph Philip Baby . . . . .                                            |                                                  | Morrisburgh.                                                                        |
| Cavana, Allen George . . . . .                                                    | Engineer for Townships of Rama, Mara and Dalton. | Orillia.                                                                            |
| Chipman, Willis, B.A.Sc. (McGill); M. Am. Soc. C.E.; M.<br>Can. Soc. C.E. . . . . | City Engineer.                                   | Brockville.                                                                         |
| Coad, Richard . . . . .                                                           |                                                  | Glencoe.                                                                            |
| Coleman, Richard Herbert . . . . .                                                | Engineer for Canada Company.                     | Toronto.                                                                            |
| Cozens, Joseph . . . . .                                                          |                                                  | Sault Ste. Marie.                                                                   |
| Davidson, Walter Stanley . . . . .                                                | Engineer for Township of Moore.                  | Arkona.                                                                             |
| Davis, John . . . . .                                                             | Engineer Guelph Junction Railway.                | Guelph.                                                                             |
| Davis, Wm. Mahlon, Grad. R. M. C. (Kingston); A. M.<br>Can. Soc. C.E. . . . .     | Town Engineer, Woodstock.                        | Woodstock.                                                                          |
| Deans, William James . . . . .                                                    |                                                  | Oshawa.                                                                             |
| De Gursé, Joseph . . . . .                                                        |                                                  | Windsor.                                                                            |
| Dickson, James . . . . .                                                          | Inspector Crown Lands Surveys.                   | Fenelon Falls.                                                                      |
| Doupe, Joseph, C.E. (McGill) . . . . .                                            |                                                  | 7 Princess Street, Winnipeg, Man.                                                   |
| Drewry, Wm. Stewart, A. M. Can. Soc. C.E. . . . .                                 | Engineer for Townships of Sidney and Thurlow.    | Box 386, Belleville.                                                                |
| Ellis, Henry Disney . . . . .                                                     |                                                  | 74½ St. Patrick Street, Toronto.<br>Assistant Engineer N. & N.-W. Division G. T. R. |

## LIST OF MEMBERS.

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| NAME.                                                             | OCCUPATION. | ADDRESS.                                                                                      |
|-------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------|
| Esten, Henry Lionel                                               | .....       | 26 Adelaide Street East, Toronto.                                                             |
| Evans, John Dunlop                                                | .....       | Trenton.<br>Chief Engineer Central Ontario Railway, Engineer Weddell Bridge and Engine Works. |
| Fawcett, Thomas, D.T.S.                                           | .....       | Gravenhurst.<br>Dominion Government Surveys, British Columbia.                                |
| Fitton, Charles Edward                                            | .....       | Orillia.                                                                                      |
| Foster, Frederick Lucas                                           | .....       | 176 Argyle Street, Toronto.                                                                   |
| Franks, Cecil Bushe, M. Can. Soc. C.E.                            | .....       | Box 116, Hamilton.<br>Assistant Engineer G. T. R.                                             |
| Galbraith, John, M.A.; Assoc. M. Inst. C.E., D.T.S.               | .....       | Toronto.<br>Professor of Civil Engineering, School of Practical Science.                      |
| Galbraith, William                                                | .....       | Bracebridge.                                                                                  |
| Gardiner, Edward                                                  | .....       | St. Catharines.<br>City Engineer.                                                             |
| Gaviller, Maurice, C.E. (McGill)                                  | .....       | Barrie.                                                                                       |
| Gibson, Peter Silas, B.Sc.; C.E.; M.Sc. (Univ. of Mich.)          | .....       | Willowdale.                                                                                   |
| Hanning, Clement George, C.E. (Trinity College, Dublin, Ireland), | .....       | 135 Bloor Street East, Toronto.                                                               |
| Henderson, Eder Eli                                               | .....       | Brownville, Me.<br>Engineer on International Railway, Maine.                                  |
| Jones, Charles Albert                                             | .....       | 215 Dundas Street, London.<br>Engineer for Townships of London, Delaware and West Nissouri.   |
| Jones, Thomas Harry, B.A.Sc. (McGill)                             | .....       | Brantford.<br>City Engineer, Engineer for Townships of Burford, Brantford and South Dumfries. |
| Keefer, Thos. Coltrin, C.M.G.; M. Inst. C.E.; Pres. A. Soc.       | .....       | Ottawa.<br>C.E.; M. Can. Soc. C.E.                                                            |
| Kirk, Joseph                                                      | .....       | Stratford.<br>Engineer for Townships of Mornington and South Easthope.                        |
| Kirkpatrick, George Brownly                                       | .....       | Toronto.<br>Chief Clerk Survey Branch, Department of Crown Lands.                             |
| Klotz, Otto Julius, D.T.S.; C.E. (University of Michigan)         | .....       | Preston.<br>Astronomer for Department of Interior.                                            |
| Laird, Robert                                                     | .....       | 771 King Street West, Toronto,                                                                |

| NAME.                                                         | OCCUPATION.                                                                       | ADDRESS.                          |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------|
| Lumsden, Hugh David,                                          | M. Inst. C.E.; M. Can. Soc.<br>C.E. ....                                          | Sherbrooke, Q.                    |
|                                                               | Engineer for Atlantic & North-West and International Railways.                    |                                   |
| McAree, John,                                                 | Grad. S. P. S.; D.T.S. . . . .                                                    | 237 Parliament Street, Toronto.   |
| McDonell, Augustine . . . . .                                 |                                                                                   | Chatham.                          |
| McEvoy, Henry Robinson . . . . .                              |                                                                                   | St. Marys.                        |
| McGeorge, Wm. Graham . . . . .                                |                                                                                   | Chatham.                          |
| McGrandle, Hugh . . . . .                                     |                                                                                   | Huntsville.                       |
| McKay, Owen . . . . .                                         |                                                                                   | Windsor.                          |
|                                                               | Assistant Engineer L. E. E. & D. R. Ry.                                           |                                   |
| McKenna, John Joseph . . . . .                                |                                                                                   | Dublin.                           |
| Maddock, Junius Arthur . . . . .                              |                                                                                   | Gladstone, California.            |
| Manigault, Wm. Mazyck . . . . .                               |                                                                                   | Strathroy.                        |
|                                                               | Engineer for Townships of Caradoc, East Williams, Adelaide and Town of Strathroy. |                                   |
| Miles, Charles Falconer . . . . .                             |                                                                                   | Walkerton.                        |
| Moore, John McKenzie . . . . .                                |                                                                                   | London.                           |
| Murphy, Chas. Joseph . . . . .                                |                                                                                   | 30 Adelaide Street East, Toronto. |
| Niven, Alexander . . . . .                                    |                                                                                   | Haliburton.                       |
|                                                               | Outline Surveys, Crown Lands Department.                                          |                                   |
| Ogilvie, William, D.T.S. . . . .                              |                                                                                   | Ottawa.                           |
|                                                               | Exploration Survey Alaskan Boundary.                                              |                                   |
| Paterson, Jas. Allison . . . . .                              |                                                                                   | Moose River, Me.                  |
| Patten, Thaddeus James . . . . .                              |                                                                                   | Little Current.                   |
| Proudfoot, Hume Blake, C.E. (University of Toronto) . . . . . |                                                                                   | Clinton.                          |
|                                                               | Engineer for eleven Townships.                                                    |                                   |
| Purvis, Frank . . . . .                                       |                                                                                   | Eganville.                        |
|                                                               | Engineer for Townships of Bromley and Wilberforce.                                |                                   |
| Robertson, James, Grad. S. P. Sc . . . . .                    |                                                                                   | Glencoe.                          |
|                                                               | Engineer for several Townships.                                                   |                                   |

| NAME.                               | OCCUPATION.                                                               | ADDRESS.                       |
|-------------------------------------|---------------------------------------------------------------------------|--------------------------------|
| Rogers, Richard, Birdsall ;         | B.A.Sc. (McGill)<br>Assistant Engineer Trent Canal.                       | Peterboro'.                    |
| Russell, Alexander Lord             |                                                                           | Port Arthur.                   |
| Sankey, Villiers                    |                                                                           | 17 Toronto Street, Toronto.    |
| Saunders, Bryce Johnston,           | B.A.Sc. (McGill)                                                          | Brockville.                    |
| Scane, Thomas                       |                                                                           | Ridgetown.                     |
|                                     | Engineer for Townships of Howard and Ridgetown.                           |                                |
| Selby, Henry Walter                 |                                                                           | Stayner.                       |
|                                     | Engineer for Townships of Nottawasaga and Sunnidale.                      |                                |
| Sewell, Henry DeQuincey,            | Assoc. M. Inst. C.E.                                                      | Port Arthur.                   |
| Smith, Henry, M. Can. Soc. C.E.     |                                                                           | Toronto.                       |
|                                     | Superintendent of Colonization Roads in Ontario.                          |                                |
| Speight, Thomas Bailey              |                                                                           | Arcade, Yonge Street, Toronto. |
| Sproatt, Charles, M. Can. Soc. C.E. |                                                                           | Toronto.                       |
|                                     | City Engineer.                                                            |                                |
| Stewart, Elihu                      |                                                                           | Collingwood.                   |
| Traynor, Isaac                      |                                                                           | Dundalk.                       |
|                                     | Engineer for Townships of Egremont, Proton, Melancthon and Osprey.        |                                |
| Unwin, Charles                      |                                                                           | 17 Toronto Street, Toronto.    |
| Van Nostrand, Arthur Jabez          |                                                                           | Arcade, Yonge Street, Toronto. |
| Vicars, John                        |                                                                           | Cannington.                    |
| Warren, James                       |                                                                           | Kincardine.                    |
|                                     | Engineer for the Townships of East Wawanosh, Huron, Bruce and Kincardine. |                                |
| Weatherald, Thomas                  |                                                                           | Goderich.                      |
| West, Robert Francis                |                                                                           | Orangeville.                   |
| Wheeler, Arthur Oliver              |                                                                           | Ottawa.                        |
|                                     | Department of Interior.                                                   |                                |
| Wheelock, Chas. Richard             |                                                                           | Orangeville.                   |
|                                     | Engineer for Counties of Wellington, Dufferin and Peel.                   |                                |
| Whitson, James Francis              |                                                                           | North Bay.                     |
|                                     | Engineer for six Townships.                                               |                                |

| NAME.                    | OCCUPATION.                                                     | ADDRESS.                     |
|--------------------------|-----------------------------------------------------------------|------------------------------|
| Willson, Alfred          | Chief Engineer Canada Company.                                  | Toronto.                     |
| Wilson, Hugh, F.G.S.     |                                                                 | 433 Carlton Street, Toronto. |
| Yarnold, William, Edward | Engineer for Townships of Reach, Scugog, Mariposa and Georgina. | Port Perry.                  |

---

JUNIOR MEMBERS.

|                            |                                   |            |
|----------------------------|-----------------------------------|------------|
| Rathbun, Edward Walter, Jr | Assistant Engineer N. T. & Q. Ry. | Deseronto. |
| Sherman, Ruyter            |                                   | Brantford. |

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HONORARY MEMBER.

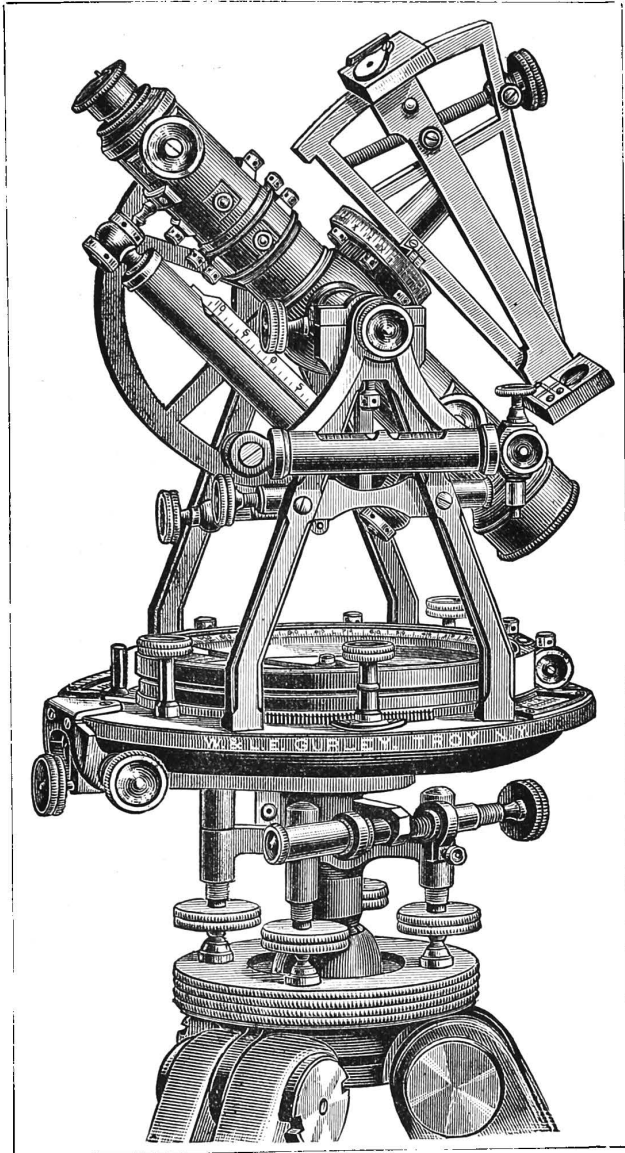
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| Carpmael, Charles, M.A. | Superintendent of Meteorological Service. | Toronto. |
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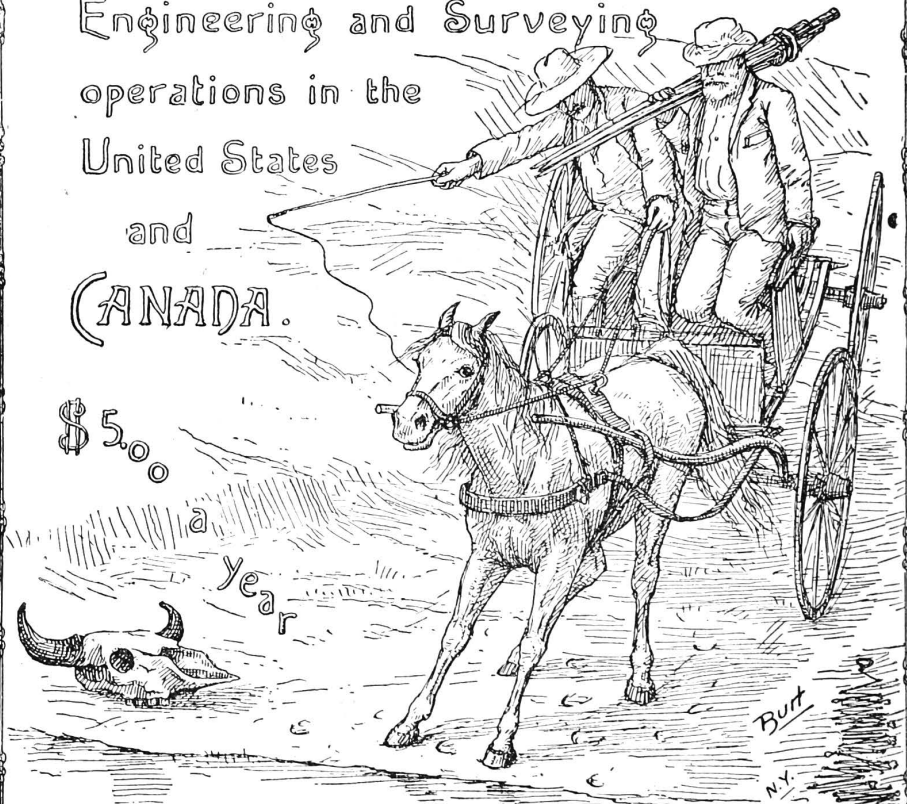
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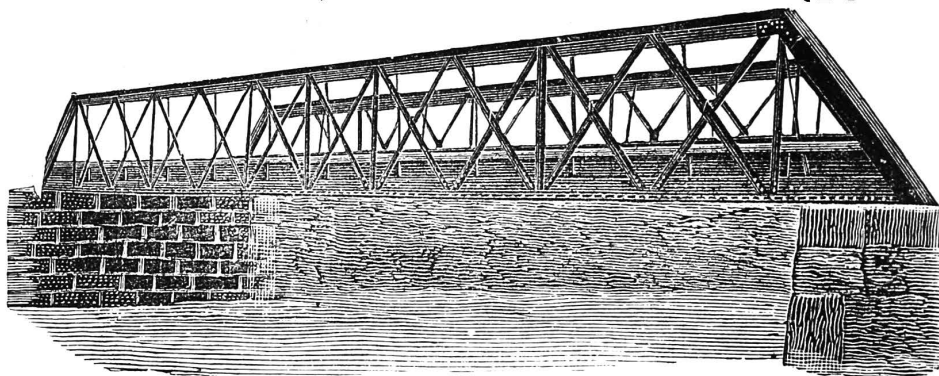
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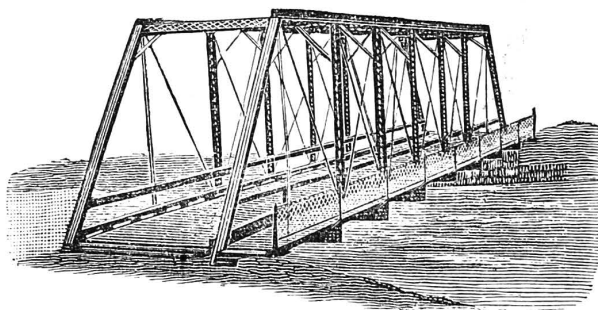
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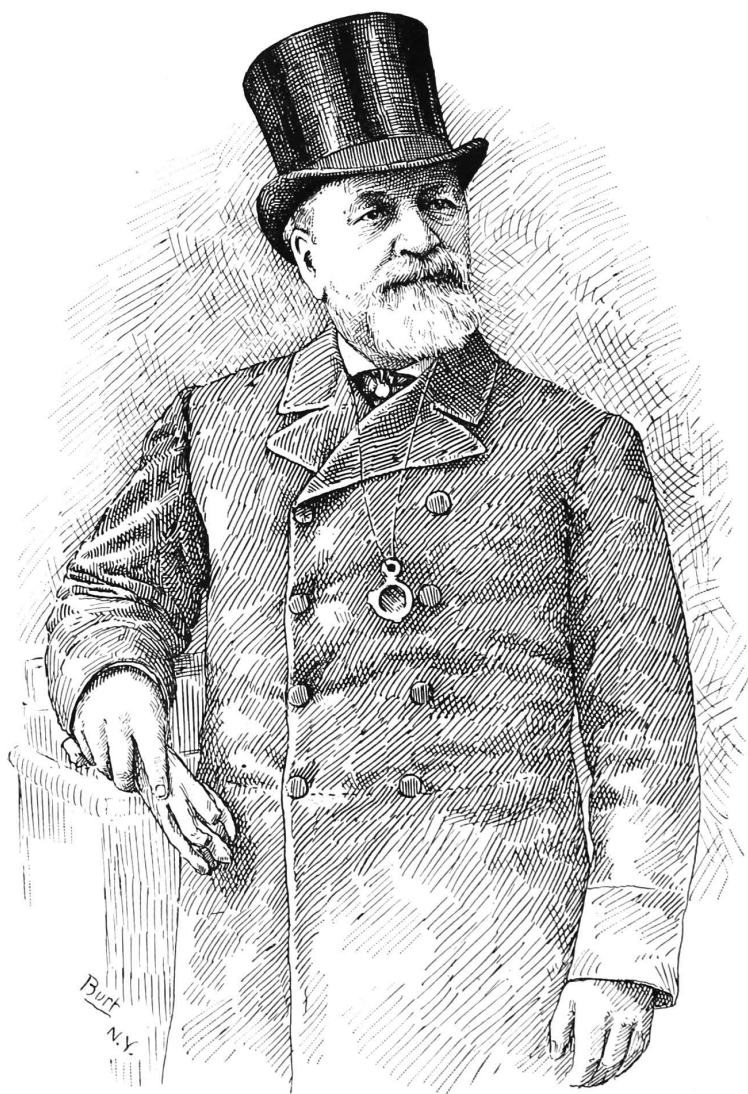
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Thomas Devine  
D.S.G.







PROCEEDINGS  
OF THE  
ASSOCIATION OF  
PROVINCIAL LAND SURVEYORS  
OF ONTARIO,

AT ITS FOURTH ANNUAL MEETING HELD AT TORONTO,  
ON FEBRUARY 26TH, 27TH AND 28TH,

1889.

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*The Fifth Annual Meeting will be held in Toronto, on Tuesday,  
25th of February, 1890.*

---

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NOTICES.

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

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Each member is requested to add to his business card the following:  
“*Member of the Association of Provincial Land Surveyors of Ontario.*”

---

Members can be supplied with copies of the Proceedings for 1887 and Proceedings for 1888 by remitting fifty cents to the Secretary.

Copies of the Constitution will be sent upon receipt of three cent stamp.

**PATRONIZE OUR ADVERTISERS.**

## PREFACE.

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*To the Members of the Association of Provincial Land Surveyors of Ontario :*

THE Proceedings of the Association at its Fourth Annual Meeting, held in Toronto, in February last, are herewith presented.

This meeting was the most successful yet held, the registered attendance was greater than at any preceding meeting, and great interest was taken in the subjects discussed, while the discussions were more to the point than at any former meeting.

Much of the success of this meeting is to be attributed to the exertions of the Entertainment Committee, the drive around the city and the sumptuous dinner being fully appreciated by the visiting members.

We regret to say that a few, but a very few, of the active members of our profession are not members of our Association, although reaping the benefits of the legislation passed at the instance of the Association. We hope each member will consider it a part of his duty to convince non-members of their egotistical folly in not becoming members, and that this year we may see enrolled every Surveyor worthy of the name. We are endeavouring to "promote the general interests and elevate the standard of the profession"—a task which would become much easier if all Provincial Land Surveyors were members of this Association.

Respectfully submitted on behalf of the Executive Committee.

WILLIS CHIPMAN,  
*Secretary.*

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ASSOCIATION OF  
PROVINCIAL LAND SURVEYORS  
OF ONTARIO.

---

ORGANIZED 23RD FEBRUARY, 1886.

---

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Alexander Niven, P.L.S., Haliburton.

VICE-PRESIDENT.

Villiers Sankey, P.L.S., City Hall, Toronto.

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DRAINAGE.—James Robertson (Chairman); D. S. Campbell, H. W. Selby, Jas. Kirk, C. F. Miles.

ENGINEERING.—W. M. Davis (Chairman); A. W. Campbell, C. G. Hanning, H. J. Bowman, T. H. Jones.

LEGISLATION.—W. R. Aylsworth (Chairman); J. Dickson, G. B. Kirkpatrick, W. Chipman, Wm. Ogilvie.

INSTRUMENTS.—J. W. Tyrrell (Chairman); E. Bray, W. R. Burke, B. J. Saunders.

PUBLICATION.—H. L. Esten (Chairman); H. D. Ellis, T. P. Speight, John McAree.

ENTERTAINMENT.—A. J. VanNostrand (Chairman); V. Sankey, H. D. Ellis, G. B. Abrey, F. L. Foster, C. Murphy.

---

PROGRAMME OF THE  
Association of Provincial Land Surveyors of Ontario

AT ITS FOURTH ANNUAL MEETING HELD IN TORONTO,  
FEBRUARY 26TH, 27TH, AND 28TH, 1889.

---

PROGRAMME.

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

Meeting of Executive Committee.  
Meeting of Standing Committees.

*Afternoon, 2 o'clock.*

Reading Minutes of Previous Meeting.  
Appointment of Scrutineers of Ballots of 1888.  
Reading of Correspondence.  
Report of Secretary-Treasurer.  
Appointment of Auditors.  
President's Address.  
Report of Committee on Land Surveying, E. Stewart, P.L.S.,  
Chairman.  
Discussion of Proposed Amendment in Survey Act.

*Evening, 8 o'clock.*

Paper—"Original Land Marks," Maurice Gaviller, P.L.S., C.E.  
Paper—"Cadastral Surveys in the Province of Quebec," J. P. B.  
Casgrain, P.L.S.  
Amateur Photography.  
Report of Committee on Boundary Commissioners, V. Sankey,  
P.L.S., Chairman.

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

Report of Scrutineers of Ballots of 1888.  
Report of Committee on Drainage, L. Bolton, P.L.S., Chairman.  
Paper—"City Surveys," T. B. Speight, P.L.S.  
Paper—"Descriptions," O. J. Klotz, D.T.S.  
Paper—"Timber Exploring," W. R. Aylsworth, P.L.S.

*Afternoon, 2 o'clock.*

Report of Auditors.

Report of Committee on Engineering, T. H. Jones, B.A.Sc.,  
Chairman.

Paper—"Awards and Plans under Ditches and Watercourses  
Act," Lewis Bolton, P.L.S.

Paper—"Railway Right of Way Surveys," C. G. Hanning, C.E.,  
H. J. Browne, P.L.S., Jno. Davis, P.L.S., H. D. Ellis, P.L.S.

Paper—"Brantford Water Works," T. H. Jones, B.A.Sc.

Paper—"Wooden and Composite Bridges," H. K. Wicksteed,  
B.A.Sc.

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

Report of Committee on Legislation, W. R. Aylsworth, P.L.S.,  
Chairman.

Report of Committee on Publication, T. B. Speight, P.L.S.,  
Chairman.

Report of Committee on Instruments, John McAree, D.T.S.,  
Chairman.

Paper—"The Transit," John McAree, D.T.S.

Paper—"Reproduction of Plans."

Paper—"Decimal *vs.* Duodecimal Measures," V. Sankey, P.L.S.  
Volunteer Papers.

*Afternoon, 2 o'clock.*

Report of Committee on Entertainment, A. J. VanNostrand,  
P.L.S., Chairman.

Unfinished Business.

Election of Associate Members, Junior Members, and Honorary  
Members.

Nomination of Officers.

Appointment of Scrutineers—Ballot of 1889.

New Business.

Adjournment.

---

Full discussion after each Paper and each Report.

---



ASSOCIATION OF  
PROVINCIAL LAND SURVEYORS  
OF ONTARIO.

---

MINUTES OF THE FOURTH ANNUAL MEETING.

FEBRUARY 26TH, 27TH AND 28TH, 1889.

---

The Association met at 2 p.m. on February 26th, in the Library of the Canadian Institute, 46 Richmond Street East, Toronto.

The Association was called to order by the President, Alexander Niven, Esq.

Moved by Willis Chipman, seconded by D. L. Sanderson: That the Minutes of the last meeting, as printed in the Proceedings, be taken as read. Carried.

Moved by V. Sankey, seconded by M. Gaviller: That C. F. Aylsworth and O. McKay be appointed Scrutineers to examine ballots for 1888-89. Carried.

The Secretary-Treasurer, Willis Chipman, then presented his report, which, upon motion, was received and adopted.

Moved by V. Sankey, seconded by C. F. Miles: That J. A. Paterson and D. L. Sanderson be appointed Auditors, to audit accounts for year 1888, and report to-morrow at 12.30 p.m. Carried.

The President then read his annual address. (See page 37.)

The Report of the Committee on Land Surveying was then presented by the Chairman, E. Stewart, which, after discussion, was received and adopted. (See page 20.)

The Committee on Entertainment here notified the meeting that on Wednesday, 27th, at 3 p.m., the Reception Committee of the City Council would take the members of the Association for a drive about the city, visiting the Don improvements, city waterworks, Rosehill reservoir, and other places of interest about the city.

The paper on Wooden and Composite Bridges was read by the Secretary, in the absence of the writer, H. K. Wicksteed.

Moved by G. B. Abrey, seconded by H. J. Browne: That H. J. Browne, E. Stewart, A. Niven, M. Gaviller, T. B. Speight, C. F. Myles and J. P. B. Casgrain, be a Committee to consider, and report to this meeting before its close, on a table of Tariff of Fees for adoption by surveyors. Carried.

The proposed amendments to the Survey Act were then discussed by the meeting. (See page 23.) Moved by E. Stewart, seconded by J. Kirk: That the proposed amendments be referred to the Committee on Legislation, to report as soon as possible. Carried.

Meeting adjourned at 5.30 p.m.

#### EVENING SESSION, 8 P.M.

President in the Chair.

M. Gaviller read his paper on "Original Landmarks." (See page 39.)

J. P. B. Casgrain then read his paper on "Cadastral Surveys in the Province of Quebec," illustrated by plan and book of reference. (See page 46.)

Committee on Boundary Commissioners presented their report. (See page 32.)

Moved by V. Sankey, seconded by H. L. Esten: That the paper read by Mr. Casgrain be referred to the Land Surveying Committee, with instructions to report on same, particularly with regard to how the provisions mentioned in the same may be applied to Section 68 and Subsections of our Act. As at present the details of preparing compiled plans are left entirely to the ideas of individual surveyors, and are not regulated by law as they should be. Carried.

Meeting adjourned at 10 p.m.

---

#### WEDNESDAY, FEBRUARY 27TH, 10 A.M.

Communications were read from David Boyle, Esq., Curator of the Canadian Institute, cordially inviting the members of the Association to visit the Archæological Museum of the Institute, and from W. B. McMurrich, Esq., Vice President of the Amateur Photographic Association, of Toronto, inviting the members to visit the rooms of their Association on Thursday afternoon at 5 p.m.

Moved by L. Bolton, seconded by D. S. Campbell: That the Report of the Committee on Drainage not being at present ready for reading, on account of the absence of several of the members of the Committee, it be handed into the Secretary of the Association in time to be published in the Report of Proceedings. Carried.

The Report of the Committee was then read by the Secretary in the absence of the Chairman.

The Report was received and adopted.

T. B. Speight then read a paper on "City Surveys."

Mr. Sanderson, of Toronto, then exhibited "Tate's Patent Arithmometer," explained its mechanism, and gave examples of what problems in the simple rules could be performed by the machine.

Moved by T. Fawcett, seconded by C. F. Miles: That the thanks of this meeting be tendered to Mr. Sanderson for exhibiting this improved Arithmometer, and for his explanations in the working of the same. Carried.

The Scrutineers of Ballots for officers for 1888-89 presented their report which was adopted.

O. J. Klotz then read his paper on "Descriptions."

The paper of T. H. Jones on "Brantford Waterworks" was taken as read and ordered to be printed in the Proceedings.

L. Bolton then read his paper on "Awards and Plans under the Ditches and Water Courses Act."

The papers on "Railway Right of Way Surveys" were then called for by the President.

Moved by J. Davis, seconded by C. R. Wheelock: That in view of the fact that a great deal of business remains to be got through with in the very short time at our disposal, that the paper on "Railway Right of Way Surveys," by John Davis, be taken as read. Carried.

H. D. Ellis read his paper on "Right of Way Surveys."

Meeting adjourned at 1 p.m.

No meeting was held in the afternoon of Wednesday, 27th, the members accepting the invitation of the Reception Committee of the City Council for a drive around the city. (See Report of Committee on Entertainment.)

---

#### THURSDAY, FEBRUARY 28TH, 10 A.M.

Paper on "Timber Exploring," by W. R. Aylsworth, was read by the Secretary in the absence of Mr. Aylsworth.

In absence of the Chairman, the Committee on Legislation made no report.

Report of Committee on Publication was then presented by T. B. Speight, Chairman.

Report of Committee on Instruments was then presented by Jno. McAree, Chairman.

The paper on "The Transit" was then read by J. McAree, the writer.

Moved by Mr. Stewart, seconded by Mr. Ogilvie: That the President and Messrs. Proudfoot, Abrey, McAree and the mover be a Committee to urge on the Ontario Government the desirability of carrying out, in connection with the Surveys Branch of the Crown Lands Department, a system of explanatory surveys in the new territory. Carried.

Mr. Stewart: My object in moving this is to bring the matter before you. I think it would be well for the Government to have a permanent staff of surveyors for this purpose. There are large tracts of land in Ontario which we know nothing about, especially timber lands, and it would be much to the advantage of the Government to know what is on these lands before they sell the limits. Very often the timber men have the lands surveyed and know all about them when the Government do not know what is on the lands. My idea is that there might be a Mining Engineer along with the surveying party and they could make rough traverses and be able to report where the good timber and farm lands are also.

Mr. Abrey: I suppose that is a matter which the Geological Department should take up, they might be combined with the Surveyors' Department. If surveyors had been sent out with the mining engineers it would have been a good idea, and could have been done at a very small expense.

Mr. Stewart: I think it would be greatly in the interests of the Province, and if the Commissioner of Crown Lands would consider it and adopt it, he would be able to know what valuable timber there is in the Province. I do not think there should be any conflict with the Geological Survey. This is just a supplement. We have just lately acquired a very large territory, and we know very little about it. The Province would only be consulting her own interests in appointing such a survey party.

Mr. Gibson. I think it is a good suggestion both in the interests of the Province and of the surveyors. It is well known that large timber men make it their business to find out about these pineries and the Government know nothing about it. Those large timber men employ a large staff.

Chairman: With regard to the matter I may say that I have explored, to some extent, the land to the north of the Ottawa River, and I think something like this suggestion is desirable. An exploration party is sent out to survey, but they have no time to give the country that examination which is necessary. They might be passing over very rich minerals and know nothing about it. There should be some one with the party who has a knowledge of mining industries. I think the suggestion is in the right direction. It certainly could do no harm to have the matter talked over with the Government.

The Committee on Tariff then reported.

Moved by P. S. Gibson, seconded by Mr. Gaviller : That the tariff recommended by the report of the Committee be received and adopted. Carried

Moved by E. Stewart, seconded by C. F. Miles : That a circular showing the tariff adopted by this Association be printed and one or more copies forwarded by the Secretary to every practising surveyor in the Province. Carried.

Moved by Willis Chipman, seconded by G. B. Abrey : That if at any time it be ascertained that any Provincial Land Surveyor be charging any less fees than those adopted by this Association in their "Minimum Tariff of Fees," that it be considered the duty of any member cognizant of the fact to report the same to the Executive Committee of this Association, and the Executive shall then take such action as they consider proper.

Lost on the following division—

*Yeas*—W. Chipman, C. F. Aylsworth, A. J. Van Nostrand, J. Kirk, R. H. Coleman, H. R. McEvoy, W. Galbraith, G. B. Abrey, E. Bray, J. W. Tyrrell, R. Sherman—11.

*Nays*—E. Stewart, P. S. Gibson, H. L. Esten, C. J. Murphy, H. W. Selby, M. Gaviller, C. F. Miles, F. L. Blake, Wm. Ogilvie, C. R. Wheelock, J. F. Whitson, A. Niven—12.

#### AFTERNOON SESSION, 2 P. M.

V. Sankey then read paper on "Decimal vs. Duodecimal Measures.

Moved by A. J. Van Nostrand, seconded by V. Sankey : That the Report of the Committee on Entertainment be taken as read and be printed in the Proceedings. Carried.

Moved by Willis Chipman, seconded by V. Sankey : That any omissions or clerical errors in the Record of the Proceedings of this meeting, now in the hands of the Secretary and the Stenographer, be corrected by the Committee on Publication before being printed. Carried.

Moved by E. B. Abrey, seconded by V. Sankey : That the sum of \$40.00 be granted to the Secretary-Treasurer for his services during the past year. Carried.

#### ELECTION OF ASSOCIATE MEMBERS, JUNIOR MEMBERS AND HONORARY MEMBERS.

Mr. Chipman : I have received no applications for associate or junior members. I would suggest that the Association take a recess of five minutes to talk over business before we proceed to the nomination of the officers.

Chairman : I think the suggestion of Mr. Chipman a good one. Let us adjourn.

## NOMINATION OF OFFICERS.

Mr. Aylsworth: As our former President was in for two years, I think it would be right that the present President should be in again. I consider he has been a very efficient officer and has discharged his duties with great credit.

Mr. Kirk: I have much pleasure in seconding the motion.

Mr. Sankey: I think that this nomination should be made unanimous. Our worthy President has filled the chair with a great deal of satisfaction and I think we cannot do better than ask him to serve as President for another year. I think this should be a unanimous election.

Mr. Gibson: I suppose if there are no nominations in against it it will be unanimous.

Chairman: My feeling in this matter is that the officers should be changed every year. A number of gentlemen have asked me if I would take it for another year. I would therefore not care about taking it unless it is really the unanimous wish of the members. My opinion is that it would be better to change the officers yearly.

Mr. Abrey: We can do that after the present year.

Chairman: Gentlemen, as it appears to be your wish that I should hold the position another year, I accept it on the understanding that it is the unanimous feeling. At the same time I would have been better satisfied to have allowed some one else to get it. I feel very thankful to you for the honour you have conferred upon me and for the assistance you have given me in carrying out all the business of the meeting, and I shall endeavour through the present year to advance the interests of the Society; I would do that even although I was a full private. Accept my thanks, gentlemen, for electing me to hold the position for another year.

## ELECTION OF VICE-PRESIDENT.

Chairman: I must say I think you have made a very good choice, and before the meeting closes we should have something else to move as to Mr. Sankey.

Mr. Sankey: I do not know exactly how to express my feelings in this matter. I take it as a very great honour to be elected for a second term as Vice-President. I agree with what our President has said about changing officers. I believe that in an association of this kind a change is beneficial. It ought to be our aim to aspire to office. As each year comes round I always feel that I have not done enough.

## ELECTION OF SECRETARY-TREASURER.

Mr. Abrey: I beg to move, seconded by Mr. Fawcett, that Mr. Willis Chipman be re-elected Secretary-Treasurer. Of course the question of changing officers from year to year does not come in here.

Chairman: I am sure that I agree with your choice in the matter. I have thought that whoever is changed we should not change our

Secretary so long as we can keep him. We might say "Men may come and men may go, but Mr. Chipman goes on forever."

Mr. Chipman: I thank you for the honour in electing me, but I may also state that the work of the Secretary is not quite so easy as you might imagine. It is not difficult, but it takes considerable time. I am afraid that after this year some other aspiring young member will have to accept the office. I thank you.

#### ELECTION OF COUNCILLORS TO FORM EXECUTIVE.

Chairman: It is now necessary to elect three Councillors who shall constitute the Executive Committee.

The following were nominated: Mr. Stewart, Mr. Gaviller, Mr. P. S. Gibson, Mr. J. P. B. Casgrain, Mr. McAree, Mr. Unwin.

Moved by R. H. Coleman, seconded by M. Gaviller, that B. J. Saunders, H. L. Esten and A. J. Van Nostrand be scrutineers of ballots for 1889. Carried.

#### NEW BUSINESS.

Moved by V. Sankey, seconded by T. Fawcett: That the Committee on the Boundary Commission be permitted to report again as it is not yet able to bring a definite report on the matter. Carried.

Mr. Sankey: In last year's Report a Committee was appointed, of which I was the Chairman, about the Boundaries Commission Scheme, as suggested by Mr. Ogilvie. We have not been able to bring before the Association a full report of what we would suggest. We have now Mr. Ogilvie with us and I would ask the Association to re-commit the matter to us. Mr. Ogilvie will be of great assistance to us.

Moved by V. Sankey, seconded by G. B. Abrey: That a committee of three, consisting of T. Fawcett, and the mover and seconder, be appointed to consider the question of the decimal *vs.* duodecimal systems, as referred to in the paper by Mr. Sankey, and prepare a short statement to be printed and sent to our sister associations and others likely to be interested, the publishing of this statement to be under the direction of the Publishing Committee. Carried.

Mr. Sankey: The reason I make this motion is because the matter is rather a hobby of mine. It is a matter that this Association ought to take up. It is one that will certainly bring no discredit on our Association. It may take two or three years to get it to a conclusion, but it is interesting to know what the public at large think of it.

Mr. Abrey: I may say that, as every one knows, it would simplify our work very much and lessen the risk of error. It is a great advantage. With the other system there is a great deal of risk and it is tedious. I do not know that there would be much trouble in getting this system adopted.

Mr. Gibson: I think if the matter was brought before the Minister of Education, it would help us. It should also be brought before the manufacturers.

Moved by Mr. Van Nostrand, seconded by Willis Chipman: That this Association urgently request that Mr. Gibson prepare a paper for our next meeting on "Compiled Plans." Carried.

Chairman: Under the head of new business, Mr. Coleman has a question that he would like discussed shortly.

The difficulty Mr. Coleman had he explained to the Association by diagrams.

Moved by E. Stewart, and seconded by Lewis Bolton: That a vote of thanks be hereby tendered the Toronto City Council for their very great kindness and attention to the members of this Association on their present visit to the city. And that a committee, consisting of Mr. Ogilvie, and the mover and seconder, be appointed to draft a resolution to be forwarded to said Council. Carried.

Moved by Mr. Esten, seconded by Charles Murphy: That a vote of thanks be tendered to the exhibitors at this meeting: Rice, Lewis & Co., The Harris Paint & Colour Co., Hart & Co., Mr. Sanderson and Mr. Sankey; that the Secretary signify the vote to them. Carried.

The fourth annual meeting adjourned at five o'clock.

After adjournment many of the members visited the rooms of the Amateur Photographers' Association and spent an interesting half hour examining their collection of photographs, and the latest and most approved apparatus for securing negatives.

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### VOTE OF THANKS.

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TORONTO, Feb. 29th, 1889.

*To the Mayor and Aldermen of the City of Toronto:—*

GENTLEMEN,—By a unanimous vote of the members of the Association of Provincial Land Surveyors in convention to-day it was resolved that a hearty vote of thanks be tendered your honourable body for the kind reception and hospitality shown the Association on their present visit to your city; and that the undersigned Committee should convey the same to you. In addition to this we would say, on behalf of the Association, that as a body we are greatly pleased with the appearance of your city, which through your kindness we were enabled to view to great advantage. We were pleased, not only at viewing the immense progress your city is making in enlarging its bounds and increasing its population, but also that you are keeping pace with the age in providing for the health and also for the conveniences of life of its rapidly increasing numbers. In conclusion we may say that our Association, embracing members from all parts of



the Province, all wish the greatest prosperity to the City of Toronto, the capital of our Province. And thanking you again, gentlemen, we have the honour to be your obedient servants,

E. STEWART,  
W.M. OGILVIE,  
LEWIS BOLTON.

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MEMBERS IN ATTENDANCE AT THE TORONTO  
ANNUAL MEETING.

|                    |                     |                    |
|--------------------|---------------------|--------------------|
| Abrey, G. B.       | Fawcett, Thos.      | Ogilvie, Wm.       |
| Aylsworth, C. F.   | Foster, F. L.       | Paterson, J. A.    |
| Blake, F. L.       | Galbraith, Prof. J. | Proudfoot, H. B.   |
| Bolger, T. O.      | Galbraith, Wm.      | Robertson, Jas.    |
| Bolton, Lewis.     | Gaviller, Maurice.  | Rogers, R. B.      |
| Bray, Edgar.       | Gibson, P. S.       | Sanderson, D. L.   |
| Browne, H. J.      | Hanning, C. G.      | Sankey, Villiers.  |
| Browne, Wm. A.     | Kirk, Jos.          | Selby, H. W.       |
| Campbell, D. S.    | Kirkpatrick, G. B.  | Sherman, Ruyter.   |
| Casgrain, J. P. B. | Klotz, O. J.        | Speight, T. B.     |
| Chipman, Willis.   | McAree, John.       | Stewart, Elihu.    |
| Coleman, R. H.     | McEvoy, H. R.       | Tyrrell, J. W.     |
| Davis, John.       | McKay, Owen.        | Unwin, Chas.       |
| Deans, W. J.       | Miles, C. F.        | VanNostrand, A. J. |
| Ellis, H. D.       | Murphy, C. J.       | Wheelock, C. R.    |
| Esten, H. L.       | Niven, Alex.        | Whitson, J. F.     |

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CIRCULAR NO. 22.

RESULT OF ELECTIONS.

*President* . . . . . Alexander Niven . . . . . (by acclamation).  
*Vice-President* . . . . . Villiers Sankey . . . . . (by acclamation).  
*Secretary-Treasurer* . . . . . Willis Chipman . . . . . (by acclamation).

*Councillors.*

|                            |                                |
|----------------------------|--------------------------------|
| Elihu Stewart . . . . . 44 | Charles Unwin . . . . . 29     |
| John McAree . . . . . 35   | M. Gaviller . . . . . 18       |
| P. S. Gibson . . . . . 35  | J. P. B. Casgrain . . . . . 13 |

I therefore declare the following Councillors elected:—Elihu Stewart, John McAree and P. S. Gibson.

WILLIS CHIPMAN,  
*Secretary-Treasurer.*

Examined and found correct.

(Signed) B. J. SAUNDERS,  
*Scrutineer of Ballots.*

## REPORT OF THE SECRETARY-TREASURER.

MR. PRESIDENT :—The undersigned herewith submits the following report on the business of the Association for the year 1888 :—

Our membership remains where it was a year ago ; 118 paid up members.

The following Counties have no representatives on our list : Gengarry, Stormont, Grenville, Prescott, Russell, Lanark, Prince Edward, Addington, Lennox, Wentworth, Welland, Haldimand and Norfolk. All the towns of importance and all the cities are now represented.

A group of Counties at the extreme east end of the Province, and a group west of the Niagara frontier are the chief ones not represented.

Two meetings of the Executive were held in Toronto during the year, which were well attended.

The following circulars have been issued by the Executive since our last meeting :—

No. 15—Result of elections.

“ 16—Notice to pay fees.

“ 17—Notice of issue of “ Survey Act ” and other Acts in pamphlet form.

There are some members of the profession who neglected to pay their fees even after receiving several notices that they were due. The business of this Association is conducted upon a strictly cash basis, and any surveyor who considers that he does not get full value for his subscription fee should, of course, withdraw ; but if any of very old members were so situated that they could not remit, according to notice, and found that their names have been omitted from the list of members, we may state that by remitting at any time they can again become members, as according to our Constitution there is no initiation fee, and there are no back fees or fines imposed.

The Secretary begs to acknowledge the great assistance given the Executive by the members of the Committees on Entertainment and Publication in the work of the year.

Your attention is again called to the fact that those who advertise with us should be better patronized than they have been in the past.

Our Association exchanged Proceedings during the year with the following Societies : Michigan Engineering Society, Ohio Society of Surveyors and Civil Engineers, Indiana Society of Civil Engineers and Surveyors, Illinois Society of Engineers and Surveyors, and the Arkansas Society of Engineers, Architects and Surveyors.

Copies of our Proceedings were sent to all libraries and scientific institutions that applied for them.

We now have in stock about 100 copies each of our Proceedings for 1887 and for 1888 ; the Proceedings for 1886 are now out of print.

The usual reduced rates have been extended to the members of the Association by the railway companies.

The financial condition of the Association is about the same as last year.

A statement of receipts and expenditure of the Association from January 1, 1888, to January 1, 1889, is appended.

All of which is respectfully submitted.

WILLIS CHIPMAN,  
*Secretary-Treasurer.*

STATEMENT OF RECEIPTS AND EXPENDITURES OF THE ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO FOR THE YEAR 1888.

| 1888. RECEIPTS.                             |          |                 |
|---------------------------------------------|----------|-----------------|
| To Balance for 1887.....                    |          | \$64 90         |
| " Fees, 113 Active Members at \$3.....      | \$339 00 |                 |
| " " 2 Junior Members at \$3.....            | 6 00     |                 |
| " " D. Beatty .....                         | 2 00     |                 |
|                                             |          | <u>347 00</u>   |
| " Advertisements, 1887.....                 | 3 50     |                 |
| " " 1888.....                               | 84 00    |                 |
|                                             |          | <u>88 00</u>    |
| " Proceedings sold.....                     |          | 1 85            |
|                                             |          | <u>\$501 75</u> |
| Total.....                                  |          |                 |
| 1888. EXPENDITURE.                          |          |                 |
| By Postage and Telegrams .....              |          | \$51 89         |
| " Stationery, etc.....                      |          | 5 00            |
| " Rental of Rooms and tables .....          |          | 15 00           |
| " Printing Circulars, Programmes, etc.....  |          | 49 03           |
| " " Proceedings.....                        |          | 161 20          |
| " Engraving, Lithographing, etc.....        |          | 45 48           |
| " Express, Cartage, Freight, Duty, etc..... |          | 29 15           |
| " Amount granted Stenographer.....          |          | 50 00           |
| " " " Secretary-Treasurer .....             |          | 40 00           |
| " Balance .....                             |          | 55 00           |
|                                             |          | <u>\$501 75</u> |
|                                             |          | <u>\$501 75</u> |
| Total.....                                  |          |                 |

REPORT OF SCRUTINEERS.

MR. PRESIDENT,—We find upon examining the ballots that the following members were elected as officers for 1888-89:—A. Niven, President; V. Sankey, Vice-President; W. Chipman, Secretary; John McAree, H. B. Proudfoot, W. R. Aylsworth, Councillors.

C. F. AYLSWORTH, JR.,  
OWEN MCKAY.

*Scrutineers.*

### REPORT OF AUDITORS.

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The undersigned Auditors beg to report as follows:—We have examined the books of the Secretary-Treasurer, and have annexed a statement showing the amounts of receipts and expenditure, which shows a balance on hand of \$55. We found vouchers for all accounts except postage.

All of which is respectfully submitted.

JAS. A. PATERSON,  
D. L. SANDERSON.  
*Auditors.*

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### REPORT OF COMMITTEE ON LAND SURVEYING.

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

I. They would recommend a reconsideration of the Act relative to Town and Village surveys, with a view to amending the said Act.

II. A careful consideration of the amendment to the Act suggested by Mr. Niven last year in his Paper on Practical Surveying relative to running division lines in certain townships on the given astronomical course.

III. They would also suggest the advisability of endeavouring in some way to have brought before the Association at its annual meeting any difficult question that any of its members may at any time during the year experience in practice. It has been thought that the most effectual way to accomplish this would be for the chairman of your Committee to receive all such questions at any time during the year, and then at some date shortly before the regular annual meeting of the Association to call his Committee together and thoroughly consider and pronounce on such questions and report their decision to the Association.

Respectfully submitted.

E. STEWART.  
*Chairman.*

### DISCUSSION.

Mr. Stewart—I may say before moving the adoption of the Report with regard to the last clause it seems to me if we were to agree to the idea here we would make our meetings much more interesting than they are at present. We have come here to-day with scarcely anything definite for us to do. For two or three years we had a question drawer and some very interesting questions came up before us. The proposal made here is a good one and I think it would add

greatly to the interest of the Association if we would carry out this idea. My own idea with regard to this is, supposing any surveyor had a difficult question coming up in his practice, before it passed out of his mind let him submit it to the Chairman of the Committee, he would submit it to the Committee and they would consider it and when they came here they would be better able to give an opinion. Such an opinion should be worth as much as the decision of our Courts.

The Chairman—I would like to hear the views of any member who would like to express them. I would also like the Committee on Drainage to take up this matter in the same way. With regard to the suggestion here to take the place of the question drawer it has been suggested that any one having a difficulty in his practice during the year should send it to the Chairman of the Committee and the Chairman should send it to the Committee, and before the annual meeting they should compare their views and give their opinion then. I certainly think that would be a very good way of disposing of the matters, and an opinion of that kind would certainly have some weight and should be a good opinion, equal to some of the Courts and at all events better than some lawyers.

Mr. Aylsworth—The suggestion is a good one. If we had those question drawers and these difficult matters laid before them we would get some enlightenment. I have had a case where I have made a difference of half a rod in the measurements.

Mr. Sankey—With regard to the proposal it is a remarkably good one. We would get opinions worth something. Another point is unless we take down the suggestions made in these papers they have slipped our memory when the paper is read. The suggestion in that view is I think a very valuable one. Probably it would be well to put the matter in a definite form before this meeting closes and make it one of the rules of our Association.

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#### REPORT OF COMMITTEE ON DRAINAGE.

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This Committee had nothing to report.

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#### REPORT OF COMMITTEE ON ENGINEERING.

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MR. PRESIDENT,—The Committee on Engineering beg to report as follows:—

Pursuant to notice a meeting of the Committee was called in Toronto in December last.

Owing to some of the members being absent from home, and others residing at a long distance from the Queen City, only two

members of the Committee were present. The results of the work of the Committee is shown however by the number of Papers on engineering subjects prepared for this meeting.

As there is no precedent in our annual reports as to the line of work this Committee should pursue, we would beg to suggest an outline for the future.

We think the work might be divided into Railway Engineering, Municipal Engineering (including Drainage, City Water Supply, and Electrical Engineering), Bridge Engineering, and Mining Engineering, or such other divisions as the Committee should see fit; and that each member should have charge of one of these branches, and should be responsible for one or more papers in his branch of the subject. We would suggest that the above division be borne in mind when the members of this Committee are appointed. Each member should also prepare a short report bearing on his branch of the subject to be embodied in the general report of the Committee.

These reports might follow the outlines given in the report of the Engineering Committee of the Illinois Society for 1888, which is as follows:—

I. Call attention to important engineering works begun, finished, or contemplated during the year; giving reference to such plans and descriptions of the same as have been published.

II. Discuss briefly such topics of general interest to the engineer as call for a general expression of opinion, or a concert of action among engineers as a body.

III. Call attention to new publications and papers read before the various societies, which are of especial interest to the profession.

IV. Call attention to any general progress made in engineering methods or work.

V. Call attention to branches of engineering in which improvement in methods or work is badly needed.

VI. Call attention to failures of engineering works or projects.

T. HARRY JONES,  
*Chairman.*

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## REPORT OF COMMITTEE ON LEGISLATION.

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GENTLEMEN,—Your Committee on Legislation begs leave to report that they have had under consideration the proposed amendment to Surveyors' Act,—Circular 18; and also Mr. Sankey's notice of motion in respect to Registration of Field Notes of surveys for private parties, defining boundaries of lots in townships, villages, towns and cities; but your Committee is not at all unanimous as to the advisability of either of these matters being recommended for legislation.

Hence, your Committee would respectfully suggest that the same be brought up at our next annual meeting for the consideration and decision of the Association.

All of which is humbly submitted on behalf of your Committee by

W. M. R. AYLSWORTH,  
*Chairman.*

[Circular No. 18.]

PROPOSED AMENDMENTS TO SURVEYORS' ACT.

*1st Amendment*,—"The 46th, 47th, 48th, 49th, 50th, 51st, 52nd and 50th sections of this Act shall not apply to the survey of division or side lines of lots in those townships surveyed after the year 18....; but a surveyor, when called upon to run any division or side line between lots in any township surveyed after the year 18...., shall run such division or side line on the astronomical course given in the original survey thereof, as shown on the Plan and Field Notes of Record in the Department of Crown Lands."

Read last three paragraphs on page 49, and first two on page 50 (Practical Surveying) Proceedings of Association of Provincial Land Surveyors of Ontario, 1888.

You are requested to forward your opinion on above proposed amendment, to the President, Alex. Niven, Haliburton, on or before February 20th, 1889.

*2nd Amendment*,—That in view of the fact that there are no adequate means whereby the field notes of surveys made for private parties on concession lines, side lines or other lines defining the boundaries of lots in townships, cities, towns or villages can be registered, and that in consequence much valuable information is lost, this Association therefore suggests that the following means be adopted :—

"Surveyors shall prepare and draw up concise field notes of such surveys, with a plan, if necessary, and shall deposit same in the Registry Office for the county. The surveyor to be paid a reasonable fee by the Registrar, who shall charge the same in the expenses of his office. A fee shall be charged to all inspecting said field notes, a percentage of which (to be fixed) to be paid to the surveyor."

Will you kindly give the above your careful consideration, and be ready to give the Association the benefit of your advice.

If possible bring with you some field notes such as the above refers to, so that the probable size of such may be arrived at.

DISCUSSION.

The Chairman—I will read the answers I received to the Circular, No. 18, we sent out. The following were in favour of the proposed amendment :—(1) F. Bolger, Penetanguishene; (2) W. R. Burke,

Ingersoll ; (3) Chas. E. Fitton, Orillia ; (4) Jesse N. Bolton, Albion ; (5) Peter Burnet, Orillia ; (6) James Warren, Kincardine ; (7) Jos. Kirk, Stratford ; (8) T. Harry Jones, Brantford ; (9) W. E. Yarnold, Port Perry. Against it : (1) C. F. Aylsworth. Neutral : (1) Lewis Bolton, Listowel.

Mr. Stewart—I think the proper way would be to refer this to the Legislation Committee, and let them report on it. I think after we have their opinion it would be a great benefit to the Association in arriving at a conclusion.

Mr. Sankey—I do not know whether my motion is an amendment. I do not suppose that this should become part of our regulations unless the Legislation Committee had something to do with it. I think it would be well that a sub-committee be appointed to look into the letters just read and bring up the matter again before we adjourn, so that the members will have it before them.

Mr. Aylsworth—In reference to the amendment, I understand from one of the letters that all you had to do was to go to the post and get your meridian. I do not think this is so.

Mr. Kirkpatrick—Most of us approve of the idea of just going direct to the point and making an astronomical observation and running the line. But it would be found in nine out of ten cases that the posts are not on the corner of the lots. One often finds that in a few years a great number of the distance posts are gone. A fatal objection is that when taking an astronomical observation you would not be able to command the elements. You would have sometimes to wait two or three days until the weather gets fair. How is this going to pay you? When we go to the Legislature with a Bill they will see that this is more expensive and will throw out the Bill. The object of all legislation is to cheapen it to the public. I think it is better to leave well alone.

Mr. Chipman—I think the meeting is losing sight of two or three facts. One is that we should endeavour to do our work in the most scientific way possible—not the cheapest way. Cheapness should not be the greatest element in favour of a system. Although it might be expensive to wait for the elements, yet Science may often tell us what kind of weather we are going to have. Another thing, you have not got to stay up all night to take observations. I have not taken a night observation for five or six years. I take them in the day time. A modern surveyor can take observations just as well during the day as at night.

Mr. Stewart—It would be far more work than the old system. There is one way that suggests itself to me. That is where the lines are run at right angles, the right angles might be run off the concession line. The side lines would be correct also.

The Chairman—In reply to the remarks of Mr. Kirkpatrick as to the elements, Mr. Chipman has stated that the observations could be made during day, still the majority of us stick to the night yet. While there is some truth in what they say about waiting for an



observation, it does not often happen and we can very often know what the weather is going to be. I was employed one time by a poor man settled in rear of Lots 18 and 19 in the 3rd Concession, and the first thing I did was to go to the side road between 15 and 16 and run across that mile and half to get the bearings. The land was rocky and some places 200 or 300 feet high. I took a day and a half with a gang of men to do this. I had to charge \$15. That was a hardship. If the Amendments had been in force I could have gone at night and made the observation and could have run the line next morning, or, perhaps, living in that neighbourhood, I would not require to take an observation on every concession. A surveyor in practice in the neighbourhood will have after a while a great number of observations, so that it will become only necessary to make observations about once in six surveys. The object I had in view was to save time, trouble and expense. It took me two and a half days to do what could under the new Amendment be done in a few hours.

Mr. Aylsworth—You might have two or three people interested, so that would bring the price down to a reasonable figure. Then again, to recognize your Survey System, where you had to charge \$15, you might have to go into the back country and take two or three days as you might have a cloudy evening, so that you would have to charge him \$15 or \$18, the same as what you did charge in the other case.

The Chairman—In the majority of cases it would be better. As I understand the Act these lines are all to be run on the Astronomical course.

Mr. Foster—In the case of Surveys in Townships they do not take observations on each line; they run them on such a line as to give them a certain bearing. That line is run not from Astronomical observation. It is mathematically correct, but if run out could not be run out correctly. It would not entirely agree with it.

The Chairman—I understand what Mr. Foster means. As the law stands now those lines are to be run on the same course as the side line. It frequently happens that that line is on the course N. 20° 51' 40" W. and that there might be a difference of twenty chains or greater. If you were to produce a line here you might cross that line two or three times before you got over to the next concession. I have seen the lines in one concession 4° different from the lines in the other one, and producing a line here with a view of striking that line, I would not guarantee that you would come on it. I have often been tempted to run them on an astronomical bearing.

#### SECOND AMENDMENT TO SURVEYORS' ACT.

Mr. Sankey—I will further make this proposal. I may say that for some time past I have been of the opinion that surveyors are locking up in their vaults a lot of information that may or may not be worth something to us all. It depends if parties requiring surveys happen to go to those surveyors or not. The subject of permitting surveyors' field notes to be brought into a Court of Law as evidence

of a survey has been taken up before now at meetings of this Association. I understand that the principle of admitting a surveyor's field notes as evidence when the surveyor is dead is a principle that lawyers will not admit. From the information we have of how those field notes are sometimes got up the objection is well taken. The surveyor goes out and takes a lot of notes that really have no bearing on what he is going to do, and having taken a lot of notes and spent a day or two in connection with the survey, he on mature deliberation practically does something that the leading evidence of the field notes will not warrant when he gets back to his office. And the field notes as such are not a proper or concise record of what he did but are only a preliminary that led him to a conclusion. As regards surveys the public lose all trace unless there is some means adopted of putting the field notes on record. If a surveyor practises for some time he gets a local reputation and parties go to him and get him owing to the fact that he has certain field notes. If that surveyor dies these field notes are publicly lost and his family lose any value that the field notes might have had. A surveyor leaving a locality takes his field notes with him and they are of no value at all. The proposal is that after the survey is made the surveyor should make out a precise record of what he has done. Two or three sheets of foolscap would be enough. A little plan would be sufficient to illustrate what he is driving at. The surveyor should have a reasonable remuneration for the time he takes to draw up the field notes besides what he gets from the man who employs him. He ought to get this from the Registrar just the same as the Registry fees for registering documents; this fee might easily be included in that charge. The surveyor gets so much for his work, apart from that he reaps nothing from the field notes and any other surveyor goes to the Registry Office and at the cost of \$1 finds out what was done and the Registrar could charge so much (of which 50 or 60 per cent. or something like that should go to the surveyor), so that so long as the surveyor is alive he reaps the benefit from his work. I understand in Quebec for a certain number of years after the death of a surveyor the public have to pay a certain fee for the use of his field notes. It certainly is a matter well worthy of our attention, but there is no use discussing these matters till we put it in more practical shape perhaps. I shall be glad to hear from the members of the Association who are practising in the country.

Mr. Stewart—How is the Registrar to be reimbursed?

Mr. Sankey—Charge it in the expenses of his office.

Mr. Chipman—The Registrar is to be reimbursed by people coming and looking at the surveyor's field notes.

Mr. Stewart—You say all surveyors are to be compelled to take these notes to the Registrar and he is to pay them for it.

Mr. Casgrain—If we are called upon to run a boundary line in Quebec we must give the Government a concise report and say whether it was with the consent of the parties, etc., etc. There is a sort of deed drawn up by the surveyor and it is signed by the parties.

The surveyor is paid for it, over his day's work. He gets \$1 a copy for it if not more than 100 words. Whenever that report is wanted they go to the surveyor and get another copy. If the surveyor leaves the country he is obliged to leave his reports in the Court House, and one can get a copy there by paying for it. If the Surveyor cannot be found then a copy of the report can be produced. With that system any boundary can be put right. Field notes would of course not be of very much use to a party not in the business, but such a report as this can be used.

Mr. Stewart—The Surveyor does not receive in that case anything from the authorities.

Mr. Casgrain—Not a cent. By our Act we are not obliged to give any man a report.

Mr. Aylsworth—With reference to Mr. Sankey's idea of supplying field notes, supposing he deposits them in the Registry Office, a surveyor has to do all the work over again. What use would the field notes be unless locating the posts? I do not believe in supplying other surveyors with information about posts.

Mr. Stewart—I think the way it is done in Quebec is a good way. In some respects I think their law is ahead of ours.

Mr. Sankey—There is no question about it that those field notes are of value. In many cases surveys made between five and ten years ago cannot be retraced by a surveyor, whereas by this new method one would only have to go to the Registry Office and find the old field notes of the last survey. I think a private individual if he finds a surveyor had traced the lines before, would go to him because he would think he would get the survey easier and cheaper. The principal point is:—"Is it the opinion of this Association that it is advisable to preserve a legal record of surveys?" If it is found that it is necessary the details can easily be settled.

The Chairman—One or two points suggest themselves to me in this discussion. It frequently happens that a person is running a line a long way from the Registry Office. It would be practically impossible for the surveyor to go to that Registry Office and examine these notes. There would be more or less expense. Suppose you apply this in the City of Toronto, any number of surveyors make the same survey. Has every surveyor to record his notes. If so, the Registry Office would soon be full of notes. You say in your proposal the Registrar is to charge these in the expense of his office. I do not understand what is meant by that.

Mr. Sankey—The Registrar, as I understand it, pays his own assistants, and he takes all the fees that are collected in the office up to a certain figure. I do not see that there can be much greater difficulty in charging \$1 or \$2 for each survey than paying an amount for registering a deed.

REPORT OF COMMITTEE ON INSTRUMENTS.

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MR. PRESIDENT,—Your Committee on Instruments have very little to report as regards their official labours since our last meeting. The Toronto firms of instrument makers were waited on and invited to make an exhibit of their goods at this meeting, but they declined on the plea that they had nothing novel to shew in addition to what was shewn last year. They thought it not worth while to exhibit the same things over again.

Messrs. Hart & Co. responded to the invitation by making an exhibit of draughtsmen's supplies, books of tables, etc.

No attempt was made to secure an exhibition of instruments from American makers, as the attempts in this direction made by a former Committee disclosed the fact that the customs regulations between the two countries stood in the way.

This incidental mention of the customs duty on Surveyors' instruments will serve as an introduction to a few remarks on this subject which your Committee desire to make. We cannot forbear to record our opinion that the duty on Surveyors' and Engineers' instruments is altogether too high, and that a combined effort by the different Surveyors' Associations and the Engineers' Society of the Dominion should be made to have a change made in the tariff. From the larger instruments the duty should be removed altogether, and on all others it should be reduced to not more than 15 per cent. at the highest; at present the duty is 30 per cent. We shall not go into a long argument in support of the change we have suggested, but will say briefly that the duty is, pure and simple, a tax on the Surveyors and engineers of the country.

It is a prime article of belief in the fiscal creed of the advocates of protection that the heaviest duties should be laid on those things which can be profitably produced at home in order to develop the manufacturing interests of the country, while a nominal duty, or the lightest duty, should be placed upon articles of importation which from natural or exceptional circumstances must come chiefly from abroad.

Now, surveyors' and engineers' instruments come under the latter category; it is no disparagement to native talent and enterprise to say that for an indefinitely long time to come these instruments, especially those of the more expensive class, must be imported. In the first place the whole Dominion, even, is too small a constituency to support even one establishment for the manufacture of high-class instruments; such makers as Troughton and Simms, and some of the German artists, sell their instruments all over the civilized world, not excepting the United States, where there are several excellent makers protected in the patronage of fifty millions of people by a duty of 40 per cent. Our Canadian dealers will find it more profitable to sell the work of the English and German or American manufacturers than to attempt to produce the home-made. Again, it stands to reason that the older

and more populous and more wealthy countries must outrival the newer and less populous and poorer countries in the production of works of art; every one knows that this holds in regard to the fine arts of painting and sculpture and music, and it holds also in respect to the production of the finest class of mathematical instruments, which are the highest achievement of mechanical constructive art.

The fact that our instruments are on the customs list described as "manufactures of brass" is in itself sufficient to shew the ignorance of the customs department in regard to the surveying and engineering professions, and is an indication of the urgent necessity that exists for us to assert ourselves and secure our rights. But every member of the surveying and engineering profession in the Dominion is, I am sure, convinced that the duty on our instruments should be greatly reduced, and the practical consideration which your committee desire to insist on is that in their opinion this injustice can be lifted from us if the various associations throughout the Dominion whose interests are affected will only unite and bring the matter before the customs authorities, and your committee hope that during this present session of our Association some steps will be taken towards communicating with the kindred societies in the Dominion to ask their coöperation in an attempt to remove the common hardship.

Your committee beg to direct attention to the fact that there is not, so far as they are aware, a really good book of mathematical tables for field use. All of the books, while they are too bulky by reason of their containing irrelevant matter, are at the same time deficient in matter that would be most useful. One essential in such a fieldbook should be a Traverse Table, calculated to every minute of the quadrant. With such a table the position of points on a traverse survey of any kind could be found as readily by computation as they are now by the usual method of plotting, and angles could be plotted by the method which is capable of greater precision than any other.

Another book which, in the opinion of your committee, is needed by many members of our profession is a text book of map lettering. Any of the books at present in print are comparatively useless to the ordinary surveyor, the letters of nearly all the alphabets which they give being difficult to draw an account of the number of curves. The *block letter* is the one on which the average draughtsman depends for expressing the titles of his plans. A manual which would give the various modifications of the block letter with a similar development of the small Roman would be really useful to the majority of us who have any lettering to do, and this is a great deal more than can be said of the works now on sale.

Such a manual, besides giving the alphabet should give examples of combinations of the letters of the different alphabets, as they would appear in a well-designed title on a map.

In conclusion your committee observe that the work which the various committees of our Association can accomplish from one annual meeting to another can only reach its highest point of efficiency through the coöperation of all the members of the Association. If any member meets with anything in his practice, or in his

reading, or in any way that would be likely to prove of interest to the profession, or if he has any suggestions to make on any of the various matters which concern us, he should feel it to be his duty to communicate his information or his ideas to the chairman of the appropriate committee who would thus be furnished with data for accomplishing the object for which his committee existed.

All of which is respectfully submitted.

JOHN McAREE,  
*Chairman.*

#### DISCUSSION.

Mr. McAree—In moving the adoption of this report I would like to hear the opinions of the surveyors on this question. We will have to assert ourselves. I think the duty is too high on our instruments. The practical point is that we ought to combine with the Engineers' Association when we will likely be able to have our rights vindicated.

Mr. Aylsworth—We might have some difficulty in getting the duty off as it is the Americans who pay it.

The Chairman—With regard to Mr. Aylsworth's remarks I know I had occasion to have an instrument repaired in the States and I know that the Americans did not pay the duty on it.

Mr. Gibson—Our trouble is this, we have a pretty big debt in our Dominion and money has to be raised to pay it. I bought an instrument the other day for \$225 and had to pay \$67 duty. I think the suggestion is a good one. We surveyors should look after our own interests. I think the duty is excessive. Thirty per cent. is very high. I think the Secretary of our Association should correspond with the Secretary of the Engineers' Association, and we should have combined action.

Mr. Abrey—I think if we want a first class instrument we have to go away from Toronto for it, but for repairs I have had good satisfaction and new ideas carried out here well and cheaply. Certainly this large duty on instruments is a tax on knowledge. I think we have to pay too much for both our scientific books and instruments. I do not think it is fair that the users should pay all the taxes on this sort of thing.

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#### REPORT OF COMMITTEE ON PUBLICATION.

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MR. PRESIDENT,—There were 900 copies of our report printed and the members having got 800 copies there are still 100 copies in the hands of the Secretary for sale, the others were given to the sister societies in exchange for their copies. There was also a list of members printed by the committee and sent round with the Manual issued by the Crown Lands Department which was sent to all the municipalities in the Province.

Prof. Carpmael has prepared a paper which we thought would be read to the members at this meeting. The cost of this is \$25, and printing about \$10, and it will be for the Committee to say whether the Society will be able to publish this annually. I do not think our funds will permit us to publish this and pay \$30 or \$40. This, however, is for the next year's Committee to decide.

T. B. SPEIGHT,  
*Chairman.*

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## REPORT OF COMMITTEE ON ENTERTAINMENT.

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MR. PRESIDENT AND GENTLEMEN,—Your Committee on Entertainment beg leave to report as follows :—

A standing arrangement having last year been made with the Canadian Institute for the use of its rooms, no trouble was met with in regard to our place of meeting, and we have reason to congratulate ourselves on the ample and comfortable accommodation afforded us. The attendance at this, our fourth annual meeting, was greater than that at any previous one.

On the afternoon of the second day the members of the Association assembled at the City Hall, in response to an invitation from the Civic Reception Committee, and were welcomed to the city by Alderman Frankland, in a neat little speech. Ten sleighs were placed at our disposal, and the members were then given a drive about the city, chaperoned by Alderman Graham and the Secretary of the Reception Committee.

The Don Improvement, Gerrard Street Bridge, Rose Hill Reservoir, the new Parliament Buildings, Water Works and other places of interest were visited during the drive. At the Reservoir luncheon was prepared for the members and was duly appreciated by them.

Liberty having been given your Committee to add to its members, it was decided to invite all the members of the Association resident in Toronto to assist in making our annual dinner more attractive than those of previous years, and the additional entertainment afforded was due to the Toronto members as a body.

In the evening, after the drive, the annual dinner took place at the "Reform Club." and at 7.30 o'clock, about fifty members and guests gathered around the board. Justice having been done to the good things provided the following toasts were proposed :—

"The Queen,"—Followed by all joining in singing "God Save the Queen."

"The Ontario Legislature,"—Responded to by Aubrey White, Esq. and Kivas Tully, Esq.

"The Toronto City Council,"—Responded to by Alderman McDougall, and Chas. Sproatt, Esq., City Engineer.

“The Canadian Society of Civil Engineers.”—Responded to by Messrs. H. Smith, H. W. P. Armstrong, W. H. Merritt and William Armstrong.

“The Association of Dominion Land Surveyors,”—Responded to by Messrs. William Ogilvie, O. J. Klotz, Thomas Fawcett and J. P. B. Casgrain.

Mr. White then proposed “The Association of Provincial Land Surveyors,” which toast was responded to by the President, the Secretary and Prof. Galbraith.

An adjournment was then made to the ante-room of the Club for the following entertainment:—

SONG..... “Sleep, My Lady.” .....F. L. Foster.  
 SONG.. “Never take the Horse-shoe from the Door.” .. Capt. Manley.  
 SONG..... “The Low-Backed Car.” .....Kivas Tully.  
 SONG..... “Bonnie Dundee.” .....A. Niven.  
           CHORUS..... “Rule Britannia.”  
 SONG..... “Pat O’Hara.” .....Villiers Sankey.  
 STORY..... “The Yukon Miner.” .....W. Ogilvie.  
 SPEECH.....: “Amateur Photography.” .....H. Neilson.  
 SONG ..... “Schweizer Heinrich” ..... O. J. Klotz.  
 SONG..... “Annie Laurie.” .....A. Niven.  
 PIANO SOLO .....O. J. Klotz.  
 SONG..... “Just Before the Battle, Mother.” .. Capt. Manley.  
           CHORUS..... “Auld Lang Syne.”  
           CHORUS..... “God Save the Queen.”

Thus ended our annual dinner for 1889, and with it the duties of your Entertainment Committee.

Signed on behalf of Committee,

A. J. VAN NOSTRAND,  
*Chairman.*

## REPORT OF COMMITTEE ON BOUNDARY COMMISSIONERS.

MR. PRESIDENT,—With regard to this commission it is a matter that requires a very great deal of investigation and detail before the report can be brought out. We are not in a position to make such a report to-night. We wish to discuss with Mr. Gaviller some matters. The principal difficulty we have found in the way is the conflict that may occur as to the legal powers of such a commission :

1. Whether the court would be a final court.
2. Whether the powers of a County Judge could extend to questions which are at present only decided by the Chancery Division.



But still the Commission might be a sort of court of enquiry. They could take evidence and report on the facts to the higher Judge.

A court such as Mr. Gaviller suggests would no doubt be a very useful and practicable one. The head of the court should be a legal gentleman, and for that reason the matter is one that would require a great deal of care.

We do not want to bring this matter forward and have it thrown out on account of some little alteration. It is better to go slow.

Any suggestions you have to make in regard to what the powers of such a court should be would be most acceptable. I think there was a case decided recently in which the Canada Company were interested where the boundary commission would have been very useful. In that case, after a great deal of litigation and expense, the court found that a sufficient survey had not been made, and the whole case had to be begun over again at great cost.

V. SANKEY,  
*Chairman.*

#### DISCUSSION.

Mr. Stewart—It may be well, as a compromise, to have such a commission appointed, and when a case came before one of the courts to have this commission as a sort of reference court to which cases could be referred the same as to arbitration. The first question is whether its decision would be final or should be open to appeal. My view is that it would be almost useless if we allowed an appeal. We might have a sort of commission of reference when it was just a question of survey. I do not think we should have such a radical change all at once.

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#### REPORT OF COMMITTEE ON PROPOSED TARIFF OF CHARGES.

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Not less than \$6 per day to be charged for field and office work

First assistant \$3, 2nd \$1.50 per day.

Not less than one-half day to be charged.

Days to be eight hours, including time going to and returning from the work.

No description to be drawn for less than \$1.

Services at registry office and at consultations not less than \$1 per hour, and no charge to be for less than one hour.

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NOTE.—Extra copies of the "Tariff" will be sent to any member upon sending three cent stamp to the Secretary.

Single city lots not less than \$6 unless previous surveys have been made of adjoining lots on same plan, then \$5 to be charged.

All expenses, such as railway fare, hotel, conveyance of any sort, posts, etc., to be charged for as extra.

H. J. BROWNE,  
C. F. MILES,  
M. GAVILLER,  
E. STEWART,  
A. NIVEN,  
T. B. SPEIGHT,  
J. P. B. CASGRAIN.

#### DISCUSSION.

Mr. Aylsworth—Surveyors had been accustomed to charge \$4 a day when I went down to practise. When I started I charged \$6, but they would not pay it. I approve very much of that tariff; it is just the charges I have been accustomed to make always.

The Chairman—I started out over twenty-five years ago, and I adopted \$6 a day, and have never worked for less. You can get \$6 a day just as well as you can get \$4; I would rather see it \$8.

Mr. Abrey—The fee for a first assistant is intended for a man who is able to use the transit. As for \$6 a day, I have never since I practised seen a case where less was charged. Then the charge for meetings and consultations, etc., is low enough—\$1 an hour. We have to travel all over to make our field notes, file them, etc. Then our office rents are high in the city. I pay \$300 a year for a room. We must have a tariff to cover these small things. There is some difficulty in fixing a tariff to suit both the city and country, but I think by a consultation and talk we might arrange it better.

Mr. Chipman—I think this the most important discussion we have had. Every other profession has a tariff. We have to blame ourselves. I think there might be a difference between charges in the country for surveys and the town, but in the country a surveyor generally furnishes his own conveyance. I charge a man for making the plan I file and for the field notes. I charge \$6 a day for an assistant when he has charge of the survey. I have a considerable number of field notes. I have a hobby for buying field notes. They have cost me \$1,000, and I charge well for a reference to these notes. Take a surveyor who gets \$5 a day in the city, who has an office but no assistant. He does not get work every day, perhaps 250 days in the year. That would be \$1,500 a year. His office expenses will be \$500 a year, leaving \$1,000 for living expenses, and I think \$1,000 is too little for a professional man to exist on in Toronto. It may be enough in a village. I think the tariff should be increased fifty per cent., and if the Toronto surveyors will stick together, and not play a three-handed euchre game all the time, we will carry our point.

Mr. Gaviller—The feeling among the farmers is that they are very shy about having an assistant sent out. If the assistant is out along

with his principal we do not put him higher than say \$3. When the pupils are sent out alone we charge \$5 a day.

The Chairman—I know the country that Mr. Aylsworth practises in, and I know he can get \$6 a day just as well as \$4.

Mr. Robertson—How would you get at those who are charging lower figures? In township work some send in applications at a certain figure, and some are lower. The township always give it to the man who is going to do it cheapest. How will we arrive at this?

The Chairman—My opinion about that is that every member of the Association should be bound by the opinion of the Association to carry it out. The man living in the neighbourhood who charges the best prices will be most thought of in the end. I think if the members will carry out the tariff strictly and honourably, we will have no difficulty in getting the whole of Ontario under the one tariff. As far as townships are concerned there is no use in paying any attention to them; they would get it done for \$1 if they could.

Mr. Aylsworth—I know cases where the township council have employed men who were not engineers, and these men got into a mess, and the township had to fall back on a proper engineer at last.

Mr. Gibson—I think that tariff is a fair one, but there are some districts where the people cannot afford it.

Mr. Aylsworth—I see you are to charge \$6 for the first plan. It might take you three or four days to make the first survey.

Mr. Abrey—That is not for an original survey. If you are surveying four or five lots you are not bound to charge more than \$4 or \$5 each lot. Would you charge \$11 for two lots for the same man?

Mr. Browne—No, we would not.

Mr. Stewart—I think there should be copies of this tariff sent to all the surveyors in the Province.

Motion by Mr. Chipman, seconded by Mr. Abrey, regarding any Provincial Land Surveyor charging less than Tariff Rates.

Mr. Abrey—I feel that we must have some way of enforcing our opinions, or else they would be no good. That is my reason for supporting this motion.

Mr. Gaviller—I think the motion is rather premature, and puts us in the position of reporting our brother. We know that this tariff is a new thing, and we have had no rule, and we will have to get the public into the way of understanding what this tariff is. If we make this a case of reporting we will be tied down to this tariff, and will not be allowed more.

Mr. Stewart—We cannot get more than the legal fee.

Mr. Gaviller—That is for attending the Court.

Mr. Gibson—There is a difference between an Engineer and a Land Surveyor. There are persons appointed who are not engineers, but they compete with engineers. I consider surveying business requires a great deal of skill and ability. I understand this tariff is only for Provincial Land Surveyors. I would not vote for the second

resolution. I think this matter should be put in the same way as the lawyers' fees, then we would have a chance. I do not think there is anything gained by pressing a heavy fee where people are poor and unfortunate.

Mr. Chipman—I do not think we can go to the Legislature and ask for legislation unless we are united. I do not think that the surveyor works for the poorer classes of the community—not poorer than the lawyers. Doctors charge their fees all the same whether the people are poor or not, but in some cases where the people are unfortunate they let them off, through charity. We could do that also.

Mr. Ogilvie—It is so long since I have done any provincial work that I do not know that I can say much on the subject. When I practised in Ottawa I know we charged so much for all our work. I remember one instance where I made \$96 in one week. Next week I worked harder, and made \$16, and have only got half of it yet. We sometimes had \$6, and sometimes \$10 a day. There was no regular tariff, and everybody got all he could. I remember once in Ottawa a man asked me what I would charge to do some surveying for him. I said \$12. He said, "What do you think I could have got it done last winter for? For \$4," he said. I asked him why he did not let the other man do it, and he replied that he did not want to have to pay twice for it.

Mr. Coleman—In moving around the country I have learned this much, that the Association are making a mistake in making it a "Surveyors' Association." We all know that in the west part of the Province a large number of the Surveyors are Drainage Engineers, and if you do not intend to give them protection by this tariff a large constituency of the Association is lost. I know a large number of the Engineers west have taken offence at what has happened here; they think they have been slighted. The man who is making his living from drainage engineering ought to have the same protection as we have. I would like to know this: Do you intend, or do you not, to include the Drainage Engineers?

Mr. Stewart—As a member of the Committee I beg to say that the Tariff of Fees is established for the surveys of Land Surveyors, whether they are Engineers or not. It covers any Surveyor engaged in taking levels in connection with the Water Course Acts and Drainage Acts.

Mr. Gibson—Sometimes in working for a municipality you have sometimes to work for less than \$6, but you get more other times as an engineer.

The Chairman.—I think the intention of the Tariff is that those are the minimum charges. If any one wants to charge more it is all right. Sometimes the surveyor has the field notes of all the country round about, and does not require to go out, but he is entitled to charge all the same.

A division was then taken on Mr. Chipman's motion, and it was declared lost.

Mr. Chipman asked that the Yeas and Nays be taken.

PRESIDENT'S ADDRESS.

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GENTLEMEN OF THE ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO,—I have much pleasure in extending to you a hearty welcome to this our Fourth Annual Meeting :

Under a kind Providence we have been permitted to follow our avocations since last we met, without, to my knowledge, the removal by death of any of our members.

We have been reminded of our mortality, however, by the death of one formerly connected with our profession, and who, for thirty-three years held a position in the civil service of our country. I refer to the late Thomas Devine, Deputy Surveyor-General of the Province of Ontario, whom many of us know and who passed away on the 14th of November last.

Coming to Canada in 1846, Mr. Devine shortly afterwards entered the service of the Department of Crown Lands. In 1872, the Ontario Government conferred on him the title of Surveyor-General, a position he held until 1879 when he retired from the service and returned to Ireland, his native country. After a few years' residence there he returned to Montreal, where he resided until his death.

Canada is much indebted to him for many beautiful maps brought out from time to time while in the employ of the Government. His services were recognized by the Royal Geographical Society which elected him a Fellow. He was also a corresponding member of the Geographical Society of Berlin and of the American Geographical and Statistical Society.

Our membership now stands at 118, a decrease of four since our last annual meeting. I believe that, by a united effort, we could largely increase our numbers—we want with us the *busy* men and those who take a pride in their profession. Let us hope that our membership may increase, and that our meeting together annually may have the effect of improving and elevating the profession.

The Survey Act was, during the Session of 1887 of the Ontario Legislature, very much improved, and further improvements are much needed. In fact a re-cast of the Act relative to Town and Village Surveys seems to be a necessity, and will be dealt with by the Committee on Land Surveying.

Other purposed amendments to the Act will come before the meeting for discussion.

The question drawer should bring before us many points that may be profitably discussed, and the discussion of these points is just what we want at our meetings—we want to combine the practical with the scientific. We should learn much from the experience of others and an interchange of ideas must result in good. During the past year the different Acts governing surveyors, printed in pamphlet form, under the reading of "Acts, Ordinances and Regulations Respecting Crown Lands in Ontario," has been issued from the Department of Crown Lands, and a list of members of this Association has been sent

out with this pamphlet to various quarters, as suggested by our friend, Mr. Kirkpatrick, in his address to you last year.

By reference to the programme, it will be seen that quite a number of papers are to come before us, and I trust that we may have a pleasant and profitable meeting, and that as time rolls on these annual gatherings may be looked forward to by the members as a short respite from our labours when, for a few days, pleasure may be combined with improvement, to the advantage of all connected with our Association.

Before closing I may be permitted to refer to a matter that should probably take form in the Land Surveying Committee, I mean that of a tariff of charges by which the surveyors of Ontario should be governed. It appears to me that something of the kind should be agreed upon. The members of the legal and medical profession have a tariff or scale of charges by which they are governed, and why should not surveyors?

I trust some one may, before the close of the meeting, bring in a motion upon the matter, and so give one and all an opportunity of expressing their views thereon.

The question of Incorporation is also one that should engage the attention of our Association as a number of our members feel that incorporation would be for the benefit of the profession.

I thank you, gentlemen, for the kind attention you have given me, and I now invite your consideration of the further business of the session.

A. NIVEN,  
*President.*

*February 26th, 1889.*

# PAPERS.

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

## ORIGINAL LAND MARKS.

By MAURICE GAVILLER, P.L.S.

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WHEN we consider that volumes might be written upon the subject I have taken for my paper, I can only hope that if by this short essay some points are raised for discussion, and others incited to give us the benefit of their knowledge and experience in subsequent papers, that as an introduction to this most important subject a good result shall be attained.

### DEFINITION OF AN ORIGINAL.

What is an original?

A post, monument or boundary placed or defined in the first survey, or subsequent survey (for re-subdivision or completion), done under proper authority by a properly qualified person.

See R. S. O. chap. 25, 50 Vic., 1887, sections 34 to 40, and subsections and sections 60, 62.

### TO FIND AN ORIGINAL.

The authority given a surveyor to obtain evidence as to the knowledge of existence of an original boundary is defined in R. S. O. chap. 25, sections 71 and 72; but the manner of hunting up on the ground and compiling the affidavit must be governed by the circumstances of the case in hand, and the experience of the surveyor.

To quote from Bellow's and Hodgman's Manual of Land Surveying, "The thing to find out is, not where the corner or line ought to have been, but where it actually was." And again from same: "Do not give up a corner as lost while any means of finding its exact location are left untried."

### PLANTING ORIGINALS.

How the measurements are to be made; material and manner of putting down original monuments for surveys done for the Government are given in the instructions issued for the survey; but the material and manner of placing boundary marks at street corners are still a fruitful subject for discussion.

Great care should be taken by the surveyor in following out instructions given by the Government. To quote again from same manual as above: "Want of due care and precaution in making permanent land marks upon the ground at the time of the original survey is the fruitful cause from which arises most of the litigation about boundary lines."

The durability of different woods when used as land marks ascertained by actual experience from seeing them in different kinds of ground; also, the ages of trees as defined by growth rings, are subjects upon which our space will not permit us to touch. I am sure all of us would like to have more information on these points.

#### TAKING EVIDENCE AS TO POSITION OF ORIGINALS.

In cases where the original survey has been only some few years made, the clearings are not extensive, and as in late surveys of townships bearing-trees have been marked, the task of getting up evidence is comparatively easy. In old settled townships it often requires the exercise of much care and patience to ascertain the position of the *nearest* original.

In a case of this kind, the oldest inhabitant of the vicinity should be inquired for. Often we are told that he is too weak to come and point out the spot, or "getting simple." It is as well to see him if possible. I have often acquired information in this way that brought to the recollection of the younger residents the position of the point required, and was able to compile an affidavit confirming the old man's description, and to satisfactorily establish the starting points. Endeavour to write down the words used by the person making the affidavit, asking questions when necessary, but avoiding as much as possible "leading questions." To quote Skeels in Michigan Report, 1865:

"Wherefore I will take what they say in spirit and in letter,  
Mankind should be, like rivers, free—the less they are damned the better."

#### THE R'S.

All surveyors are aware of the importance of defining the number and position of the *R*s, as in many cases one or more of the marks may have been obliterated by decay. If a post, when first seen by the person giving evidence, it may have been turned around, if a tree, fallen down; besides there is a strong inclination to recollect the *R*, being so placed as to extend the lot boundaries as much as possible.

In such cases try and find out if your informant saw the blazed line for road before the road was cut out, and, if so, on, or on which side of the line the post stood when first seen by him. I recollect a case in which a surveyor located a side road, from the position, as sworn to him, of the *R*s that had been on a decayed tree, taking it as centre of the road. It was afterwards ascertained that a blazed line had been run for this side road, record of which, in the original field notes, was in the Crown Land Department, and noted as having been



run from the original tree, between the adjacent lot and the side road allowance.

This, of course, changed the position of the original point to one side of the road allowance, which caused much dissatisfaction to an adjacent owner. I was employed by the township council to investigate the case. I took some six or eight affidavits as to the marks that had been on the tree; not one agreed either as to the number or position of the Rs. It was evident that all the settlers acquainted with the point considered that the position of the road depended upon the Rs marked upon the tree.

Without saying for what purpose, I got in some affidavits accurate evidence as to the old blazed line, then mostly cleared off. That there had been only one blazed line at that place, running towards the north, and that the old fence, some of which still remained, had been built where the line had been cleared away, and by that means settled the dispute.

#### REMOVED ORIGINALS.

Where an apparent original post is found, an affidavit is often necessary to determine the length of time this post has been seen standing in the same place, and also as to the probability of its not having been moved from one place on the line to another, and become, to use the expression of an old D. P. S., "A perambulating original." I have come across several cases of this kind. One in particular, in a township in the County of Hastings, noted for its iron ore and peculiarly mixed condition of its concession lines. Two of these lines met on a convenient island, leaving a space nearly equal in width to two concessions for some three miles from end of lake to boundary of township. The lumberman came in, the farmer after him, and myself to locate the latter, having been referred to the "walking boss" of the lumberman for information. I was informed by him of the location of a concession line. On this line, he said, I would find a squared maple tree, marking the position where an original post stood, this post being in a crevice of the rock close by. The post I found an undoubted original, point decayed off, lot numbers visible, but concession number obliterated. The original survey had been made some forty years. The blazes of the asserted concession line looked suspicious as to age. I cut out and tested a number of them. The asserted concession line was only some twelve years old. Some original line had lost one of its original posts.

#### COMPILING AFFIDAVIT.

It is important, also, in many cases to include in the affidavit a statement as to what the party giving evidence *has not seen* as well as what he *has seen*. I have had a man state so positively, that neither he or anyone he knew of had seen a blazed line in a certain locality, that I did not include in his evidence anything to that effect, concluding that the point could not come up. This same man afterwards made an affidavit to another surveyor that he had seen an old blazed line at that place.

## USE OF COMPASS.

The ordinary surveyor's compass, the use of which, as an instrument for defining new boundaries has almost been abandoned, is most useful in tracing up old partly obliterated lines, that were in the first place run with that instrument.

## BLAZING.

Where the compass is used the line run should be blazed on the two sides of the tree, in the direction of the line only.

Where a transit line is run the blazes should be on three sides, two as on former line, and one on side of tree next the line.

## MARKING.

I have known an undoubted original abandoned as such because the marks on it had been made with a knife, the probable loss of the marking iron at the time of its being planted not having occurred to the surveyor investigating.

## REGISTERED MARK.

Would it not be practicable and useful for each Provincial Land Surveyor to have a registered private mark to be put on important monuments marking boundaries established by them? They might be similar in design to the registered "brands" of the cattle ranches in the North-West.

## LOCATING ORIGINALS.

When locating originals it is important to have on the ground a copy of the original field notes showing the topography in the vicinity. Ascertain by chaining and noting, topography of the line, the distances between some well defined streams or hills as near the desired point as possible. Compare these with distances given in original field notes, making allowance for apparent difference in length of chain (which is often detected) and check to the point as sworn to, or that it is intended to examine by digging. Michigan Report, 1885, gives an excellent method of proceeding to search the ground, from which I make a short extract:—

"In seeking for the stake remove carefully all debris not connected with the search that may be upon the ground sufficiently to have a good opportunity for investigating. Next remove the sods, if any; then carefully hoe away, or remove with the spade or shovel, the surface earth an inch or so in thickness, and remove it further than would be necessary if all things were recorded correctly; proceed in this manner to the desired depth, and usually if you have properly located the spot, you will either find the stake, or observe as you proceed deeper and deeper the discolouration imparted to the earth by the decayed stake, or possibly the hole with only the web-like fibres of the long since decayed stake."

## PRESERVATION OF POSITION.

To preserve the knowledge of the position of original land marks original methods have been employed. In England we are told the custom prevailed in many parishes of what was termed "beating the bounds." A number of youngsters, accompanied by their elders, who were well acquainted with the boundaries of the parish, being armed with switches, beat around the bounds. In fact it is even asserted that at intricate points the switches were applied to the persons of the boys themselves to make a lasting impression upon their memories. So lately as in December, 1888, we find an illustrated account in the *London Graphic* of "walking the parish bounds" at Bisley, in Surrey: "On Ascension day of that year the rector, wearing a cap and gown, and carrying the parish map, was followed by two boys with flags, and others, some with spades for use when required. Several of the party were successively bumped according to the traditional idea that this would fix the boundary line in their memories, and some resisted the ordeal so strongly as to return minus several buttons. The rector came in for his share with the rest, but took matters more philosophically, submitting quietly to being bumped against an old barn door."

## PRESERVATION OF POSITION OF ORIGINALS.

In this country, as the old settlers who located their lots by the original land marks hewed their clearings out of the forest, and did settlement duty to open the way for the ancient corduroy, are fast dying out, the difficulty of getting evidence as to the position of old land marks is increasing yearly. As a rule we find that the present generation, where the boundary fences have been long built, has paid but little attention to the original corners. I remember a case in which the original marks had been cut off a tree, and for safety deposited in the garret of the magistrate's house. The house was burned, and the chips with it. The stump of the tree remained in position, but trouble began as to location on the stump of the removed marks. When staking out the Crookshank Common that formerly existed on Bathurst Street of this city, I had taken some time to locate a street corner, and driven the post one evening. On my return next morning the post was gone and the hole obliterated. A man living near by came up and informed me that an old man and woman had gone along the street, collected many lot stakes in a bag, and carried them off. "But," he said with an air of triumph, "I have got that post you took such trouble to plant; it is up in my house."

To stow away with the intention to preserve the original post for lot corner in a farm house is not such an uncommon occurrence, the remark being made, "Oh, it was decaying away!" But the importance of accurately marking the place where it stood seldom seems to have occurred to the careful ones.

## LEGISLATION FOR PROTECTION OF ORIGINALS.

In Ohio Report, 1886 (J. D. Varney), are these remarks, which, I submit, apply well to us in this country: \*‘Accepted land marks become more and more valuable each time a recorded measurement is made from them. We need legislation to protect us from the careless moving of them. Our criminal laws are adequate to punish intentional moving with a purpose to do wrong. . . . The legislation we need is to provide against the excuse, ‘I did not know there was a monument in that place.’ The first step in legislation should be a public record of the location of monuments, as will be easily accessible and readily understood, and then that such record should be a legal notice to all people, so that the removal, without proper provision for preserving the point, shall be *prima facie* a criminal act, to be punished with a penalty as shall impress people with the fact that monuments are sacred things—surveyors’ idols, if you please, to be removed only by due formality if not without ceremony.’”

## RECORDING POSITION OF ORIGINALS.

Our Surveyors’ Act provides that affidavits as to boundaries shall be filed in the Registry Office; but there is no provision for marking or recording on the ground the position of a decayed original monument, so that it can be known as such by others coming after. It has been too much the case that the knowledge as to the position of an original point has been treasured up by surveyors, kept to themselves, and used in court as a surprise to break up a survey made by another. When requested to plant a stake or stone in place of a decayed original, or at an established point, it is as well to make a practice, when possible, to have two or more young men, resident in the vicinity, present on the occasion as witnesses that the correct point has been established, and to record their names in the note book entry of the transaction.

In conclusion, I would say to the members of our fraternity, carefully establish your points, and true record keep of the same, not only for your own information and benefit, but consider yourselves placed in a position that affords you the highest opportunity to be peacemakers between neighbours, and thereby be benefactors to generations to come.

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 DISCUSSION.

The Chairman—I think Mr. Gaviller made many good points. The paper is written in a very practical way. Many of us, no doubt, could recall instances, similar to those mentioned, in our own history. With regard to the point that one should take negative evidence, I remember a case in the Township of Blanchard, where there had been an extensive law suit over a line. The story was that a man who was then in the States was in possession of certain information which would change the whole course of affairs. Having occasion to make a

survey, I went out to the Township, and this man having returned from the States, I asked him to come and give me the information. He would not come. I had to apply to the proper authority and get a judge's order to compel him to attend and make affidavit. When he came he told me he knew nothing about it. I took his affidavit that he did not know anything, so that he could not come in afterwards and say he did. With regard to information being in the hands of a surveyor, which he keeps back so that he may drop upon some brother in a law suit, I do not think it advisable for a man to keep all this information to himself. He should give it to his neighbour. It is similar to a man dying with the information; he could just as well not have been in the country as not impart it to any one.

Mr. Kirkpatrick—That was a very good point about surveyors putting their own mark to their posts. I know that I could always swear to the posts placed by the man I served my time with. He had a mark of his own on them. I remember coming across one about twenty years after it was placed. It had his special mark upon it, and I recognized it at once. I always myself put a special mark so that I would recognize mine again even fifty years afterwards.

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

## CADASTRAL SURVEYS IN THE PROVINCE OF QUEBEC.

BY J. P. B. CASGRAIN, P.L.S.,  
*Morrisburg.*

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OUR genial and obliging secretary, Mr. Willis Chipman, has been good enough to invite me to read a paper before this meeting on "Cadastral Surveys in the Province of Quebec." I responded cheerfully to his call, because I believed this subject to be new to many of my Ontario *confrères*, but I must crave your indulgence for my many shortcomings as an English reader.

### INAUGURATION OF THE CADASTRE.

This work was commenced in 1866 under the supervision of the Honourable Alexander Campbell, then Commissioner of Crown Lands, now Sir Alexander Campbell, Lieutenant-Governor of Ontario, and in virtue of Chapter 37 of the Revised Statutes of Lower Canada. This great geodesic work has now cost the Province of Quebec over six hundred thousand dollars. This large sum, which has been expended on surveys and in the preparation of plans and books of reference, has to a great extent been distributed amongst the land surveyors of the Province.

Operations were carried on from year to year, and now that they are almost completed, in the permanent records of the Crown Lands Department at Quebec may be found every particular lot or parcel of land in the Province shown on a plan and numbered, and in the official book of reference, opposite the corresponding number, the owner's name, and a correct description, with measurements, of this same lot or parcel of land. A somewhat similar book exists in England, called the "Doomsday Book."

### THE OBJECT OF THE CADASTRE.

The operations of the Cadastre in the Province of Quebec were undertaken with a view of furnishing the registrar of each registration division with a correct designation of all the landed properties in the cities, towns and townships forming a registration division, in order to follow with regularity all the mutations and mortgages which take place therein.

The duties of a surveyor engaged on Cadastral work consist in the preparation of a plan showing all the landed properties in a certain

territorial division, and of a book of reference giving a correct and separate description of each and every lot or parcel of land in such division.

#### OPERATIONS IN THE FIELD.

The usual mode adopted for the operations in the field has been to make an accurate traverse by circuits of the public highways, railroads and rivers, noting the intersection of the concession lines and of all the dividing lines as indicated on the ground by fences, etc., or other visible boundary marks. Careful inquiries are made on each lot, so as to enter in the field book between the divisional lines of a property the owner's name, the approximate area, the figuration, etc. When a lot or parcel of land does not run the full length of a concession its depth must be ascertained, but in regular concessions the depth as found on the side line roads can be taken as correct for this purpose. In ascertaining the dimensions of each property, only those sub-divisions which are actually recognized or existing on the ground are entered in the field book. The Cadastral surveys are given by contract at a fixed rate of one dollar for each designation. The Government leave a great deal of latitude to the surveyor in the mode of performing his work in the field. The sole aim of the Department is to obtain an accurate plan, on which no dimensions are shown, the only information being the number given to each lot or parcel of land, which number it will bear for ever.

#### OFFICIAL PLAN.

In rural districts where the lots are comparatively large the official plan is plotted to a scale of twenty chains to one inch, and drawn on Whatman's antiquarian drawing paper. The plan shows clearly the divisions of each property by a clear, firm line, each parcel bearing within its figured limits the number given to it distinctly printed.

The concessions preserve their original name or number. The primitive subdivision and the original number of the lots are also preserved on the Cadastral plan, and are shown by red lines and red figures, and all the parcelling which has taken place since the township was opened for settlement is indicated by black lines. So that one can realise at a single glance the original laying out of the land and the existing minor subdivisions at the time of the Cadastral survey.

It is useless to emphasize on the immense advantages derived from this system, which clears up, every day, many vexed and intricate questions, which without this plan might have remained obscure and uncertain even after having entailed a large expenditure.

The original numbers being preserved and marked in red, the minor subdivisions, say of lot 5, range 2, Township of York, will be numbered thus in black, *5a*, *5b*, *5c*, *5d*, etc., if the parcelling does not exceed one alphabet. Should the parcels in one lot exceed the number of the letters in the alphabet, as it will frequently occur for lots in or near towns or villages, then a series of numbers instead of letters will be used, thus: 5-1, 5-25, 5-45, etc. The roads are

coloured in raw sienna, the rivers and lakes are tinted in blue, and the railroad lines in pink. Astronomical and magnetic meridians are drawn on the plan, the angle between them giving the declination of the needle. Not to mar the clearness of the lines indicating the limits of the parcels, it is preferred that no topography of the mountains, hills or buildings should be shown on the plan. In case of an agglomeration of certain parcels too small on a scale of twenty chains to one inch to insert thereon the number designating them, then a small plan is drawn on the margin on a scale of four chains to one inch, on which the numbering may be more intelligibly shown.

The title of the plan is as follows: "Official plan of the Township of Clifton, in the County of Compton, made in conformity with the provisions of Chap. 37 of the Revised Statutes of Lower Canada."

It is advisable to leave around the plan a sufficient margin so as to be able to insert thereon any omission or correction. The plan, after having been dated and signed by the surveyor, is transmitted to the Crown Lands Department at Quebec, where it remains as a permanent record. A copy of it is made and forwarded to the registration office of the division to which it belongs.

#### THE PLAN IN CITIES, TOWNS AND VILLAGES.

Landed properties in cities, having a greater value in proportion to their extent than those in the rural districts, and being also more subject to numerous subdivisions and frequent mutations, require that the Cadastral plan should be prepared on a large scale and with great accuracy. The scale adopted for the city of Montreal is of one hundred feet to one inch, and this has been found to be the most suitable scale for large cities. For the purpose of the Cadastre and to expedite the carrying into effect of the Registration Act, each ward in a city is considered a distinct municipality. It has its own series of numbers, and the Cadastre, within its limits, can be put into force on the issuing of a proclamation by the Lieutenant-Governor as soon as the plan and book of reference of a ward are completed.

Every subdivision of land generally known under the designation of building lot, every landed property distinguished or divided from another by a wall, a fence, hedge, or delimited by established boundaries or pickets planted on the spot by a Provincial Land Surveyor to mark such subdivision, or any beach or deep water lot granted by letters patent, is considered for this purpose a Cadastral lot, and receives a Cadastral number, and each of these lots is distinctly measured, so as to be designated and numbered in sequence, although they may be contiguous and belong to the same proprietor.

The measurements in cities are taken with a metallic tape, and the angles of the streets carefully measured with a transit, and generally all necessary precautions are used to ensure the accuracy of so important a work.

The breadth of all streets, squares, passages and lanes are also carefully noted, and it is ascertained whether they cover public or private property. If on private property streets, squares, passages



or lanes are considered as lots and numbered and designated as such.

When a ward of a city is too considerable to be represented on a single sheet, it is laid down on different sheets and numbered as follows: Plan of the centre ward of the City of Montreal, 1st sheet, 2nd sheet, etc. Each sheet is dated and signed by the surveyor before its transmission to the Department of Crown Lands.

OFFICIAL BOOK OF REFERENCE.

The form adopted for the official book of reference is always the same, and it can only vary in the title, the paper being prepared, ruled and printed, is furnished by the Department. The book of reference is divided into four columns. The first contains the number of the lot on the official plan. The second column gives the name of the owner of the lot, as ascertained by the surveyor by information taken on the ground, or by research at the registration office, or by examination of the assessment roll, a copy of which a surveyor always takes for his own personal use, in the preparation of the book of reference, as the quantities given in the roll will generally agree closely enough with the measurements taken on the ground to prevent any serious mistake, and enable him to identify the name of the owner. The third column headed "general description" contains, firstly, the name or number of the concession at the top of each page, then a description by metes and bounds, giving all the Cadastral numbers adjoining the lot, and if it is of irregular form the width, depth and area. When the lots are of irregular form the area alone is given.

For example, for a regular lot the entry should be made as follows:

OFFICIAL BOOK OF REFERENCE.

| Nos. Indicated on Plan. | Names of Proprietors. | GENERAL DESCRIPTION.<br>Township of Clifton—County of Compton.                                                                                                                                                                                                                                                                                                                   | REMARKS. |
|-------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 5a                      | Peter Smith.          | Forming part of lot No. 5 of the 2nd range of the primitive subdivision of Clifton, bounded on the north by the line between the 1st and the 2nd range, on the east by No. 5d, on the south by the line between the 2nd and 3rd ranges, and on the west by No. 5c, measuring five chains in front by eighty chains in depth, containing an area of forty acres (40 acres O. O.). |          |

The fourth column is reserved for remarks and all that may complete the designation of the parcel. It also serves for the entry of all the amendments to the description opposite. The book of reference, like the official plan, before being transmitted to the Department signed and dated by the surveyor.

## INSPECTION OF PLAN.

When the Cadastral plan of a locality is completed the Commissioner of Crown Lands, after being notified of the fact by the surveyor, causes official notices to be posted up in the division and inserted in the public press, if any, in, or in the vicinity of the division, to the effect that the plan of the Cadastre shall, on a certain date, be on exhibition at the town-hall, or at some other suitable building, for the examination of the interested proprietors of the respective landed properties. The Inspector of the Cadastre, himself, is present during this examination, and he notes all the complaints that may be made by the proprietors, and if they prove to be founded he orders the Surveyor to make the required alterations. The owners are shown on the rough plan their landed properties, and they are requested to give beside their own name, in full, that of their neighbours, and the Inspector can at once verify whether these names have been correctly entered by the surveyor. The width, depth and area of any lot is also given to the proprietors, and if these dimensions disagree materially with their statements the Inspector may either verify the plan by looking through the field notes of the survey, or make the surveyor measure again the particular lots. The Inspector then makes his report to the Department, and if it is favourable the Commissioner of Crown Lands orders the

## VERIFICATION.

Instructions are given by the Department to a Provincial Land surveyor, of recognized ability in his profession, to proceed to the locality where the inspection has taken place, and there to make a second traverse of some of the roads or lines already surveyed in the original Cadastral operations. This traverse is plotted on the same scale as the first plan, and a tracing of it is forwarded to the registration branch office of the Crown Lands. This tracing is placed upon the plan furnished by the surveyor who made the Cadastral operations. If the two plans do not agree within a reasonable limit of accuracy, the work is gone over again by the first surveyor, who, if his part of the work proves to be correct, may claim damages or re-imburements from the surveyor who made the verification. With this system in force the Government is justified in assuming that the plan forwarded to the registrar is correct.

On the reception of the official plan and book of reference the registrar prepares an Index to Immoveables. A special book is opened under the above title, and a full page is left for each Cadastral number, on which page every transaction concerning that particular number is entered. When the registrar has completed his part of the work, and has sent an acknowledgment of the receipt of all the official plans and book of reference to the Department of Crown Lands, the Government issues a proclamation in the Official Gazette of the Province of Quebec, putting the Cadastre into force in this registration division. A period of two years is allowed for the re-registration of all claims against any of the lots where the Cadastre has been pro-

claimed in force; after which time, any claim not registered loses its priority.

#### SUB-DIVISION OF CADASTRAL LOTS.

After the Cadastre is in force in a locality, when a proprietor wishes to sub-divide his land into building lots or otherwise, he is bound, under a penalty of one hundred dollars for each and every lot he might sell over six lots, to have the desired parcelling marked out by a Provincial Land Surveyor, whose name appears on the list of the members of the Corporation of Land Surveyors for the Province of Quebec, and one who has paid his annual dues to the said corporation. The surveyor thus retained prepares a plan on a suitable scale, showing the lots laid out by himself, and a book of reference, giving a correct description of each lot. Two tracings of this plan of sub-division and two copies of this book of reference must be made by a Provincial Land Surveyor. One of these copies is to remain as a permanent record in the Department of Crown Lands, and the other is to be deposited with the registrar of the division to which it belongs. Each copy, after having been signed and dated by a surveyor, is signed by the proprietor of the land, and countersigned by the Commissioner of Crown Lands. In the "Index to Immoveables" a full page is given for each of these sub-divisions in a special book kept for this purpose. The Government is recouped for its outlay by the sale of registration stamps, which have to be affixed to deeds when recorded. This shows that those who are taxed for Cadastral purposes are those only who have occasion to benefit by its operations.

This short paper can only give a very imperfect idea of the numerous advantages derived daily from the workings of this system to the Government, the legal profession, freeholders and Provincial Land Surveyors.

#### DISCUSSION.

Mr. Chipman—From the paper just read I am of opinion that the land surveyors of Ontario have a good deal to learn yet. This paper is just what we want at the present time, when we are thinking of registering our field notes and plans. There are several points that ought to be brought out clearly. Are there any dimensions shewn on any of the plans?

Mr. Casgrain—No; no numbers on the plans, excepting the numbers of the lots. The lots are so irregular that we could not give the dimensions. The plans are only for registration purposes.

Mr. Chipman—People, I suppose, settled on these lots and held them by right of possession, and things got in such a shape that you had no record?

Mr. Casgrain—In the Province of Quebec the original number of the lot is preserved. In Quebec, take a man named "John Smith," and look up his name, there would be any amount of John Smiths,

but the lot is numbered, and in the book we have the number and a full page showing the parties in the possession of the lot. By paying fifty cents we can go to that book and find out all that is entered against the lot.

Mr. ——— —What would you do in the case of lot numbers where the old lots are also numbered?

Mr. Casgrain—The old numbers are kept, but with new sub-divisions. The original numbers are kept and a series of new figures added.

Mr. ——— —But supposing the lot was originally No. 10.

Mr. Casgrain—It would be the same.

Mr. Stewart—I understand this “Cadastral Survey” corresponds with our “Original Survey,” and was commenced in Quebec in the old parishes that were never properly surveyed?

Mr. Casgrain—It was at first so intended, but afterwards, when they found the system working so well, they have used it for the newly surveyed Townships. You just take the visible mark on the ground. When you want it subdivided you run a boundary line and establish your points.

Mr. Sankey—I think this Cadastral Survey is one from which we in Ontario can reap a good many pointers. We have something similar in Ontario, the Compiled Plans of Incorporated or Unincorporated Villages. There is a section in our Act which at first sight appears to be an omission in our legislation. Amongst surveyors in Ontario a good deal of doubt has arisen as to what a surveyor is, and what his responsibilities are in regard to a compiled plan of a village. The Act says the registrar or any one interested can give notice to the head of the municipality, in writing, that within a certain time, if the plan is not approved of, a fine can be levied on the municipality. This plan is to show how the land is owned. Surveyors say, “Am I bound to go to the Registry Office and look over every man’s deed? And am I bound to go to every man’s land and stake out the distances?” This is becoming very important in Ontario, and it is a question which in the future will be much looked into. In some cases, perhaps, the registrar has given notice that such a plan must be supplied. The expense attending such a plan is very considerable, and the municipalities do not care about expending that amount of money. We should get some definite knowledge of the facts, and see how this can be improved. There is a great deal of difficulty in Toronto in hunting up old lots. I would draw your attention to lands between Front Street and the Esplanade. The original grants came under three different patents. Some warehouses on Front Street stand on ground granted by three different patents. If the Cadastral system were here the plan would be in the Registry Office instead of there being three different patents. This Cadastral System would do us a great deal of good if we could get the legislation to put it in force so as to be of use to the public. This is a matter for the public good. There are lots of people who have to pay hundreds of dollars into

lawyers' pockets to get their title put right, and a certificate that their title is all right, and after all this the certificate is often not worth the paper it is written on. This certificate is only the lawyer's opinion. Within the last few years we have the "Land Titles Act" in force in Toronto, and it appears to act very well, but I know that the expenses attendant upon it are working very seriously against it. Some people thought the Land Titles Act was the best system, and put their lands under it, but their experience was that the expense was so heavy that they would not have anything to do with it again. Once lands are put under the Land Titles Act it is useful and effective, but the first cost works against its success. I should be glad to see this Association take the matter up. Our Acts should state exactly what steps a surveyor should take. There is nothing in the Act as to what certificate should be put on the plans. In Ontario, if you are making a plan you have to show other lots surveyed by other surveyors. This is not right. When we get together it is a good thing to discuss this matter.

Mr. Stewart—There are one or two remarks Mr. Sankey has just made that seem peculiar to me. Is there not a plan in the Crown Lands Department showing these lots in the water front? If there are three patents for these lots there should be three plans in the Crown Lands Office.

Mr. Sankey—I can answer by giving you the facts relating to the water fronts. Sometime prior to 1818 a piece of land was granted by the Crown on the west side of Berkeley Street east of Peter Street on the south side of Front Street, Palace Street and Front Street again, with an allowance for roads. There is a reference in the patent as shown in the plan of the Town of York, but which lot is mentioned there I have not discovered. In 1840 two other patents were issued to the City of Toronto, which contain thirty-two descriptions, the descriptions in the first sixteen taking the water lots from the original shore lots. In some cases in the plan the distance from Front Street to the bank was not more than a chain; the general distances were 132 feet, covered by two patents, and there are many warehouses extending over 132 feet. The lawyers go back to the patents, and have to satisfy themselves that the land is properly described in the three patents. The plan has to be certified to by a land surveyor before the patent issues. This plan was made by Mr. Thomas Yonge, an architect, who was not a surveyor at all, and it is not used at all.

Mr. Stewart—Where we are laying out a portion of a village and have to put in other portions, we colour the portions and say in the certificate that the portions coloured are what the certificate covers.

Mr. Sankey—The Act says the plan shall be certified by a surveyor, but it does not say what the words of the certificate shall be.

Mr. Aylsworth—I have prepared plans partly from actual survey and partly from plan.

The Chairman—I think the paper we have just heard read is a very important one, and I think the surveyors of Ontario may very well take it up and apply it to many parts of this Province. With reference to the question of the compiled plan referred to by Mr. Sankey, I know of a town in this Province where very great difficulty has arisen in that way. We were asked to compile a plan of the town, and we took perhaps twenty different plans, and you could not fit them together; some would overlap. I think the Act is defective in that respect, and I think that it would be well for the land surveyors to consider that with the view of carrying it out in some part of the Province.

Mr. Kirkpatrick—A short time ago we had a letter from the Minister of the Interior about some of the old lands on West Pelee Island in Lake Erie. It was surveyed after the people had settled on it, and it was most amusing to see some of the descriptions. One was known as “the farm that John cleared,” “the store-house farm,” etc. On this plan there were just the numbers that Mr. Casgrain says, and all sorts and shapes of descriptions. It was settled by people who had vineyards, and surveyors went on afterwards and surveyed on the old titles, and the plans were made out in that way.

Mr. Aylsworth—I made an attempt to get up an amendment to the surveyor's certificate, and I gave it up in despair. I wanted the certificate to read that the compiled part was in one colour and the survey in another. There should be two surveys.

Mr. Stewart—There is another thing we should take up. It is known that the municipalities need not take over any plans unless the streets are sixty-six feet wide, but this is now avoided by calling them lanes. Registrars say there is nothing in the Registry Act about it. It is only in the Municipal Act that it is found.

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

## CITY SURVEYING.

By T. B. SPEIGHT, P.L.S.

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A GLANCE at the map of almost any of our older cities shows us one or more points from which winding roads of various widths run in different directions and are intersected by others at different angles. As the distance from these centres increases a nearer approach to uniformity is reached, but unfortunately this is only an approach.

Looking back to the early days, we can easily trace the origin of this irregularity. A cart trail or colonization road connects one trading post with another. At a certain point, selected for various reasons, a few houses are erected by settlers and a hamlet is begun. From this point, new roads are opened to distant objective points, and these roads become the property of the public.

As settlement advances the necessity for building lots becomes apparent, and these are laid out with what appears at the time to be the best means of access to these lots, without any thought for the convenience of future generations.

In course of time the land in the vicinity falls into the hands of different owners in parcels of all sizes and shapes. When the needs of increasing population, or the possibilities of speculation arise, these parcels are subdivided by their respective owners, each with an eye single to individual personal profit, and with no regard for the convenience of the public at large.

It is probable that when just about this period in the history of the future city is reached the surveyor becomes a recognized necessity in the community, and he commences his operations with a compass of doubtful reliability, and a chain which age has attenuated. The diagrams which set forth measurements of the chain aforesaid are considered "good enough," if an occasional measurement is recorded to serve as collateral evidence of the scale to which the sketches are alleged to be drawn.

From this view of the growth of cities it is not difficult for us to understand why such lack of symmetry is to be seen on all sides.

In more modern times our newer territories present a different state of affairs.

Railways are the great factors in the creation of towns and cities. An enterprising speculator pioneers abreast, or in advance of, a proposed railway, decides on a point where the physical features of the surrounding country indicate an eligible site, and says within himself, "Here will I build me a city," or in other words, "Here will I establish a squatter's right, and await the tide of immigration, which

brings wealth to the first comer." If his selection has been well made, and circumstances warrant it, the science of surveying is next called into requisition, and usually a large tract of land is at once laid out into regular blocks.

In such cases there would seem to be no excuse for the irregularity or want of system such as is met with in older cities, where holdings are so numerous and interests so varied.

But what we have now to deal with is not so much the past as the present and future. Some of the errors of our ancestors are now being corrected in the extending and widening of streets, by expropriation, but at what a cost! With the details of the system of expropriation as now carried on in our various cities, and the fairness or unfairness of its workings in regard to holders of improved properties, we, as surveyors, have nothing to do, but we may, with all due modesty, venture suggestions as to how the necessity for costly expropriations in the districts yet unsubdivided may be avoided. Before commencing to prepare this paper, I wrote to the heads of the Engineering Departments of some of the more progressive American cities, and in every instance received a courteous reply, with more or less complete details of the surveying branches in the respective cities.

Through the kindness of the officials in charge of matters relating to our profession in Philadelphia, Detroit, Buffalo, Rochester, Providence and Baltimore, I have had an opportunity of examining and comparing the various systems in force in those cities, and think that we may learn much from our American cousins.

Take, for example, Philadelphia. In that city the main thoroughfares, about 400 feet apart, are projected in advance of improvements, and marked on the ground by stone monuments; and plans—showing names and widths of streets, block distances, intersection angles, topography and profiles—are made and filed in the Bureau of Surveys, open to public inspection. These plans are then advertised for one month, in order to give all interested parties sufficient opportunity of examining them and entering their objections previous to their confirmation by the Board of Surveyors. By the confirmation of these plans the public are given notice of the location of streets, building thereon is prevented, and thus both the city and property owners are saved subsequent loss, and the system rendered uniform and continuous. Within the boundaries of these thoroughfares the owners are allowed to locate streets as they may desire, but of a width not less than thirty feet, and extending from one principal street to another. The widths of principal streets are regulated by their locality and vary from fifty to one hundred and twenty feet.

This system appears to give satisfaction in all respects to the property owner and the public, and there seems to be no reason why, with the modifications necessary to suit our different forms of municipal government, it could not be adopted by Canadian cities with great advantage to all concerned. The lands included in the projected streets would be available to the owner until such time as it might be deemed necessary to open the streets. The owner should be notified say from three to six months in advance of the opening, and the only



compensation he could in justice claim would be for loss occasioned by blocks too shallow for building lots being left between the street lines and the boundaries between different owners.

The price of such blocks at the time of projection would probably be small in comparison to their value at the time of opening, and their use for cultivation, etc., in the meantime would not be interfered with.

The assessment of damages would, of course, be done in the usual manner. The advantages to the public of a layout of streets systematic as to width and location is apparent and requires no explanation. It may be urged that much of the irregular style of subdivision is done and established long before the property is included within city limits; but could not city corporations be empowered to exercise jurisdiction over suburban districts for the purpose of projecting streets or else to incorporate these districts and assess the same as farm property?

There may be insurmountable difficulties in the way of such schemes as these, but we feel confident that at some future day the people of Canada will realize that streets are intended for highways for the public and not simply as a means of deriving the greatest possible profit for the land speculator.

Under the present system of subdivision a great injustice is sometimes done to a purchaser, who, after paying for his lot, finds to his cost that a street shown on a registered plan is not necessarily under the care of the corporation, owing to its not having been accepted by the Council. I think an improvement to this would be to make it necessary for all plans affecting streets to be submitted to the Municipal Council for sanction before being accepted by the registrar. This sanction might be withheld where the proprietor had ignored existing adjacent streets.

Another want much felt is that of durable monuments to define street corners. The planting of substantial stone or iron monuments to define street line intersections should be made compulsory to owners of properties when subdividing. The cost of this would be trifling when we consider that in most of American cities the cost of grading streets must be borne by the owner before being accepted by the corporation. The registration plan should show whether such monuments are planted at exact street line intersections or at certain offsets from intersections.

I would like to hear the opinion of members of this Association in reference to the certificate to be placed on registration plans.

The certificate now required renders a personal survey necessary, but there is nothing in it to show whether or not the subdivision has been staked out.

Could we not have an additional certificate setting forth the facts as they are, to serve as a guide in after years as to what stakes are originals?

In this short paper I have endeavoured to call the attention of our members to some much-needed improvements in city surveying, and should it be in any way instrumental in inaugurating a movement in the directions suggested, I shall feel that it has not been written in vain.

## DISCUSSION.

Mr. Gibson—I think the paper we have heard read is in the right direction. But the trouble comes in here. Surveyors generally have to make a bargain with the man who employs them, and the lawyer or land agent generally wants the plan at once. In Toronto there are hardly any boundaries that are governing points. On King and Yonge Streets I suppose all my father's old posts have been taken up long ago. During last summer I made a compiled plan of a village to cover all the registered plans and all properties subdivided and sold under subsequent descriptions I made profiles of. These profiles are filed with the township clerks and parties have to conform to them. The streets were properly graded and left buildings in a very bad condition, and naturally the parties who owned them had claims for damages. All our villages have the power to regulate these streets, etc. In Hazelton Avenue I was employed by the authorities to lay it off. I found it was irregular, and I wanted it to be laid out correctly, and I had to explain my views very fully, and even then I had to take my own way against the wishes of a great many in the neighbourhood. In preparing these plans I search up every registered plan and get the dimensions of thirty or forty lots and put them all on the plan. Where there is a street or lane the Registry Act provides for that and the man is paid for it. In townships there are a great many subdivisions. The trouble is to get a proper system to be used all over. The United States system of divisional survey makes no provision for roads. There is a certain reservation in Algoma district for roads.

Mr. Browne—Disputes are arising every day about the grade of the streets. The city comes on and block paves and raises the street three or four feet and there are often claims of damages against city. It is often found that the original grade of the street was not known. I think the matter should be brought up and the profile registered when the plan is registered so that no one could have a claim of damages against a corporation. As to the monuments it is often very difficult to get them. If they are placed at the corner of the street, when the buildings are being put up, they are obliterated, and if they are placed in the centre they are dug up when the drains are being dug. I do not know if there is really any place in the street where a monument would be safe.

Mr. Gibson—I think about a foot and a-half from the corner.

Mr. Browne—Well, that would not be safe, as it would likely be removed when they dug up the cellars. I think the profile is very important. We must trust to ourselves to keep the monuments.

The Chairman—I think the suggestion made by Mr. Speight as to the profile of the Streets is a very good one, and the paper might be referred to the Committee on Engineering.

Mr. Gibson—I understood from Mr. Sankey that there is a possibility of the City of Toronto taking the matter up. There should be specific instructions given as to the making of these plans.

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

## DESCRIPTIONS.

By OTTO J. KLOTZ, D. T. S.

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THE subject of descriptions is very important to the surveyor and more so to the public, and I do not think that that attention has been bestowed upon it that the subject deserves. For without proper descriptions of the land to be conveyed the refinements of survey that are now gradually aimed at will not bear their full usefulness, in fact may be totally lost by a poor or indefinite description.

To my knowledge there is no work or treatise extant from which the young aspiring surveyor can obtain any information on the subject. Frequently the master with whom he serves takes little trouble in instructing him in this or any other subject, but lets the pupil grope for himself and pick up as best he can.

The public pays dearly for the services of a surveyor who can not make proper descriptions, I may say far more so than if the surveyor had made a poor survey. A survey can be changed if improperly or carelessly performed, a description embodied in an instrument under seal and registered stands for all time.

Under improper and inaccurate descriptions I do not include gross blunders as the giving of the wrong number to the lot, etc.

When a surveyor is called upon to make a description he should, before he attempts the same, thoroughly understand the description of the land, as given in the deed of which the parcel to be conveyed forms a part, and must distinctly know what is to be conveyed—then he is prepared to put his thoughts to paper and make an intelligent and proper description.

As every province or country has its own peculiar forms and phraseology for documentary matters the surveyor should apply the same in making his descriptions so that every word that he has written may be inserted into the deed and not require remodelling by the conveyancer or lawyer.

Never put into a description any more words than necessary—overdescribing land—because you are apt to impair rather than improve it thereby.

In documentary phraseology there are no three words more abused and improperly applied than “more or less.” My experience in extensive searches in registry offices revealed to me the fact that this abuse is of a chronic nature and of a malignant type. It seems as if in the past surveyors and conveyancers thought it an impossibility for a person to buy a definite quantity in linear or superficial measurement; like a spectre, “more or less” haunts every crevice and cranny in the old indentures.

The words "more or less" are full of meaning and are very significant if properly applied, and the reverse if not so applied, and may in fact destroy the very essence of what is intended to be conveyed by deed.

This will be illustrated later on by examples.

For elucidation of various cases that come up in practice I will give the following :—

#### CASE I.

Mr. A. owns lot number one in the second concession of the Township of Derby, in the County of Wentworth and Province of Ontario, and sells to Mr. B. the easterly half of the lot.

In the patent from the Crown for this lot its area is given as 200 acres, more or less. In the Crown Lands Office the original plan shows this lot to be rectangular and eighty chains by twenty-five chains, the bearing of the former as N. 10° E. and of the latter N. 80° W.

A description of the part to be conveyed would be :

"All and singular that certain parcel or tract of land situate lying and being in the Township of Derby, in the County of Wentworth and Province of Ontario, containing by admeasurement one hundred acres, be the same more or less, and being composed of the easterly half of lot number one in the second concession in said township."

In this description it is desired to draw attention to two points: Firstly; as the part sold is an aliquot part of the original lot, and all original lots have their areas "more or less" (the boundaries thereof being a matter of evidence more than of survey) hence the aliquot part must have its area "more or less" also. Secondly; being a recognized legal subdivision of the original lot, and the boundaries of such lot fixed either on the ground or by statute, the boundaries of such half must be fixed also without any particular description by metes and bounds being given.

No description by metes and bounds in this case would establish the boundaries any better than without such metes and bounds, in fact the probability is that they would conflict with the description—the easterly half of lot number one.

In Dominion Lands legal subdivisions of sections are specified by statute and comprise multiples of one-sixteenth of the section. In Ontario I know of no statutory legal subdivision although halves and quarters are recognized as such.

#### CASE II.

Taking the same lot, A sells to B a field lying along the easterly boundary of the lot; the westerly boundary of the field to be the fence (supposed to be straight) then standing. The surveyor is called to make the survey and from it the description.

The judgment and discretion of the surveyor here come into play.

When the surveyor arrives on the field he will soon learn whether the fence is merely a side to complete an area or whether there is

something particular to be included by the present position of the fence—as a valuable spring or building close to the fence—in short, something of a comparatively permanent character; I say comparatively, for alas, nothing material is permanent, only the abstract—truth.

The buyer generally pays for the land at so much per acre, and if a lump sum be paid it must for farm land be based on a certain value per acre according to the producing power of the land; hence, area is the guiding principle as frontage is in city property.

He will know that if in his description he refers to the fence, that fifty years hence it will be gone, probably replaced by another one, and then the position of that boundary (westerly one) will be a matter of evidence primarily and not of survey, and this means frequently litigation.

It will be observed that we have, in this case, the easterly, southerly and northerly boundaries of the field as original boundaries with the westerly one to be defined by description.

Let the surveyor carefully establish the above original boundaries, then measure from the south-east angle of the lot along the southerly boundary to the centre of the fence (as division fences in fields in Ontario are mostly rail fences there is an unavoidable margin of one or two or even three links in assuming the centre), do similarly along the northerly boundary from the north-east corner of the lot, besides measuring the easterly and westerly sides of the field, although these last two measurements are not absolutely necessary for the description as far as metes and bounds are concerned, but are taken for computation of area and to have uniformity in the description.

He is now prepared to make his description. Assuming the fence to be merely a side to complete an area we have for a description as follows:—All and singular that certain parcel or tract of land situate lying and being in the Township of Derby, in the County of Wentworth and Province of Ontario, containing by admeasurement twenty-seven and one-half acres, be the same more or less, being composed of a part of lot number one in the second concession in said township and which parcel may be more particularly described as follows, that is to say:—Commencing at the south-east angle of said lot thence westerly along the southerly boundary of said lot ten chains and thirty-two links, thence northerly in a straight line twenty-five chains and five links more or less to the point on the northerly boundary of said lot distant eleven chains and sixty-eight links westerly from the north-east angle of said lot, thence along said northerly boundary easterly eleven chains and sixty-eight links to the north-east angle of said lot, and thence southerly along the easterly boundary of said lot twenty-five chains, more or less, to the place of beginning.

It will be seen that the lengths given for the easterly and westerly boundaries of the field are really not necessary in the description but as before stated are given for uniformity as the other two boundaries are given.

Some may ask why I do not give a bearing for the westerly boundary, the others having original bearings. This opens up the whole subject of bearings.

Nearly all the bearings in Ontario are magnetic, only of late years are the astronomic bearings being introduced, but as original boundaries and new division lines often abut, the surveyor who desires to do more accurate work and use astronomic bearings must give for an original boundary its original magnetic bearing also to preserve the identity of the line and thereby simplify searching documents for title. Some surveyors have been in the habit of using the compass and combining one line with present bearing with another possibly of ten years date, and lastly with an original boundary whose bearing was taken seventy-five years ago. This makes a nice jumble, and it is not a rare occurrence either.

To every practitioner it is well-known that the ordinary bearings given are not nearly as reliable as the linear measurements. Astronomic bearings are definite and unalterable.

Had I given a bearing for the westerly boundary in the last description, if it meant anything at all, it meant that that line ran in one particular direction and no other, and hence must intersect the northerly boundary in some particular point, but from my hypothesis that point must be eleven chains and sixty-eight links from the north-east angle of the lot; these two conditions for one and the same point are highly improbable of being simultaneously fulfilled. Hence I have to choose between giving a bearing for the line or a definite distance along the northerly boundary. As the latter is more readily determined and tends to preserve the area (the guiding principle here) in case of a resurvey, I chose it, and thereby avoid explaining, in case a bearing had been given, whether such bearing is astronomic, present magnetic or made to conform with the original bearing of one of the other boundaries.

Professor Johnson, in his admirable work, "Theory and Practice of Surveying," which should be in the library of every surveyor, discusses the relative merits of linear and angular measurements, and concludes with "It thus appears that when the side lines of lots are located perpendicular, or at any other angle with the street upon which the lot fronts, it is susceptible of more accurate location than by two (front and rear) measurements, unless the usual limit of error can be greatly reduced." In short he gives preference to the theodolite compared with the chain or steel tape. Theoretically, using the instruments quoted, such preference is unassailable; however, its conclusive application (angular measurements) practically is confined to triangulations in geodetic work. In practice, lots are generally laid out with an even number of feet or links, frontage and depth. This is intelligible to the public, who know nothing of bearings; and where there are gores or oblique lines, I think that, in the large majority of cases, the course is computed from the linear measurements. It would be a mere accident if such a course would end in even minutes, and a minute being the limit of refinement in ordinary surveying, it follows that the course given will not be mathematically consistent with the distance given. Hence more weight should be given to the latter than to the former.

In another place he says, "With the transit to define directions of courses, and the chain still to measure distances, such a maxim (distances govern courses) would not have voiced the results of experience, but would have been sheer nonsense." I am confident that at the present day, in the vast majority of cases, "distances do govern courses." A line can be measured independent of any other line, a course can undoubtedly also be determined independent of any other course, but, practically, is this done? No, the course is made dependent upon some other course, that on another, and so on, until we finally arrive at the basal course, possibly established by Polaris. Now I would like to ask, if not in our city surveys, the surveyor will give the preference to linear measurements in most cases as against angular measurements as deduced from the courses or angles given on the plans, for determining a point or line.

Linear measurements shown on plans have, as a rule, been actually made, whereas courses are deduced or computed and seldom astronomically observed.

The Professor puts the question, "Shall division lines be located by an angle with the street on which the lots front or by distances from the next cross street," and then gives an example—a rectangular block of nine lots, each fifty by one hundred and fifty feet. Required to locate lot 9. He assumes the maximum error of chaining to be 1 in 5,000, and when chaining the front and rear of lots 1 to 8 inclusive (400 ft.) to produce opposite signs, that is the error of the division line between lots 8 and 9 to be .16 ft., equivalent for the distance of 150 ft. to  $3\frac{2}{3}$  minutes of arc, a quantity undoubtedly larger than permissible in a transit, but it must be borne in mind that even when using the transit one distance (400 ft.) must be measured, involving one half of the above error, to say nothing of the error arising from imperfect setting, adjustment and pointing. Furthermore, it may be necessary to set up the instrument twice to ensure parallelism of the lot lines between lots 8 and 9 and of lot 1, and finally it may be impossible, where the actual dimensions of the block differ from the intended ones, that the transit can be used at all, but that by chaining the relative width of each lot be determined.

Let us put this example to a practical solution, under the favourable assumption that the block and its lots have actually their proper distances and bearings. Let the rectangular block of lots be on Yonge Street, Toronto, where there is a steady pour of pedestrians and vehicles, or even on a less frequented street. How many surveyors would take offsets (for it is not probable that the instrument could be set on the lot line on account of fence or building) from the line of the front of the lots, set up the transit to turn off the angle for lot 9, instead of expeditiously measuring with a steel tape 400 ft. from the front and rear of lot 1?

If a surveyor could just place his transit where he chose, could keep all disturbing influences distant, could depend upon his assumed base, then he could probably more accurately define a point by angular measurement (intersection) than by linear, but at an expense of time.

The above pertains especially to city surveying, and is given under that heading in the book referred to.

If in the country, where the ground is more or less broken, it were required to run a long line parallel to and a considerable distance from another one, I would certainly prefer the transit to the chain.

Reverting now to Case II., we will see that it would have been impracticable to have given a course for the westerly boundary of the part sold. For that course is subject to the position of the fixed distances 10.32 chains and 11.68 chains, which in turn are dependent upon the position of the southeast and north east corners respectively of the lot. The change of position of these corners (original ones), as may arise from conflicting evidence given to two surveyors, necessarily changes the position of the south-west and north-west corners of the parcel, too, without however causing a material difference in area. This difference of area dependent upon the position of said south-east and south-west corners would be greater were we to give a definite bearing for the westerly limit of the parcel.

I am an admirer of fine instrumental work, but think that for some time to come yet in ordinary surveying "distances will govern courses."

The second part of Case II., of less frequent occurrence, is where the fence is to include something close to it and of a comparatively permanent character, in which case there must be no uncertainty of such being included.

Our description—the latter part thereof—would then be: "Commencing at the south-west angle of said lot, thence westerly along the southerly boundary of said lot ten chains thirty-two links more or less to the point distant, fifty links due west from the astronomic meridian passing through the north west corner of the limestone dwelling-house (being the only stone building on said parcel), thence north twenty degrees and seventeen minutes west (astronomic) twenty-five chains and five links more or less to the northerly boundary of said lot, thence along said northerly boundary easterly eleven chains and sixty-eight links more or less to the north-west angle of said lot, and thence along the easterly boundary thereof southerly twenty-five chains more or less to place of beginning."

According to the above description, no future survey could deprive the purchaser of the limestone dwelling-house, although the position of the south-east and north-east corners of the lot may be subject to change, as their position is mostly a matter of evidence as to their original position as designated by posts, or as deduced from other original corners where evidence is similarly required.

A sketch showing the position and dimensions of the building, and signed by the surveyor, might advantageously be attached to the deed for future identification in case additions to the building or other changes occur.

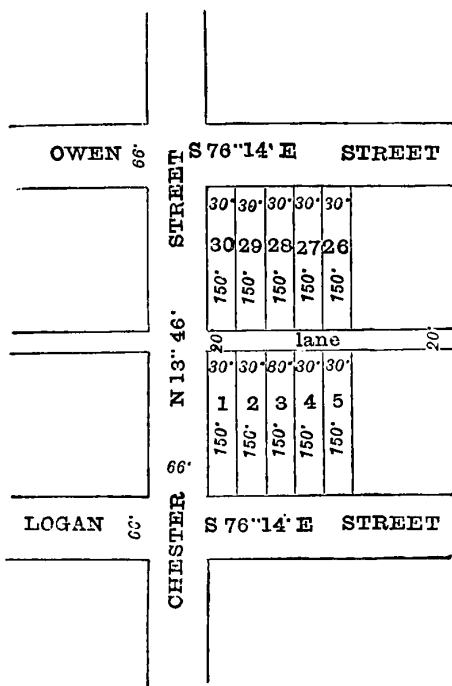
When the words "more or less" are used the "stopping" point must always be, or be referred to, some fixed point, never a wooden stake. An original corner is always a "fixed" point, although it may be shifted about by surveyors, depending upon the evidence upon



which they base their work. Stone buildings, iron or other metallic bolts set in rock may also serve as points of reference. "More or less" should hence only be used in giving the distance between two fixed points.

In the foregoing descriptions the apparent want of definiteness in not giving bearings is what really makes the description definite and without ambiguity.

CASE III.



Let the accompanying diagram be a copy of part of a registered plan.

Mr. A owns lots numbers one, two and three. On lots numbers one and two he has erected a brick block, which is supposed to have a frontage of fifty feet on Logan street, and adjoins Chester street the full depth of the lot.

Mr. A sells the brick block to Mr. B. A surveyor is called to make the survey for making the necessary description. He carefully determines the boundaries of the lots and determines the distance that the brick block extends into lot number two, and from his data he makes the following description :

"All and singular that certain parcel or tract of land and premises situate, lying and

being, in the town of Hope, in the county of Wentworth and Province of Ontario, containing by admeasurement seventy-five hundred square feet, be the same more or less, being composed of lot number one and a part of lot number two, both lots adjoining Logan street and being in Block A, as shown on the plan entitled 'Plan of subdivision of township lot number seventeen, third concession, township of Derby, county of Wentworth,' under date June 11th, 1875, signed by James Duncan, P.L.S., and filed in the registry office for said county of Wentworth, and which parcel may be more particularly described as follows, that is to say:—Commencing at the south-west angle of said lot number one, being at the intersection of the northerly side of said Logan street with the easterly side of Chester street; thence easterly, along the southerly limits of said lots numbers one and two, fifty feet, more or less, to the line of the easterly side of the brick block now erected on said lots; thence northerly, along said line of easterly side of said brick block, one hundred and fifty feet;

more or less, to the southerly limit of the registered lane twenty feet wide; thence, along said southerly limit of lane, westerly fifty feet, more or less, to the north-west angle of said lot number one, being on the easterly side of said Chester street; and thence, along said side of Chester street, southerly one hundred and fifty feet, more or less, to the place of beginning."

*Notes on the above.*

As the position of the streets or lots depends primarily on evidence where the original lot posts stood, it would be imprudent to give a bearing for the frontage of the block or for any of the other sides. To say, for instance, "thence, along Logan street, south seventy-six degrees fourteen minutes, east, etc.," is a questionable statement, being a dual statement, for S.  $76^{\circ} 14'$  E. means a certain course, and "along Logan street" possibly and probably another, hence I avoid giving the course. Although the south-west corner of the brick block was intended to be co-incident with the south-west corner of lot number one, and may have been found so by the surveyor, yet another surveyor might find it out one or more inches, and possibly on the street, hence it would be wrong to begin the description, "at the south-west corner of the brick block."

Similarly the block is intended to be on the line of the northerly side of Logan street, but for similar reasoning the frontage that A can convey does not necessarily extend to the south-east angle of the brick block, but only to the line of the easterly side of the said block. If the block is anywhere on the street, that is a matter for the municipality to deal with, but Mr. A can certainly not convey what he does not own. In this case we have two definite points defining the frontage—the south-west angle of lot number one and the intersection of the line of the easterly side of the brick block with the northerly side of Logan street, hence the distance between the points must be more or less; and likewise for the other sides of the parcel. It would be absolutely wrong to express the frontage definitely as so many feet, no matter how accurately the measurements be made and how definite and undisputed the south-west angle of lot number one may be. For there is in this world no absolute measurement, for we can only hope, by the most accurate and refined measurements, to increase the approximation to truth. Furthermore, we may put as an axiom in practical surveying, that bearings and definite linear measurements of an enclosed area are incompatibles.

CASE IV.

(Using the Diagram of Case III.)

Mr. B buys from Mr. A twenty feet frontage of lot number one, the frontage extending from Chester street along Logan street, and the parcel bought to have a uniform width to the rear thereof.

For the description no survey is necessary, but as Mr. B. desires to know the limits, especially the eastern limit of his parcel, the surveyor is called upon. In this case the accuracy of the survey is of

far more importance than in Case III., there is no "more or less" about the frontage, and as Mr. B will probably want to build up to his line, no pains nor care should be spared in giving him the most accurate measurement attainable.

When Mr. A comes to sell the remainder of the lot, the description for it will start: On south limit of lot number one, at a distance of twenty feet (no "more or less") easterly from the south-west angle of said lot number one, etc. So that if Mr. B has built one inch beyond the twenty feet he will find himself in trouble, and often very expensive trouble. In this way surveyors may be generous towards their legal brethren although detrimental to themselves. The description for the parcel will be: "All and singular that certain parcel or tract of land situate, lying and being, in the town of Hope, in the county of Wentworth and Province of Ontario, containing by admeasurement three thousand square feet, be the same more or less, being composed of a part of lot number one, on the northerly side of Logan street and on the easterly side of Chester street, and being in Block A, as shown on the plan entitled, 'Plan of subdivision of township lot number seventeen, third concession, township of Derby, county of Wentworth,' under date June 11, 1875, signed by James Duncan, P.L.S., and filed in the registry office for the county of Wentworth, and which parcel may be more particularly described as follows, that is to say:—Commencing at the south-west angle of said lot number one, being the intersection of the northerly side of Logan street with the easterly side of Chester street; thence, along said side of Logan street, easterly twenty feet; thence northerly, parallel to the westerly limit of said lot, one hundred and fifty feet, more or less, to the southerly limit of the registered lane, twenty feet wide; thence westerly, along said limit of lane, twenty feet, more or less, to the north-west angle of said lot number one; thence, along the westerly limit of said lot, southerly, being along the easterly side of Chester street, one hundred and fifty feet, more or less, to place of beginning.

*Notes on Above.*

There is probably only one point that needs explanation in the above,—and that is why I say twenty feet more or less for the rear of the lot when I have twenty feet definite on the front.

From the hypothesis or condition of sale the east and west limits are to be parallel, that is the parcel is to have a uniform width, measured parallel to the frontage of twenty feet. As the front and rear of the lot are original boundaries, and, although they were intended to be parallel, yet may not be found so on the ground, in which latter case the definite distance of twenty feet at the rear might destroy the parallelism of the east and west limits of the parcel, hence the words "more or less" are used.

CASE V.

It is seldom required to give a description wherein it is desired to have a definite area, that is a person buys so many square feet or acres and no "more or less."

If such be required, one or two lines will probably be given in position. For instance, the half of the front of the lot and the adjoining lot boundary, a further condition will likely be given that the parcel is to be a parallelogram. With these data the description can be so worded as to include a definite area although the measurement of the sides may not be definite, but in such event the one will be made dependent upon the other,—for example—so many chains more or less along the southern boundary of lot from the south-east corner thereof to the point midway between the south-east and south-west corners of said lot, thence northerly and parallel to the eastern boundary of said lot to such distance that the parallelogram contained by the two described lines and the two opposite and equal ones, each to each, shall contain ten acres, thence easterly parallel to the southern limit of said lot ——— chains more or less to the eastern boundary of said lot and thence along the same southerly ——— chains more or less to place of beginning.

I have in some of the above cases inserted distances that are not absolutely necessary for defining the land, but have added them simply as circumstantial evidence, but without impairing the definiteness of the description itself. All such measurements are naturally “more or less.”

It will be noticed that in none of the above descriptions save one have any definite bearings been given. One reason for such omission has already been advanced and that is, as a bearing means some definite course—a particular direction, it is thereby in practice generally incompatible with the linear measurements given.

Argument might advance the circumstantial evidence plea of “more or less” that was granted to distances, but this is objectionable and for two reasons,—firstly, it is totally without precedent to say for example—thence north about fifteen degrees thirty-seven minutes west; secondly, and the greater reason, it is highly probable that the circumstantial evidence of bearings would differ from that of linear measurements, and instead of being corroborative in assisting towards a solution, would confuse matters.

As before stated, linear measurements are found by experience to have far more weight than angular measurements and hence should be given the preference in descriptions.

There are numerous cases, however, where both bearings and distances must be given.

#### CASE VI.

Mr. A. sells off his township lot, an irregular parcel, probably with numerous sides.

One, generally two sides of the parcel, will be co-incident with original lot sides.

The description should begin at one of the corners of the original lot or some other established or well-defined point. The irregular sides, if I may so term them, that is those not forming part of any original lot line, should be given in bearing and distance, the former preferably astronomic, but care must be taken to have all bearings on

the same basis, not give the original magnetic bearings of the lot lines for these lines, and the rest astronomic; and when making them all astronomic, the original bearings for the lot lines should be given in parenthesis for these lines and following the astronomic bearings given therefor.

In such a description at least one course must have its distance "more or less" for "closing."

If there are any permanent boundaries such as a stone building marking any corner, the distance thereto must also be "more or less" as given under Case III.

A word about descriptions in old deeds. These instruments frequently contain errors, impossibilities and nonsense. Under the last may be classed "commencing at a stone in the corner of the field where a post has been planted"—; "Thence N. 10° W. 12 c. 50 more or less" (to where?); "Commencing at the south-east angle of said parcel where a post has been planted;" and so on.

Under impossibilities we may cite those cases where bearings and definite distances are given, which on computation are found to be far from possible.

Errors arise mostly through the interchange of the words—north, south, east and west; as an instance of this I will give the following I met in my own practice years ago:—

The description of the parcel was as follows: "Commencing at the distance of thirty-seven chains eighty-two links from the south-west angle of said lot number seventy-nine in a course therefrom north twenty-five degrees thirty minutes west, thence north seventy-six degrees east eighteen chains and six links, thence north sixty-five degrees east ten chains eighty-three links, thence north twenty-five degrees thirty minutes west three chains forty-seven links, thence south sixty-five degrees west ten chains eighty-three links, thence south seventy-six degrees west eighteen chains six links more or less to the western boundary of said lot, and thence south twenty-five degrees thirty minutes east three chains fifty-four links more or less to place of beginning."—Containing by admeasurement ten acres, be the same more or less.

The southern boundary the farmer wanted defined.

I had not run very far from the south-west angle of the parcel when he said, "You are shooting into my neighbour's." I continued and found when I reached the established eastern boundary my measurement fell short nearly four chains, making it apparent that something was wrong.

Obtaining the deeds of the adjoining lands, I soon discovered the error. The course of the southern boundary should have been north seventy-six degrees west instead of south seventy-six degrees west.—South had been through a slip written for north.

Even with the corrected description, the area was in error; the parcel contained according to metes and bounds 8.67 acres instead of 10 acres. The person who made the description having evidently simply multiplied length by breadth without observing that the

breadth at one end was not at right angles with the adjoining parallel sides.

The question now comes, what is the surveyor to do under these or similar circumstances, either in making a survey or descriptions comprising parts of such lands.

The law certainly does not constitute the surveyor Judge in such matters. But law is intended to be the incarnation of common sense, and on the strength of this I would suggest that the surveyor use common sense and make his survey and description accordingly. In the last cited parcel I certainly would have no hesitation in making a description of that parcel or its southern part if sold, by inserting the bearing intended and not the one given in the old deed.

It can not, however, be made too imperative that the greatest caution be exercised in doing anything inconsistent with the original document, although the latter may be inconsistent in itself.

By means of deeds of correction errors may be eliminated, but with old indentures where the legal representatives may be spread over two or three generations, it is next thing to an impossibility, and connected with a great deal of expense to obtain a deed of correction.

By the Statute of Limitations a person may claim land by adverse possession, but he can not legally sell such land until his claim has been ratified by the courts, a procedure that may cost more than the land is worth.

Many of the older surveyors well know that the good offices of the surveyor as mediator and peace-maker have often been exercised when neighbours were at strife about some boundary, and that through his just and good counsel harmony has been restored where litigation was brewing.

And finally look upon the making of a description as upon a problem, something definite is to be done—no ambiguity, no uncertainty. Have the proposition and data clearly in your mind—then go ahead—and there will be no difficulty in making a proper description.

A word to the younger surveyors. In making a description always express numbers in writing, the corresponding figures may be added in parenthesis. Never use abbreviations and always keep a copy of every description you make, preferably using a letter press for copying and a book specially for descriptions. A good legible hand is also imperative.

Before closing I wish to answer a question that is sometimes put by lawyers to surveyors, and generally with a patronizing air:—“Can't you measure the exact distance between two points?” “No man can measure the absolute distance between two points” is the answer.

To begin with there is only one measure of absolute length in the Dominion of Canada, it is the “Standard Yard” “A,” deposited in the Department of Inland Revenue. It is intended to be of the same length as the “Imperial Yard,” but this does not make its length absolute”; however, by Act of Parliament, 42 Vic., Chap. 16, it is made “absolute” for the Dominion. All other linear measures, and hence measurements, are dependent upon it.

It is impossible to make an absolute copy of that standard yard, and it is also impossible to make an absolute comparison between that yard and any other measure—say a chain—which shall be an even multiple of that yard, hence all measures (except the standard) are affected by error, although that error may approach the infinitesimal. Hence no absolute distance can be measured, as it is impossible to have an absolute measure for determining the same.

Another reason for answering the question in the negative, and independent of the first one, is that the operation or act of measurement between the two points is not perfect. It would be a mere coincidence if two or more measurements of a certain line were absolutely concordant. However, a careful surveyor will do his work in such a manner that discordances arising from re-measurement are kept within such limits as to be practically inappreciable.

We find in trigonometric surveys, where the greatest care and the highest refinements are applied, that the length of a base line on which the triangulation rests is always given with its probable error. The following example from Wright's "Adjustment of Observations" will illustrate this latter, in fact the whole question:—"In the measurement of the Massachusetts' base line, consisting of 2,165 boxes, the probable error of a box, as derived from comparison with the standard meter, was  $\pm 0^m\cdot000055$ , the probable error from instability of microscopes in measuring a box was  $\pm 0^m\cdot000127$ , and the probable error of the base from temperature corrections was  $\pm 0^m\cdot0332$ . Show that the probable error of the base arising from these independent causes combined is  $\pm 0^m\cdot0358$ ."

In short, gentleman, the distance between two fixed points is always "more or less."

I append verbatim a description of a mining claim in British Columbia, obtained by me last spring. It is simply an ordinary specimen of that class of documents in that Province.

#### MINING CLAIM—HAPPY FIND.

"Kootenay, near Illecillewaet, July 5th, 1886. Recorded in favour of D. W. Corbin, No. 25492, and J. P. Kennedy, No. 25493, and C. W. Wood, No. 24623, one mineral claim of 1,500 feet long, by 600 feet wide on a ledge, lode or mineral deposit. First stake commencing up the north fork of the Illecillewaet River about twelve miles from its fork on the west side of a gulch running in an easterly direction, 1,500 feet to third stake situate on the face of a bald mountain to be called the Happy Find claim, said claim has been duly staked and notices posted up according to Mineral Act, 1884, and the amendments of 1886, and recorded subject to clause 23 of Mineral Act, 1884."

Those unfamiliar with mining claims will probably feel inclined to smile at this description, which act would certainly be pardonable. The definiteness of the description shows most decidedly that the land in question is possibly not in Africa, but in mitigation it may be stated

that mining is nearly always done in a very rough, rocky and mountainous country where it is impossible to parcel out the land beforehand checker-board style.

Surveys are only necessitated through the discovery of minerals, and the above description is only intended to hold until a patent is to be issued when a surveyor is despatched to locate and define the lands.

In the above description, however, I think it would have been well if it had been stated on which side of the river the gulch is on, and save trouble in finding the bald mountain. Furthermore, one would naturally infer that a gulch "running in an easterly direction" would have one of its sides designated by north or south instead of west.

#### DISCUSSION.

The Chairman—I was very much interested in the paper. It is a very important matter and one which should receive every consideration from practitioners.

Prof. Galbraith—I listened with great pleasure to Mr. Klotz's paper. Although it is some years now since I have had to practise, I have not lost interest in such matters. It seems to me he has brought out the use of the words "more or less" very clearly. It is in the experience of every surveyor who has had to work much by descriptions that he finds what Mr. Klotz says to be true; the words "more or less" are used without any rule at all. It occurred to me that an endeavour should be made to reduce the use of these words to some rule. The principle governing them has been clearly stated by Mr. Klotz, but the practice has been very irregular. The terms "more or less" used in the measurements are only intended as a descriptive measurement. I think, whether measurement be the lineal or angular measurement, both methods of measuring should be used. As far as the surveyor is concerned, if the the description is properly made the "more or less" is of no value, such measurements from the description show the intention. There is this trouble, that it is at present difficult to say whether the words "more or less" in descriptions are explanatory or absolute. If one left out the words "more or less" altogether the description would be more intelligible. The absolute description in most cases is just as clear to the layman as to the surveyor. I think where practice shows defects it is just as well to alter it.

Mr. Stewart—I want to ask a question: Where the magnetic bearings are given in deeds years ago, are you going to hunt these up? Very frequently we say so many chains "to a post." Are you to hunt up that post, or are you to disregard it? I think it is better without a post.

Mr. Gaviller—When you have a distance given to a post, if you cannot find that post you take the distance to the post "more or less." If you find the post you take the distance in the description.

Mr. Gibson—Compasses are used more than some surveyors imagine. I look up generally the first deed, and that will very likely



give me the first survey. You get the old line from the original survey and get your compass fixed from published reports of the Magnetic Observatory. I put down the magnetic bearings and the date. When you measure along the north side of a lot your course is fixed. I find the magnetic courses are the best run by transit. If the point can be found, it governs; if not, then the distance governs. I simply put in the distance to a limit. I do not say anything about more or less. We can put in the course and distance in the deed. I think also you should put the bearings in your sketch. My practice is: I take the bearings of the governing line of the property, then run the line with a transit, and all my calculations are made from that. That is recommended by the Land Titles Act. My practice is to put the magnetic course, and put in also the patent course and say what they are.

Mr. Abrey—I may say, in reference to lawyers, that they will not put this “more or less” in if they can help it. I always put in “more or less” and fight it out with them. I find it awkward to use the magnetic bearings, true bearings and patent bearings all on one piece of land; they do not always agree.

Mr. Chipman—The main point is to try and reduce the drawing up of descriptions to a scientific basis. It is very senseless for men of intelligence to use the words “more or less” so generally in descriptions. Mr. Klotz’s method of describing property and taking bearings is the proper way. One point this Association should protest against is the servility of our profession to the legal profession. I think it is a disgrace to allow them to interfere in matters in which we should be authorities. I do not believe in a lawyer or Judge or anyone else interfering with me about a description. We should draw the descriptions as scientifically as we can and stick to them.

Mr. Sankey—I agree that we should not be dictated to by the lawyers about our descriptions. I find that here the lawyers tell you they want a plan. You ask for the original survey, and say you will have to go to the registry office for it. The lawyer will say, “Oh, never mind the original plan; just go on to the ground and make the plan.” When you bring the description to the lawyer he says, “I could have done just as well myself; you have no bearings on it,” and “You have ‘more or less.’ I can write a description well enough myself, but I do not understand about these bearings.” (Laughter.)

The Chairman—I would suggest that this be taken up by the Land Surveying Committee and attended to next session.

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

## RIGHT OF WAY SURVEYS.

By H. J. BROWNE, P.L.S.

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I SEE by the programme that this subject has assumed unusual importance, and that four papers are to be read upon it, so I trust, that amongst us it will receive full elucidation.

What is commonly known as a "Right of Way Survey" is in connection with railway work, but the same sort of survey is occasionally made for the purpose of obtaining the definite position of an ordinary road, but I believe the former is that upon which I am asked to write. The field work is not of a deep scientific character, but certainly requires good judgment and some experience in such work, especially in cities and villages. The object of the survey is to find the quantity of land taken from each owner, and, in order to obtain this, the surveyor must be given the ordinary width required, with all extra widths and the stations between which these are to be taken, of course in starting the position of the located line should be fixed from some well-known point, and, at least, at the commencement and end of every tangent afterwards, and, if necessary, for the purpose of drawing descriptions at intermediate points on both tangents and curves; it is not always necessary to chain the line as the stations may fairly be assumed to be correct, and I have always found them to be the regulation 100 feet apart, but care must be taken that no broken stations, as they are called, are passed over as being of the ordinary length. These broken stations are most commonly found at the commencement or end of a curve and are generally caused by a change of line having been made which has either lengthened or shortened the first line, and, instead of re-numbering all the stakes upon the line, the overplus or deficiency is all put into the distance between the last station on the new line and the nearest station on the old line.

In township lots should there be any doubt about the position of the fences, I have, if possible, got the two adjoining owners to agree upon a division line, for right of way purposes, this, of course, does not deprive them of the luxury of a lawsuit, if so inclined, over the remainder of the line, and I expect we all know what a pleasure it is to some people to have some cause, no matter how slight, to enable them to commence a lawsuit. When the division line is obtained, the customary way is to measure the plus or minus to the nearest station, the angles at which these lines cross the located line will then be taken; this, of course, is not necessary at each division line; the greatest care is requisite in small town lots, especially where they

are not enclosed, and, as is often the case, a large irregular subdivision or town plot is crossed diagonally by the railway, with only here and there an original post to be found; these are some of the difficulties the surveyor has to encounter in the field work, and it is in these and similar cases that good judgment will be required, but I would strongly advise any novice in such work, to examine carefully a plan of right of way, before commencing his survey, for, in my own case, a previous knowledge of these plans enabled me to make the survey much more expeditiously.

The plan should show the numbers or other designations of town or township lots—the concessions, owners, with the area of each parcel to be taken, with the length along the located line of such parcel, the ordinary width need not be separated at each line, but all extra widths should be given at each end; of course the bearings of tangents and the radii of curves should be given.

In a short paper it is difficult to describe all the minutiae of the field work and plan, but if, in the foregoing explanations of right of way work, I have drawn attention to the principal points, both in the field and plan, my object will be attained.

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By JOHN DAVIS, P.L.S.

A RAILWAY right of way survey has for its object the determining of the position of the lands required for railway purposes, with reference to certain fixed points, the determination of their areas, and such general information as shall facilitate their transfer from the owners to the railway company, and their re-location if necessary. Such information so gained is embodied in a plan, known as the right of way plan, and it is accompanied by a table of particulars, known as the book of reference.

Before referring to the survey proper it may be well to briefly outline the manner of defining the centre line, as finally located by the party on location.

Such centre line is marked out on the ground by a single row of stakes, numbered consecutively from zero, and usually placed one hundred feet apart. In some cases, especially on sharp curves, they may be placed at a less distance apart, thus facilitating very much the labours of the right of way surveyor when such curves intersect lot lines. Hubs driven in the ground with a tack to mark the centre line are placed at the beginning and end of curves, and also at the intersection of the tangents, unless in cases where running to intersection has been found impracticable, or has been omitted for other reasons. Hubs are also placed at other points along the line where a change of position was necessary on the part of the transitman. Wherever a hub occurs, be it at the beginning or end of curves, or at other points on the line, a stake standing near shows the chainage, the extra number of feet over the chainage marked on the preceding station stake being indicated as plus.

As the location party proceeds in thus marking out the centre line, a record is kept of all angles taken, all data regarding curvature, tangent distances, etc., together with the chainage on the centre line, where it intersects lot lines that can be readily seen by the party as they pass along, and also giving distances to the nearest lot angles. From the information so recorded in the field books a plan is prepared, and where possible lot lines are accurately laid down thereon. It is seldom, however, that this plan can be prepared with any degree of accuracy, as in the hurry of location time is not taken to make the necessary inquiries regarding lot lines and angles, and accurately fix all intersections. A copy of this plan, however, gives the party making the right of way survey a pretty general idea of what is required, as all lands required for the purposes of construction and operation of the railway will have been indicated thereon, so far as then known, with the widths given as extending a certain distance from the centre line, measured at right angles therefrom.

It now remains for the right of way surveyor to carefully ascertain the exact position of such centre line, noting the chainage on the centre line where it intersects lot lines, and also the angle of intersection of such lot lines and tangents.

We will suppose him to be in possession of all information that may be obtained from the engineer's office pertaining to the location of the centre line and boundaries of lands required. He should, of course, thoroughly acquaint himself with the system of survey under which the lots were originally laid out, and have copies of all necessary plans. In the case of town property these plans will be indispensable, as in many instances monuments cannot be found, and whole blocks will often have to be re-surveyed to re-locate a corner of a lot from which a measurement will be required to the centre line, or the boundary of the lands required, as the case may be.

The true dimensions should be given of all town lots through which the line passes, and measurements made along the lot lines intersected by the centre line, such measurements to be from the angles of the lots to the boundaries of the lands required, and also measurements from such boundaries to the centre line along the same lot lines.

In cases where small portions of lots remain outside the limits of lands actually required, it will be well to ascertain their area and all other necessary particulars to facilitate their transfer, as in many cases such lands, though not needed for railway purposes, can be bought to advantage by the railway company, the owners holding that such remnants, if isolated, would be valueless to them.

The angles formed by the intersection of the centre line with street or lot lines should be carefully measured where such lines are crossed by tangents, and where crossed by curves such street or lot lines should be referred to the tangents to ensure accuracy in plotting. To obtain the distance of the centre line from lot angles, where the lot line is thus crossed by a curve, due attention must be paid to the correct ordinate for that part of the curve the chord of which extends between the nearest station stakes, one being on each side of the lot line.

The chainage on the centre line where it intersects the street or lot lines must be ascertained by measuring from the preceding station stake, and entered as the number on such stake, plus the distance so measured.

In cases where whole lots are included in the right of way, the actual measurements of the boundaries should be ascertained, and the correct area calculated, regardless of any areas or measurements given on registered plans of the property, as in many cases such areas and measurements as given will be found incorrect, and will involve dispute and difficulty where lands are purchased at a certain rate per acre.

Great care should be exercised in dealing with lands owned by different parties, that boundaries legally established through lapse of time be not interfered with, and that such owner is duly credited with any lands affected, legally held by him. The writer has in view a case where the centre line of a railway was laid out parallel to the division line between the east and west halves of a certain lot, and at the distance of thirty-three feet therefrom. It was afterwards found that the fence, as built by the owners a great many years before, was not on the true line, and was less than thirty-three feet in many places from the centre line. It transpired that the owner of the land beyond the fence had to be settled with at considerable expense, and the conveyance to the other owner had to be altered to meet the altered circumstances.

The manner of conducting a right of way survey in the country, where the line passes through township lots, is very similar to that applying to town lots, described above; and very little further need be said as to the work to be performed or the methods employed. All intersections, however, are to be carefully noted, and the distances from the lot angles along the lot lines to the centre line carefully ascertained.

We have seen that in the case of town property measurements are made from the lot angles to the boundaries of the lands required, but in the country we may omit such measurements to the boundaries, and confine ourselves to defining the position of the centre line alone, from the fact that the boundaries can be referred to as being at a certain distance from such centre line; all measurements as to width being made at right angles to it. This will obviate the necessity of determining the distance by calculation or otherwise along the lot lines from the centre line to the limit of the lands required in cases where the centre line crosses lot lines obliquely. Cases will arise where lot lines cannot be readily found, either from the fact that they have not been run or all traces of them lost, and to re-run such lines from the concession line to their intersection with the centre line, through perhaps rough and wooded districts, would involve the expenditure of much time and money. This difficulty can often be effectually met by running a line parallel to such line at some place where it can be readily run—say through a neighbouring clearing—noting the distance along the concession line from the lot angle to where such line leaves the concession line, and referring the line back

by measurement, thus obtaining the true point of intersection with the railway line.

#### THE RIGHT OF WAY PLAN.

Having obtained all needful information in the field for accurately laying down the line on paper, thus preparing a permanent record, the surveyor will now proceed to the preparation of the right of way plan, and its accompanying document, the book of reference.

Little need be said with reference to the preparation of this plan. It is a simple record of the field operations. The paper should be of good quality, and if mounted on cloth all the better, as right of way plans are subjected to much handling. The scale should be large enough to permit of all distances and other information being clearly set forth. The centre line should be in a separate colour, well defined and distinct, and the bearings of all tangents and lot lines given, also the degree of curvature of all curves, with the chainage on the centre line where such curves begin and end and where lot lines are intersected, the distance of the centre line or boundaries, as the case may be, from the angles of the lots, the areas of lands required, and any other information that would assist in clearly expressing the meaning intended. The lands required should be tinted with some lasting and distinct colour.

#### THE BOOK OF REFERENCE.

As is set forth in the Railway Act, the book of reference should contain a general description of the lands required, the names of the owners or occupants thereof as far as they can be ascertained, and everything necessary for the right understanding of the map or plan. It may be prepared by ruling a sheet of paper into vertical columns, with headings as follows: No. of deed, Name of owner or occupant, Description of lands required, Lot No., Concession No., Township, County, Acreage of land required, with a concluding column for Remarks. In giving the names of owners care should be taken to ascertain the correct names, for in the event of an omission or error in entering a name special and troublesome means have to be employed to have the correction made if the plans have been filed. A very apparently insignificant error is often sufficient to set aside legal proceedings for getting possession of lands required, and give rise to vexatious delays. Hence the necessity of extreme care being taken and close attention given to all matters connected with the work.

In this paper I have endeavoured to confine my remarks to the mere method of carrying on the work, so far as such was possible, and for all particulars as to statutory requirements would respectfully refer the surveyor to the Railway Act, such requirements being more fully set forth therein than is possible within the limits of a brief paper on this important subject.

By H. D. ELLIS, P.L.S.

[*Extract from Dominion Railway Act.*]

“SECTION 123 of the Dominion Railway Act provides that surveys and levels shall be taken, and maps and profiles made, of the course and direction of the railway, showing the lands intended to be passed over and taken as far as then ascertained, and that a book of reference shall be made which shall set forth a general description of the lands.

“The names of the owners and occupiers thereof as far as they can be ascertained, and everything necessary for the right understanding of such map or profile.

“Section 124 states that these plans and profiles may be made in sections and are to be deposited in the Department of Railways and Canals.

“The same Act further states that these plans, profiles, and reference books are to be examined and certified by the Minister or his Deputy, and that duplicates shall be deposited in the Department of Railways and Canals, and copies of such parts as relate to each district or county through which the railway passes shall be deposited in the office of the Registrar for such counties or districts.

“Section 135 provides that the scale and paper may from time to time be designated by the Minister, and that the plans, profiles and reference books are to be certified by the President or Engineer of the Company.”

#### SURVEYS—PARTY.

In making the surveys for these plans, after the preliminary surveys for the railway are completed, it is usual to send out a party in charge of an Engineer consisting of a transitman, leveller, and sometimes a topographer, with, of course, the necessary assistance in the form of chainers and axemen, varied as far as numbers are concerned as the country is wooded or cleared.

You are probably all more or less familiar with the duties of the different members of the party, and it is sufficient for me to say that they place stakes every 100 feet, and locate the position of the “centre line,” in accordance with previous instructions given by the Chief Engineer, and make such local changes as the nature of the country may require.

#### DUTIES OF A P.L.S. ON PARTY.

Generally a Provincial Land Surveyor is employed in addition to those already mentioned, and it is with his duties that we are more immediately concerned. He has to trace up the lot lines, ascertain the correct position of the located centre line upon the various lots, after the line has been staked out by the Engineers, and find out to whom the different properties belong, which are cut by the projected line of railway, also make sufficient notes to compile the plans and books of reference.

In doing this work the surveyor should make very full and copious field-notes, especially where the lots are broken into small subdivisions, or the land held by different owners, in order to be able to calculate the exact area taken from each owner.

#### CHAINAGE.

The chainage where the "centre line" crosses every fence, or lot line should be carefully taken by the surveyor, and he can check his work at night with the notes taken by the Engineer's chainers, who should be instructed to note these points when they can do so without delaying their work.

All changes in the direction of the centre line should be noted and the magnetic bearing of each tangent taken as a rough check on the transitman, who, like all of us, is occasionally liable to error. If, however, the curves are being run in on the ground, and the tangents run to their intersections, this is unnecessary; as he then checks his own angles in a more certain way than can be done by any compass.

The bearings or angles at which each road allowance or public highway, as well as lot lines, cross the "centre line," should be taken, and measurements made along them to posts or well defined boundaries as frequently as possible.

In burnt and wild lands it is often a very difficult matter to find the posts or boundaries as they are sometimes entirely obliterated, and where the owners are non-resident and no fences to be found, the surveyor must govern himself to the best of his abilities under the circumstances. I can fully sympathise with any one who has tramped on a hot day over a rocky and burnt country, trying to follow the traces of an old line, perhaps for several miles, and then to find no clue wherewith to get a starting point for his measurements, then to have to walk back, and probably with the same result, on the other side of the "centre line."

#### BUSH AND CLEARED LAND.

It is often useful to note the chainage at those points where the line enters and leaves bush or cleared land, and also whether the stumps are still standing, and if the land is under cultivation. Occasionally a different price is paid by railway companies for cleared and bush lands, and if not measured on the location survey, it would be difficult to determine the relative arrears and the different amounts to be paid for each class, without going on the ground a second time. This takes very little extra time, and often saves the delay and expense of a re-measurement.

A rough pencil plan is usually platted every evening on cartridge paper by the transit man, and the right of way man should make memoranda of any omissions which may have occurred in the previous work and supply them during the following day when practicable.

#### FIELD NOTES.

Whilst on this subject, let me impress upon those who may be called upon to make surveys of this kind for the first time, the advantages of



taking notes of everything they can find time to whilst they are in the field.

Additional measurements to barns, dwellings and buildings of all kind in proximity to the "centre line" are sure to come in useful, if not for the actual right of way, perhaps in reference to the location of the centre line, which is always subject to revision until constructed. I have never yet found I had made too many notes, whilst very often I have wished additional ones had been made, and many things which seemed of little importance at the time have afterwards become important factors, owing, perhaps, to some slight changes of the original location.

#### DISTRICT MAPS.

A pocket-map on a conveniently small scale, say 2,000 feet to the inch with the approximate position of the line laid down on it, will be found of great service while searching for boundaries and save many a useless walk. Government maps of each township should be taken as a matter of course.

In order to obtain the names of non-resident owners, and often to get the correct names of the various holders of property along the line of railway, a visit to the assessor is usually needful, and from this official the surveyor will generally get much useful information about local peculiarities in the surveys of the municipality. I do not mean by this to take him as an absolute authority, but only that one can often get hints and suggestions which give him some idea where to search for more accurate information.

Where another railroad crosses the line of location it is necessary to make a survey of it for at least a mile on each side of the crossing point. The angle of crossing should be accurately taken because, if on the level, plans for the diamond have to be made.

#### PLANS FOR REGISTRATION.

After the completion of the survey plans for filing and registration have to be prepared, and it is more especially in this particular that the hand of the novice is recognized.

The Act states that plans and profiles are to be made, but to my mind it does not state very definitely what particulars should be placed on them.

The Minister of Railways and Canals usually requires that certain information shall be embodied in every map or plan made for filing. With the profiles we have nothing to do, they are prepared by the leveller.

For the assistance of those not familiar with Right of Way work I may here say that every map or plan of right of way should contain the following information, and as it is desirable that a certain amount of uniformity should be followed in this respect, I will give what has been my own practice, and with few exceptions, the system adopted by others with whom I have been associated.

## OWNERS' NAMES—BEARINGS.

The names of the owners of each separate parcel of land should be shown in black. The bearings of all tangents should be in blue, and should be calculated from a fixed bearing by the intersection angles which are measured by the transitman. This will not give the true bearing either magnetically or astronomically, but it will give the correct angles at which the tangents cut one another and from which the curves are calculated and run. A good plan is to take an astronomical bearing at each end of the work and magnetic ones in between. These help to locate any mistake which may occur in the transitman's angles if he has been running in his curves without carrying his tangents out to their intersection points.

## CHAINAGE.

The chainage of the located line should be in red and should be placed on every lot line; also on either side of road allowances and travelled roads.

## CURVES.

The beginning and end of every curve should be marked on the plan, thus, B.C. 560 + 49 E.C. 569 + 60. The radius and degree of curvature (it is better to put on both) should be marked in red inside each curve, and if it is a compound one, the point of change should be marked P.C.C. and the chainage given at that place.

All breaks in the chainage of the "centre line" should be shown on the plan giving both chainages thus  $760 + 10\frac{1}{2} = 2,070 + 59\frac{3}{4}$ .

## DISTANCES.

The distance across each lot measured on the "located centre line" should be given in addition to the chainage, and should be in red.

## WIDTH OF RIGHT OF WAY.

The distances from the located line to the corners of lots should be in black; this prevents them being mistaken for the width of the right of way which is usually shown in red. This width is defined by Section 103 of the Dominion Railway Act as not to exceed 33 yards in breadth excepting in places where the railway is raised more than five feet higher, or cut more than five feet lower than the surface of the line, or where offsetts are established and then additional widths may be taken as right of way. Where stations or depots are intended to be established 650 yards by 100 yards in breadth is allowed or more if the Minister will sanction it, which you perceive gives the Railway Company a good deal of latitude.

## EXTRA WIDTHS.

The fact of these extra widths not being accurately shown on the original plan will not however prevent the Company obtaining them

ultimately ; but additional plans and books of reference of the extra land required will have to be made. These have to be filed in the same manner as those of the located line, so that it is preferable, when possible to place them on the original plan of the location.

#### CENTRE LINE.

Where it is intended to lay double tracks it is usual to place the first track with its rails equally distant from the "located centre line" and then the distances from the "centre line" to the boundaries of the right of way will be 43 feet on the one side and 56 feet on the other ; that is for tracks with 13 feet centres. Where it is only intended to build a single track it is customary to place it in the centre of the right of way, the rails being laid equally distant on each side of the "located centre line." In making subsequent surveys it is therefore very necessary to ascertain which track was originally laid in order to know the position of the "centre line" as originally laid down, and I have known a good deal of trouble and annoyance caused by surveyors assuming that the "centre line" of a railway means a line half way between its tracks or in the centre of the right of way.

#### ACREAGE.

The acreage taken from each owner for right of way purposes should be shown on every parcel owned by that person in red and the areas of all extra lands taken for station grounds, borrow-pits, sidings or road diversions should also be shown on the plan in red, and independently of the right of way areas. This is often neglected and causes a good deal of extra work if the land is not taken which is sometimes the case because it is not compulsory on a Railway Company to purchase all lands shown on their original plan. Sometimes extra widths are shown which are disallowed by the Minister at Ottawa, and often when the line is being built some extra widths are found unnecessary and therefore not bought. In cases of this kind the extra area has only to be struck out, but if it has been included with the area of the right of way the amount has to be recalculated.

#### COLOURS.

The lot lines and numbering of lots should all be in black, and the various townships and concessions should be clearly indicated.

It is usual to colour all lands intended for the use of the Railway Company in red, and to show the centre line in red.

The general rule is to show the centre lines of all projected railways in red, and all those constructed in blue.

Where the centre line crosses another railway the foreign road should be shown on the plan together with its right of way for at least a mile on each side of the location and the angle of crossing should be stated on the plan.

## RIGHT OF WAY LIMITS.

The right of way boundaries are usually outlined in red, excepting where the boundaries happen to coincide with lot lines, in which cases they are in black.

## MILEAGE.

The Mileage is sometimes placed on these plans, chiefly for reference in the office.

## TITLE.

The Title should embody the name of the Railway and the Townships and County through which the road runs.

## SIZE.

The plan should not embrace more than one Registration district for convenience in filing, and all plans should be in triplicate. These when completed and signed by the Chief Engineer are sent to the Minister at Ottawa, and after being examined and certified by him one plan is deposited in the Department, one is filed in the Registry Office for the Municipality through which it is intended to build the road, and the third is kept for use in the Chief Engineer's office.

## SCALE.

The scale for plans through farm lands is usually 400 feet to the inch, and in towns and cities from 50 to 200 feet to the inch according to the sizes of the lots to be shown, but the Minister at any time may give instructions to have the plans drawn to any scale to suit his ideas.

## REFERENCE BOOKS.

Reference Books are easily compiled and are generally on printed forms, with blank spaces left for the name of the County and Township. They are divided into columns, in which the following particulars should be entered. Names of land owners—names of persons occupying or renting the property. The numbers of lots and concessions, and the different areas.

A column is usually left for such remarks as may be necessary to indicate for what purpose additional lands have been taken.

These books should be made in triplicate and signed and filed in the same manner and at the same time as the right of way plans.

## ARBITRATIONS.

There is another duty of the right of way surveyor, and a very important one which I will briefly touch upon here, viz.: preparing plans and descriptions in reference to lands upon which the Railway Company and the owners cannot agree as to price.

After the expiration of ten days from the deposit of the plan and book of reference in the Registrar's office for the municipality in

which the land is situated, and after notice has been given by advertisement in newspapers published in the county through which the railway runs, application may be made to the owners of lands and agreements may be entered into with them, in reference to the amounts to be paid for their properties and any damages sustained.

Should the Company and owners be unable to agree the Act provides that the amount may be settled by arbitration.

Before coming to this however certain formalities have to be gone through.

A notice has to be served upon the party by the Company containing a description of the lands to be taken or of the use intended to be made of them.

A declaration of readiness to pay a certain sum or rent as compensation, and the name of some person to be appointed as arbitrator.

Accompanying this should be a certificate signed by a P.L.S., or by an Engineer; that the land is required for the railway, or is within the limits of deviation allowed by the Act.

That he knows the land, or the amount of damage likely to arise from its use, and that the sum so offered is sufficient and fair compensation for the land and damages.

Under the head of "description of lands taken" a description by metes and bounds accompanied by a sketch showing the lands in question, coloured pink is attached to the notice. These are prepared by the engineer or surveyor who signs the certificate.

After this is done without the surveyor is called as a witness in the arbitration the matter passes into the hands of the Company's solicitors, and its ultimate fate depends entirely on which side can produce the best witnesses.

#### REMARKS.

Before closing I wish to draw your attention to the Dominion Railway Act which does not require, even in cases of arbitration (Sec. 147), the plans to be signed by a Provincial Land Surveyor, but only by the Engineer or President of the Company, neither of whom can possibly be in a position to state whether the lot lines are shown in their correct places. I think this to be a mistake and that the correctness of the plans as far as the lot lines are concerned should be certified by the P.L.S. I regret however to say I have seen specimens of right of way plans signed by surveyors, which were greatly inferior to many made by men who were not, chiefly because they were defective in the information given. Engineers generally make it their business to be thoroughly posted in all requirements of the Railway Act, whilst many surveyors seem to think that the Survey Act and possibly the Drainage and Municipal Acts embody all that is necessary for them to read. Surveyors have allowed legislation to be passed on this subject without making sufficient protest, and if we do not assert our rights no one is likely to stand up in our behalf. I think a change respecting the law in this particular might be obtained without very much opposition, and I suggest that the Committee on Legislation be empowered to take up the matter.

The C.P.R. and G.T.R. I believe usually employ surveyors, when locating new lines, to make the right of way surveys, and the G.T.R. keep surveyors among their permanent staff to attend to all questions of survey distinct from engineering work. A Railway Company can save a great deal of time and money by having its real estate attended to in this manner. Extra lands purchased when a new line is built are apt to be lost sight of after the railway is in running order and in the hands of the permanent staff. Every road should keep a surveyor, whose special business should be to define, and keep defined their proper boundaries, and to keep all field notes relating to the right of way entered up and in such order that they can readily be found when required. Engineers on construction occasionally omit to fence in all the property purchased by the Railway Company; this is the case more especially when corners of lots are purchased, as those who have charge of this work are seldom surveyors, and of course are often at a loss to know how to stake out the property according to the descriptions in the deeds, and in accordance with the Survey Act.

There is another point I should like to hear discussed at this meeting and that is as to the degree of accuracy a surveyor should attain in right of way surveys across farm lands. Of course we ought to be absolutely correct when it is possible, but I do not believe that the Act intends that the Railway Company should run out the lines between every farm lot. The existing fences, if any, I think should be taken and accepted unless the owner of the land disputes their position, in which case, he may be fairly called upon to define his own property, and then the right of way surveyor can make his measurements for the Railway Company. It would be impossible to run out even half the doubtful boundaries, over say 100 miles of country, without entailing an enormous and unnecessary expenditure on the part of the Railway Company, and taking a useless amount of time and trouble; with the probability of having the majority of your surveys disputed by the owners who are always dissatisfied.

In cities and towns where land is much more valuable and is generally more correctly defined, the course of a railway across the various properties should be ascertained with the greatest exactness, and the more carefully the first surveys and plans are made the easier it will be to make changes and alterations in the alignment, should they be found necessary, when the road is in course of construction.

In the foregoing paper I have confined my remarks entirely to surveys made for railways acting under Dominion Charters. I did this to avoid occupying too much of your time in going over ground a second time, as I saw by the programme that there were to be other papers on right of way surveys, and I thought they would in all probability make an attack upon the Ontario Act.

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

## TIMBER EXPLORING.

By W. R. AYLSWORTH, P.L.S.

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THE best time is when there is good snow-shoeing the latter part of winter or early spring.

When the limit is small and not very far from a settlement one good man at least should always accompany the examiner, but when the limit is large and remote from civilization such equipment as will enable the examiner to keep himself fairly comfortable must be provided and such a number of assistants as will be sufficient to keep the camp and equipment in places required.

No examiner should travel alone in any large woods for even one day and much less for weeks and months. Life is too precious to be thrown away by any trifling accident that might prevent the examiner from travelling unless helped.

The examiner should have proper food and a place to rest comfortably at night, or his mind and report will likely be tinged with the blues.

A good square cotton tent that will close tightly for the winter with a sheet iron stove eighteen inches square and two and one-fourth feet long, small stove pipes that will all pack in the stove with one elbow so as to run the pipe out of the gable of the tent to prevent sparks falling on and burning the tent. Blankets and cooking utensils, one large and one small axe and a coarse whetstone will constitute a serviceable outfit.

If the boundaries of the limit are defined be sure you find the right ones; but if no boundaries are run you must fix them some way either by blazed lines or broken twigs, snow-shoe tracks or otherwise so that they will not readily be crossed without being seen. Having the outside boundaries marked, then if the limit is not divided into thousand acre blocks or other convenient sections by natural boundaries, such as lakes, creeks or mountains, it should be divided by lines into describable portions.

Travel one section or portion until familiar with the timber on it, select an acre, or part of an acre, that is an average of the whole section; count, measure and estimate the quantity on this average piece and multiply this quantity by the number of times this piece

must be taken to equal the whole section or part and then repeat this for each section or portion. If the limit is small and the timber large and valuable, count and measure each tree thereon.

The foregoing will give proper results when the timber is sound, but when the trees are unsound—that is, affected by punk, black knots, shake or other defects,—the estimate will be right or wrong according to the experience, skill and judgment of the examiner.

#### DISCUSSION.

The Chairman—That is a very short practicable paper ; so far as my knowledge goes he has hit the nail directly on the head. If these suggestions are carried out I have no doubt it is one of the most practicable methods of getting at a timber limit.



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

## AWARDS UNDER DITCHES AND WATER COURSES ACT, 1883.

By LEWIS BOLTON, P.L.S.

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THIS subject will no doubt be interesting to a great many of you, but I do not consider myself capable of writing a paper on this subject or any other worthy of being read before this Association. When I was called upon in 1883, the year in which this Act was passed, having had but little experience in draining before, I took as little time as I could in making the survey of locating the drain, as I knew farmers were very much afraid of expense and would make considerable talk and create more or less unpleasantness at least. I placed in stakes 100 feet apart, commencing at the point where the party who gave me the requisition desired an outlet, I took the levels from which I made a profile to accompany the award. I took no bearings of the lines, nor did I locate the starting point. The first appeal I had. When the matter came before the judge he asked me where my plan was to show the location of the drain. I said that I had not prepared one, that I had made the survey of the drain spending as little time as possible in order to keep down the expense, as the general complaint was that the costs of the awards were too much. The judge sent me back to make whatever additional work that would be necessary to complete a plan, advising me to take my time and charge enough to pay me well for my time since that time. I have taken my time in making the surveys, but I don't think that I have followed the judge's advice about charging, as it is not very pleasant every time you meet a man on the road to hear him say that your charges in that drain matter were exorbitant, and perhaps using somewhat stronger language. To give you the manner in which I treat a case under this Act, I have copied one of my awards made in A.D. 1887, it being about the first one that I turned to in my book. In this case one, E. Broughton, the owner of lot No. 11, in the 16th concession of Elma, filed his requisition. His farm being a very level one required under-draining, as also did the farms between his and the outlet at that time opened out. At their preliminary meeting they considered it advisable to bring on the Engineer, as they had but little faith in carrying out an agreement amongst themselves. On the day appointed I made the survey in the usual way. I prepared a plan on rough paper in pencil, showing the location of the drain on the lots, giving the owners names, also containing a table giving the distances and bearings of the lines as located for the drain. From this rough plan I copied one on tracing linen, keeping the rough one on file for reference, and the one on tracing linen to accompany the award. Instead of making a profile I made a schedule, showing the depth of drain at each

stake, width of bottom, grade and slope of sides, also specifications and any remarks thereon that I thought necessary to make the matter clear to all parties interested. On the margin of the schedule I marked each man's portion, so that the clerk of the township could easily make out each man's portion without having to read over the award. I keep a large copying book in which I copy, by letter press, all my awards and correspondence, etc., in reference to any drain matter, which I find not only useful to myself, but in case any of the papers while in the possession of the clerks of the township get destroyed, I will be in a position to give certified copies or duplicates which would be of great service to the corporations and remunerating to myself. I have annexed to this paper a copy of the award and plan in the above cited case of Mr. E. Broughton; it is nothing more than a copy. There may be some things in it worthy of comparison with others. I think that an exchange of ideas on any subject interesting to our profession would be beneficial to the Association, and would suggest that each member of the Association be required to furnish something for each meeting.

#### REPORT.

I, Lewis Bolton, the Engineer appointed by the municipality of the township of Elma, in the county of Perth, under the provisions of the Ditches and Water Courses Act, 1883, and amendments thereto, having by the requisition of Edward Broughton, owner of lot number eleven in the sixteenth concession of the township of Elma, filed with the clerk of the said municipality, representing that he required a ditch or drain in said lot, and that it would be necessary to continue the ditch or drain through the following lands:—On lot number ten in the sixteenth concession of the township of Elma, owned by James Blair; on lot number nine in the sixteenth concession of Elma, owned by John Rutherford, and along the allowance for road between concessions fifteen and sixteen in the said township of Elma, owned by the municipality of said township; on lot number nine in the fifteenth concession of Elma, owned by Charles Kreger, David Keeler and Harry Weiben; on lot number eight in the fifteenth concession of Elma, owned by Richard Ross; on lot number seven in the fifteenth concession of Elma, owned by Henry Runnaberg; on lot number six in the fifteenth concession of Elma, owned by Thomas Robbie, and across or along the road allowance, being the side road between lots numbers five and six in the fifteenth concession of Elma, owned by the said municipality, into a ditch already dug under the award of the Engineer for said township—did attend at the time and place named in the said notice, and having examined the locality of said ditch or drain, and heard the parties and their witnesses (if any), find and award as follows:—That lot number eleven in the sixteenth concession of the township of Elma would be benefitted by, and requires a ditch or drain (or the deepening and widening of the present ditch or drain) to enable the proper cultivation or use of the said land, and I find that said ditch or drain will require to be extended across the land of the municipality of the township of Elma, being the road allowance between lots number ten and eleven in the sixteenth

concession of Elma, and across the land of James Blair, being lot number ten in the sixteenth concession of Elma, and across the land of John Rutherford, being lot number nine in the sixteenth concession of Elma, and across the land of the municipality of the township of Elma, being the road allowance between concessions fifteen and sixteen in said township, and across the land of Charles Kreger, being part of lot number nine in the fifteenth concession in the township of Elma, and across the land of David Keeler, being part of lot number nine in the fifteenth concession of Elma, and across the land of Harry Weiben, being part of lot number nine in the fifteenth concession of Elma, and across the land of Richard Ross, being lot number eight in the fifteenth concession of Elma, and across the land of Henry Runnaberg, being lot number seven in the fifteenth concession of Elma, and across the land of Thomas Robbie, being lot number six in the fifteenth concession of Elma, and across the land of the municipality of the township of Elma, being the road allowance between lots numbers five and six in the fifteenth concession of said township, into a ditch or drain already constructed under the award of the Engineer for said municipality. And I award the making of said ditch or drain, or the deepening and widening, as the case may be, as follows:—

Edward Broughton shall commence at stake marked A, situate on the westerly limit of lot number eleven in the sixteenth concession of Elma as shown on the annexed plan, and shall open up and maintain a ditch or drain of the dimensions, etc., set forth on the annexed schedule—N.  $57^{\circ} 30'$  W. (Mag.) twelve feet more or less to the easterly limit of grade for road. Thence northerly along said limit of grade for road one hundred and eighty-eight feet more or less to stake number two; and said portion shall be made and completed within eleven months from date hereof.

That the municipality of the township of Elma shall commence at stake number two as above described, and shall open up and maintain a ditch or drain of the dimensions set forth on the annexed schedule, northerly along the easterly limit of grade for road thirty-six feet; thence N.  $57^{\circ} 30'$  W. (Mag.) fifty-four feet more or less to the easterly limit of lot number ten in the sixteenth concession of Elma, and said portion shall be made and completed within ten and a-half months from date hereof.

That James Blair shall commence at the easterly limit of lot number ten in the sixteenth concession of Elma as above described, and shall open up and maintain a ditch or drain of the dimensions set forth on the annexed schedule, N.  $57^{\circ} 30'$  W. (Mag.) six hundred and fifty-five feet; thence N.  $32^{\circ} 30'$  E. (Mag.) three hundred and forty-nine feet; thence N.  $57^{\circ} 30'$  W. (Mag.) two hundred and forty-six feet; thence N.  $15^{\circ}$  W. (Mag.) five hundred and seventy-two feet more or less to the division line between lots numbers nine and ten in the seventeenth concession of Elma, and said portion shall be made and completed within ten and a-half months from date hereof.

That John Rutherford shall commence at the division line between lots number nine and ten in the sixteenth concession of Elma as above described, and shall open up and maintain a ditch or drain of the dimensions, etc., set forth on the annexed schedule, northerly along

the division line between lots numbers nine and ten in the sixteenth concession of Elma, two hundred and ninety-three feet to the southerly limit of grade for road at station number seven as shown on the annexed plan, and said portion shall be made and completed within ten months from date hereof.

That the municipality of the township of Elma shall commence at station number seven as above described, and shall open up and maintain a ditch or drain of the dimensions set forth on the annexed schedule, westerly along the southerly limit of grade for road one hundred and eighty-one feet; thence N.  $32^{\circ} 30'$  (Mag.) across grade of road forty feet; thence westerly along the northerly limit of grade for road one hundred and sixty feet; thence N.  $18^{\circ}$  E. (Mag.) twenty feet more or less to the southerly limit of lot number nine in the fifteenth concession of Elma, and said portion shall be made and completed within ten months from date hereof.

That Charles Kreger shall commence at the southerly limit of lot number nine in the fifteenth concession of Elma as above described, and shall open up and maintain a ditch or drain of the dimensions set forth on the annexed schedule N.  $18^{\circ}$  E. (Mag.), two hundred feet. Thence N.  $43^{\circ}$  W. (Mag.) six hundred and sixty feet more or less to the easterly limit of the five acres, being part of lot number nine in the fifteenth concession of Elma owned by David Keeler, and shown on the annexed plan, and said portion shall be made and completed within ten months from date hereof.

That David Keeler shall commence at the easterly limit of the five acres as above described, and shall open up and maintain a ditch or drain of the dimensions set forth on the annexed schedule—N.  $43^{\circ}$  W. (Mag.) two hundred and sixty-four feet more or less to the division line between lots numbered eight and nine in the fifteenth concession of Elma. Thence northerly along said division line three hundred and eighty feet more or less to the northerly limit of the said five acres; and said portion shall be made and completed within nine and three-fourths months from date hereof.

That Charles Kreger shall commence at the northerly limit of the said five acres, as above described, and shall open up and maintain a ditch or drain of the dimensions set forth on the annexed schedule northerly along the division line between lots numbers eight and nine in the fifteenth concession of Elma one hundred and ninety-two feet more or less to the north-westerly angle of that portion of lot number nine in the fifteenth concession of Elma owned by the said Charles Kreger, and the said portion shall be made and completed within nine and a-half months from date hereof.

That Henry Weiben shall commence at the north-westerly angle of that portion of lot number nine in the fifteenth concession of Elma owned by Charles Kreger, and shall open up and maintain a ditch or drain of the dimensions, etc., set forth in the annexed Schedule, northerly along the division line between lots numbers eight and nine in the fifteenth concession of Elma one hundred and ninety-five feet more or less to stake No. 48, and said portion shall be made and completed within nine and a-half months from date hereof.

That Richard Ross shall commence at stake No. 48, as above

described, and shall open up and maintain a ditch or drain of the dimensions, etc., set forth on the annexed schedule, northerly along the division line between lots numbers eight and nine as above described one hundred and thirty-six feet. Thence N. 57° 30' W. (Mag.) thirteen hundred and thirty-four feet more or less to the division line between lots numbers seven and eight in the fifteenth concession of Elma, and said portion shall be made and completed within nine and a-half months from date hereof.

That Henry Runnaberg shall commence at the division line between lots numbers seven and eight in the fifteenth concession of Elma as hereinbefore described, and shall open up and maintain a ditch or drain of the dimensions, etc., set forth on the annexed schedule, N. 57° 30' W. (Mag.) thirteen hundred and twenty-five feet more or less to the division line between lots numbers six and seven in the fifteenth concession of Elma, and said portion shall be made and completed within nine months from date hereof.

That Thomas Robbie shall commence at the division line between lots numbers six and seven in the fifteenth concession of Elma, as above described, and shall open up and maintain a ditch or drain of the dimensions, etc., set forth on the annexed schedule, northerly along said division line between lots six and seven four hundred and five feet. Thence N. 57° 30' W. (Mag.) thirteen hundred and twenty feet more or less to the westerly limit of lot number six in the fifteenth concession of Elma, and said portion shall be made and completed within eight and a-half months from date hereof.

That the municipality or the township of Elma shall commence at the westerly limit of lot number six, as above described, and shall open up and maintain a ditch or drain of the dimensions, etc., set forth on the annexed schedule—N. 57° 30' W. (Mag.) twenty feet more or less to the easterly limit of grade for road. Thence southerly along said easterly limit of grade for road seven hundred and eighty-five feet more or less to a certain ditch or drain already opened up under an award of the engineer under the provisions of the Ditches and Watercourses Act, 1883, and amendments thereto, and said portion shall be made and completed within eight months from date hereof.

That my costs attendant upon the examination and making of this award are twenty dollars, and shall be borne and paid as follows, viz. :—

|                        |                |
|------------------------|----------------|
| Edward Broughton ..... | \$3 00         |
| James Blair .....      | 2 00           |
| John Rutherford .....  | 1 00           |
| Charles Kreger .....   | 2 00           |
| David Keeler .....     | 1 00           |
| Henry Weiben .....     | 2 00           |
| Richard Ross .....     | 3 00           |
| H. Runnaberg .....     | 3 00           |
| Thomas Robbie .....    | 3 00           |
| Total .....            | <u>\$20 00</u> |

Dated this 12th day of November, A.D. 1887.

Witness,  
(Sgd.) E. D. BOLTON.

(Sgd.) LEWIS BOLTON,  
*Engineer for Elma.*

## SCHEDULE

To accompany Award affecting Lots Nos. 6, 7, 8, and 9, Concession XV., and Lots Nos. 9, 10, and 11, Concession XVI., Township of Elma.

| —                 | Stakes.          | Depth.    | Width on Bottom. | Grade.                  | Specifications, etc.                                                             |
|-------------------|------------------|-----------|------------------|-------------------------|----------------------------------------------------------------------------------|
| Broughton.....    | A                | 3.00 feet | 1 foot           | 0'.056 per<br>100 feet. | All dirt taken out<br>of drain to be spread.                                     |
|                   | 1                | 2.40 "    | "                |                         |                                                                                  |
| Elma Corporation. | 2                | 2.40 "    | "                | "                       | No dirt, timber, or<br>brush to be left with-<br>in 2½ feet of edge of<br>drain. |
|                   | 3                | 2.70 "    | "                | "                       |                                                                                  |
|                   | 4                | 3.10 "    | "                | "                       |                                                                                  |
|                   | 5                | 3.55 "    | "                | "                       |                                                                                  |
|                   | 6                | 3.15 "    | "                | "                       |                                                                                  |
|                   | 7                | 3.20 "    | "                | "                       |                                                                                  |
|                   | 8                | 2.90 "    | "                | "                       |                                                                                  |
|                   | 9                | 2.45 "    | "                | "                       |                                                                                  |
|                   | 10               | 2.70 "    | "                | "                       |                                                                                  |
|                   | 11               | 2.85 "    | "                | "                       |                                                                                  |
|                   | James Blair .... | 12        | 2.80 " | " |  | " | Slope of sides of drain to be 1 foot to 1 foot. |
| 13                |                  | 2.90 "    | "                | "                       |                                                                                  |
| 14                |                  | 3.15 "    | "                | "                       |                                                                                  |
| 15                |                  | 3.05 "    | "                | "                       |                                                                                  |
| 16                |                  | 3.10 "    | "                | "                       |                                                                                  |
| 17                |                  | 3.10 "    | "                | "                       |                                                                                  |
| 18                |                  | 2.95 "    | "                | "                       |                                                                                  |
| 19                |                  | 2.80 "    | "                | "                       |                                                                                  |
| 20                |                  | 2.95 "    | "                | "                       |                                                                                  |
| 21                |                  | 2.65 "    | "                | "                       |                                                                                  |
| 22                |                  | 2.90 "    | "                | 0'.10 per<br>100 feet.  |                                                                                  |
| 23                |                  | 2.60 "    | "                | "                       |                                                                                  |
| 24                |                  | 2.90 "    | "                | "                       |                                                                                  |
| 25                |                  | 3.05 "    | "                | "                       |                                                                                  |
| 26                |                  | 2.65 "    | "                | "                       |                                                                                  |
| 27                |                  | 3.70 "    | "                | "                       |                                                                                  |
| 28                |                  | 2.80 "    | "                | "                       |                                                                                  |
| Kreger .....      | 29               | 3.95 "    | "                | "                       | All angles of the<br>drain to be turned<br>with a regular curve.                 |
|                   | 30               | 2.80 "    | "                | "                       |                                                                                  |
|                   | 31               | 2.75 "    | "                | "                       |                                                                                  |
|                   | 32               | 2.95 "    | "                | "                       |                                                                                  |
|                   | 33               | 2.75 "    | "                | "                       |                                                                                  |
|                   | 34               | 2.95 "    | "                | "                       |                                                                                  |
|                   | 35               | 2.95 "    | "                | "                       |                                                                                  |
|                   | 36               | 4.00 "    | "                | "                       |                                                                                  |
|                   | 37               | 3.30 "    | "                | 0'.08 per<br>100 feet.  |                                                                                  |
|                   | 38               | 3.50 "    | "                | "                       |                                                                                  |
| Keeler.....       | 39               | 2.80 "    | "                | "                       |                                                                                  |
|                   | 40               | 3.10 "    | "                | "                       |                                                                                  |
|                   | 41               | 2.65 "    | "                | "                       |                                                                                  |
|                   | 42               | 2.75 "    | "                | "                       |                                                                                  |
| Kreger .....      | 43               | 3.10 "    | "                | "                       |                                                                                  |
|                   | 44               | 2.15 "    | "                | "                       |                                                                                  |
|                   | 45               | 2.70 "    | "                | "                       |                                                                                  |
| Weiben.....       | 46               | 3.05 "    | "                | "                       |                                                                                  |
|                   | 47               | 3.35 "    | "                | "                       |                                                                                  |
|                   | 48               | 3.40 "    | "                | "                       |                                                                                  |

SCHEDULE—*Concluded.*

| —                | Stakes. | Depth.    | Width on Bottom. | Grade.              | Specifications, etc.     |
|------------------|---------|-----------|------------------|---------------------|--------------------------|
| Richard Ross ... | 49      | 3.90 feet | 1 foot           | 0'.08 per 100 feet. | (Same as previous page.) |
|                  | 50      | 3.95 "    | "                | "                   |                          |
|                  | 51      | 3.75 "    | "                | "                   |                          |
|                  | 52      | 3.15 "    | "                | "                   |                          |
|                  | 53      | 3.20 "    | "                | "                   |                          |
|                  | 54      | 3.20 "    | "                | "                   |                          |
|                  | 55      | 3.20 "    | "                | "                   |                          |
|                  | 56      | 3.20 "    | "                | "                   |                          |
|                  | 57      | 3.00 "    | "                | "                   |                          |
|                  | 58      | 3.20 "    | "                | "                   |                          |
|                  | 59      | 2.80 "    | "                | "                   |                          |
|                  | 60      | 3.20 "    | "                | "                   |                          |
|                  | 61      | 3.40 "    | "                | "                   |                          |
|                  | 62      | 3.15 "    | "                | "                   |                          |
| Runnaberg .....  | 63      | 3.35 "    | "                | "                   |                          |
|                  | 64      | 2.70 "    | "                | "                   |                          |
|                  | 65      | 3.25 "    | "                | "                   |                          |
|                  | 66      | 2.95 "    | "                | "                   |                          |
|                  | 67      | 2.85 "    | "                | "                   |                          |
|                  | 68      | 2.60 "    | "                | "                   |                          |
|                  | 69      | 3.00 "    | "                | "                   |                          |
|                  | 70      | 2.80 "    | "                | "                   |                          |
|                  | 71      | 2.60 "    | "                | 0'.05 per 100 feet. |                          |
|                  | 72      | 2.60 "    | "                | "                   |                          |
|                  | 73      | 2.35 "    | "                | "                   |                          |
|                  | 74      | 2.25 "    | "                | "                   |                          |
|                  | 75      | 2.95 "    | "                | "                   |                          |
|                  | 76      | 2.35 "    | "                | "                   |                          |
| 77               | 2.20 "  | "         | "                |                     |                          |
| 78               | 2.35 "  | "         | "                |                     |                          |
| 79               | 2.40 "  | "         | "                |                     |                          |
| 80               | 2.65 "  | "         | "                |                     |                          |
| 81               | 2.40 "  | "         | "                |                     |                          |
| 82               | 2.70 "  | "         | "                |                     |                          |
| 83               | 2.80 "  | "         | "                |                     |                          |
| Robbie .....     | 84      | 2.55 "    | "                | "                   |                          |
|                  | 85      | 2.85 "    | "                | "                   |                          |
|                  | 86      | 2.90 "    | "                | "                   |                          |
|                  | 87      | 2.75 "    | "                | "                   |                          |
|                  | 88      | 2.40 "    | "                | "                   |                          |
|                  | 89      | 2.10 "    | "                | "                   |                          |
|                  | 90      | 1.85 "    | "                | "                   |                          |
|                  | 91      | 2.70 "    | "                | "                   |                          |
|                  | 92      | 2.25 "    | "                | "                   |                          |
|                  | 93      | 2.30 "    | "                | "                   |                          |
| Elma Corporat'n. | 94      | 1.55 "    | "                | "                   |                          |
|                  | 95      | 1.40 "    | "                | "                   |                          |
|                  | 96      | 2.654 "   | "                | "                   |                          |
|                  | 97      | No Stake  | "                | "                   |                          |
|                  | 98      | 2.50 feet | "                | "                   |                          |
|                  | 99      | .65 "     | "                | "                   |                          |
|                  | 100     | 1.20 "    | "                | "                   |                          |
| B .....          | 101     | 2.40 "    | "                | "                   |                          |
|                  | 102     | 2.10 "    | "                | "                   |                          |
|                  | 103     | 2.60 "    | "                | "                   |                          |

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## BRANTFORD WATER WORKS.

By T. HARRY JONES, B.A.Sc.

---

THE Grand River takes its rise in the southern part of the County of Grey at the distance of less than thirty miles from the shores of the Georgian Bay. In its meandering course of one hundred and thirty miles to Lake Erie it, with its tributaries, waters the greater portion of the Counties of Wellington, Perth, Waterloo, Oxford, Brant, Wentworth, Haldimand, and Monck, and drains an area of twenty-six hundred square miles.

On this river, about fifty-five miles from its mouth, the City of Brantford is beautifully situated. The surrounding hills, to which the city extends on the north, rise one hundred and fifty feet above the level of the river, and ninety feet above the business and main part of the city.

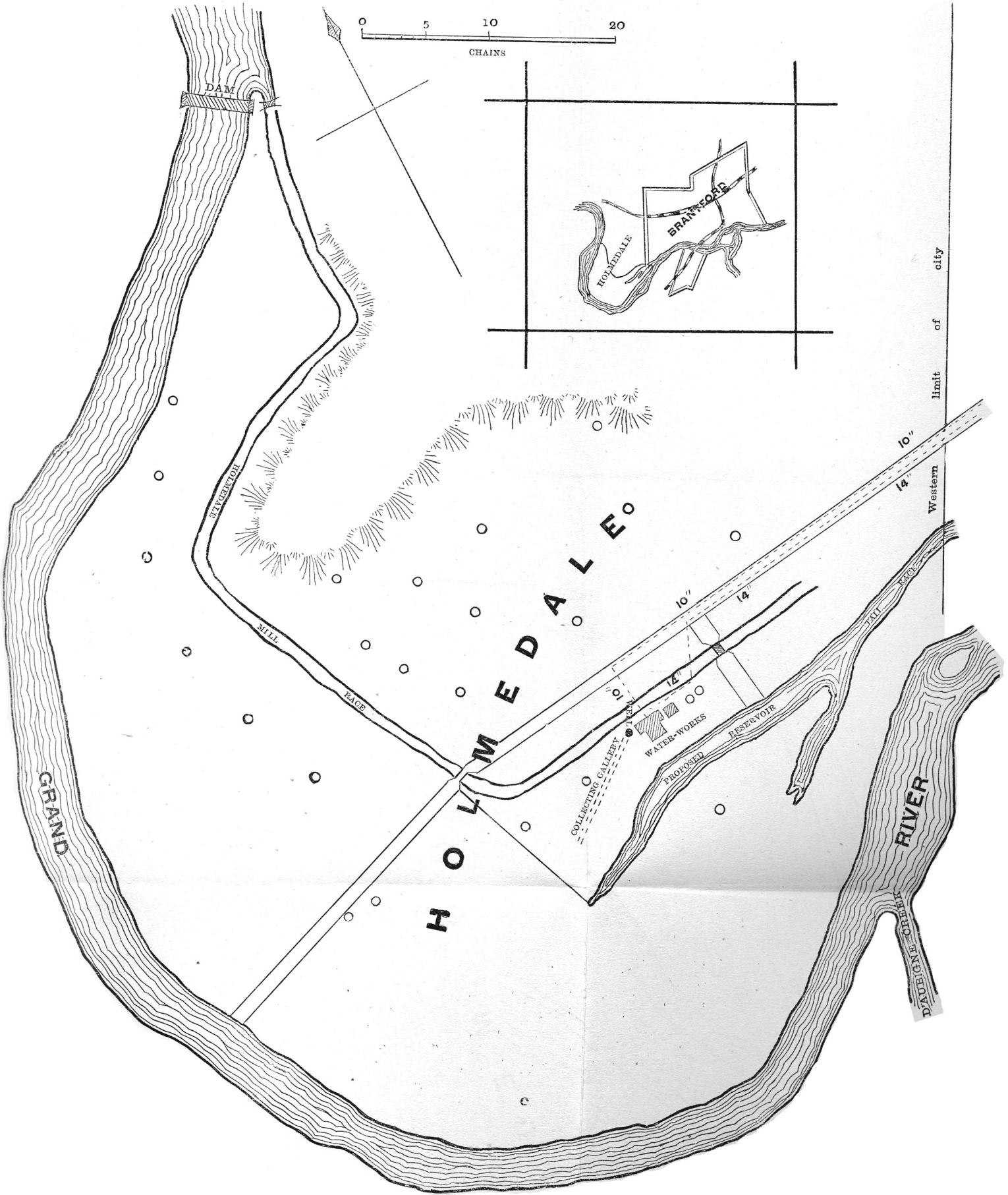
Brantford has a population of about 14,000. It has always ranked among the healthiest cities of the province, and according to the death rate during the past year stands third in this respect.

In the year 1870 the Brantford Water Works Company was formed. The water was forced by direct pressure, the supply being derived from a spring creek, which flows from the hills in the northerly part of the city; but owing to the fact that it drained a large area of the city in its course, the water became very impure before reaching the pumping house, and consequently was not in demand for drinking purposes.

In this system there are about nine miles of mains varying in diameter from four to eight inches. The total cost of the works has been about \$63,000, the city having authorized construction to the value of \$48,000, and having paid for its water supply interest upon this amount, originally at the rate of eight per cent., which latterly has been reduced to six per cent. Last year 72,000,000 gallons were pumped, and water supplied to 150 consumers, who paid \$4,400, the railway companies alone contributing \$1,900 of this amount. The City Council having decided to extend the present works, and obtain a new source of supply, tenders were called for in the fall of 1887. Only two tenders were considered, one from Messrs. Moffatt, Hodgkins & Clark, of Watertown, N. Y., who proposed to take the water from D'Aubigne Creek (see accompanying map), and erect a stand tower on the hill to the north of the city; and the other from the Brantford Water Works Company, who proposed to obtain their supply by means of driven wells to be located in the Holmedale, where the new works are now being built.



# Brantford Water-Works,





The Council of 1887 failing to agree as to the merits of these two systems, the new Council employed John A. Cole, C.E., of Chicago, to decide upon the source and location of the new supply, and prepare plans and specifications for the construction of the new works. Mr. Cole having reported to the Council, tenders were called for in June last, resulting in the Waterous Engine Works Company, Limited, of this city being awarded the contract for the new work, the price being \$106,278. In the event of a by-law providing for the city building the works being defeated, an agreement had been entered into with the Brantford Water Works Company to assume the works, the city paying for their supply five per cent. interest per annum on the full capital invested for the first five years, and four and a-half per cent. for the next five years, with the privilege of buying the works at cost price at the end of the ten years.

The average earnings of the water works in the cities of Ottawa, Kingston, Toronto, Hamilton, Brantford, Stratford, and London, have been about nine and a-half per cent. per annum on the capital invested, and the dividends declared by the Brantford Company for several years past having been ten per cent., a strong public feeling existed that the city should own the works.

Accordingly when the by-law making provision for the city buying the existing works and building the new ones was submitted to the ratepayers it was carried by a large majority.

Twenty acres of land have been purchased for the water works by the city in the Holmedale, to the west of the city limits, it being thought desirable to secure enough to prevent the supply becoming contaminated when the city extends in that direction. The new system of water works as designed by Mr. Cole, may be generally described as consisting of *Water Works Buildings, a Reservoir, a Pump Well, Collecting Gallery, Pumping Machinery, Inlets and Connecting Pipes, and System of Discharge Mains.*

The *main building* is situated 100 feet to the south of the mill race, and 200 feet to the north of the Holmedale Creek, and contains the engine-room, boiler-room and coal room; while a short distance to the east is the engineer's residence—a two-story building. The reservoir is to be formed by constructing a dam across the Tail Race or Holmedale Creek (an inlet of the river) to the south of the buildings, having a capacity of two million gallons. The *Pump Well* is located directly to the west of the engine-room. The walls of brick masonry 18 inches in thickness, laid in cement mortar, excepting the two courses of bricks above the clay, which are laid with openings to admit of the flow of the water into the well. The surface of the ground at the well is 26 feet above city datum (the level of the river below the city), and the inside of the bottom of the well 4 feet above datum, the clay being  $6\frac{1}{2}$  feet above datum. The bottom of the well is of concrete one foot in thickness. A cast iron special, with valve attachment, connects the well with the pipes in the collecting gallery. The *Collecting Gallery*, consisting of two rows of vitrified tile pipe 15 inches in diameter, and having perforations  $\frac{1}{8}$  of an inch in width upon the top and sides of the pipe, laid side by side two feet from

centres in a trench excavated to the surface of the clay for a distance of 750 feet in a south-westerly direction from the pump well. The pipes to be covered with screened gravel for two feet around the sides and above their tops.

The *Pumping Machinery* to consist of one Gaskill Horizontal Compound Pumping Engine, manufactured by the Holly Manufacturing Company of Lockport, New York, and one of Worthington's Compound Condensing Pumping Engines, manufactured by Henry R. Worthington, of New York. Each engine to be capable of pumping 2,000,000 gallons in 24 hours, with a piston speed not exceeding 90 feet per minute, against a water pressure of 60 lbs. per square inch, and capable of working satisfactorily under any water pressure not exceeding 150 lbs.; and so arranged as to run together or separately. Three boilers in connection with the engines, each 63 inches in diameter, and 14 feet long.

A cast iron pipe fourteen inches in diameter to be laid between the reservoir and the pump well, each end bending down with inlet and outlet respectively one foot above the bottom of the reservoir, and one foot above the bottom of the well.

A wrought iron pipe one inch in diameter to be laid between air pump of condenser and the highest part of this main in order to create a vacuum and secure its action as a syphon. This main also to be connected direct with the suction of one of the pumps, three fourteen inch valves being set in said lines to admit of pumping from reservoir or from well.

Valves to be set upon all pipes in the pump well, so arranged that water can be admitted from any one or be entirely shut off.

A fourteen inch pipe to be laid from the mill race where there is to be a suitable inlet of masonry covered by a screen to the pump well.

There are about *nine miles of mains* in connection with the new system, varying from fourteen inches to six inches in diameter; sixty-five double nozzle hydrants, and fifty valves. Two mains, one fourteen inches and the other ten inches in diameter, are to be laid from the engine house to connect with the present system. All hydrant connections are to be made with six-inch pipes.

Before locating the source of supply twenty test wells were driven by the writer in the Holmedale, extending up the river from the present new buildings for about a mile, and covering an area half a mile in width. Observations extending over a period of three months were made, and the depth and variation of the water in the wells and river, the character of the strata and the depth of the clay were noted. The level of the water in the different wells was found to rise on an average about one foot in three hundred going northerly from the river to the hills, whilst the water in the wells going up the river driven to the south of the mill race rose about one foot in five hundred.

It was found that when through any cause the water in the river rose the wells were affected in a like manner, although often it was not until the following day that the change of level occurred in them.

From the data thus collected it was determined to locate the works in their present position. The greatest abundance of pure water was

found there and a fine bed of gravel extending in many places from the clay to the surface of the ground. When the work ceased last fall the pump well had been built to within three feet of the surface of the ground, and the collecting gallery pipes laid for a distance of thirty feet westerly from the well. It was found that although the pipes had been laid for only this short distance they were then capable of supplying the well with over two million gallons per day. When the collecting gallery is extended, if this rate of supply continues constant there is every indication that the reservoir will not be needed as a supplementary source of supply. The depth of the water above the clay at the well will average about seven feet and at the westerly end of the collecting gallery about three feet. The average cut in the collecting gallery will be about sixteen feet, the clay being six feet higher at the westerly end of the gallery than at the well.

It was found that when the centrifugal pump, used during the construction of the well, was discharging water from the well at the rate of two million gallons per day the water level one hundred feet up the collecting gallery was lowered only one foot; whilst at the westerly end of the gallery the water level remained constant. The following extract from the analysis of water taken from a well where the present supply is located, made by Prof. W. H. Ellis, of Toronto, shows the purity of the water:—

|                                                                           | <i>In parts per 100,000</i> |                 |
|---------------------------------------------------------------------------|-----------------------------|-----------------|
| Chlorine .....                                                            |                             | .9              |
| Free Ammonia.....                                                         |                             | .004            |
| Albuminoid Ammonia.....                                                   |                             | traces.         |
| Oxygen absorbed from Permanganate of Potash at 80° F.<br>in 4 hours ..... |                             | .027            |
|                                                                           |                             | Clarke's Scale. |
| Permanent hardness .....                                                  | 8                           | 5.6°            |
| Temporary hardness .....                                                  | 12                          | 8.4°            |
| Total hardness .....                                                      | 20                          | 14.0°           |

The works are being constructed under the superintendence of the writer, Mr. Cole being retained as consulting engineer. The terms of the contracts call for the completion of the works by the first of October next.

# Wooden and Composite Bridges.

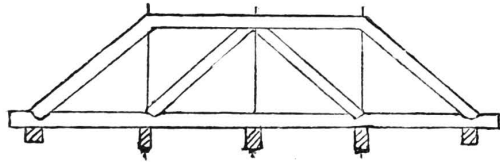


FIG. 1

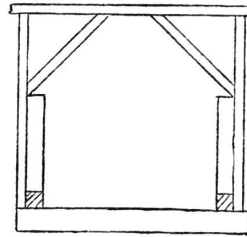


FIG. 2

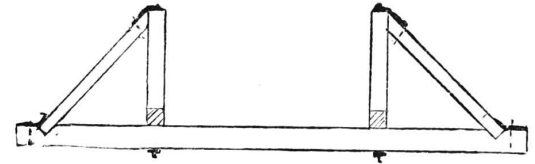


FIG. 3

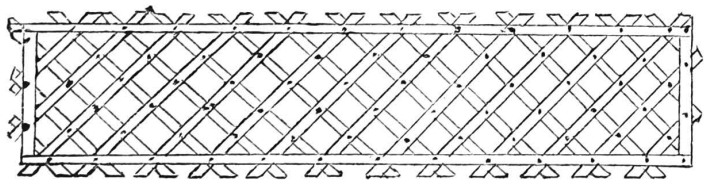


FIG. 4

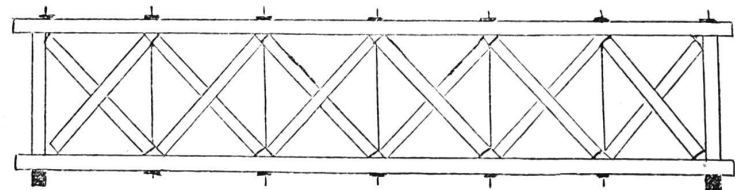


FIG. 5

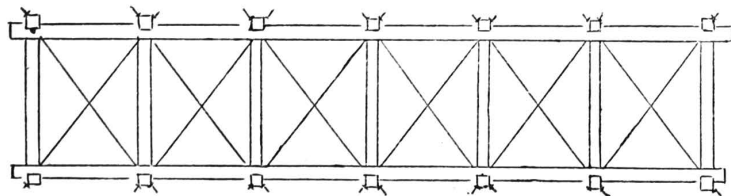


FIG. 6

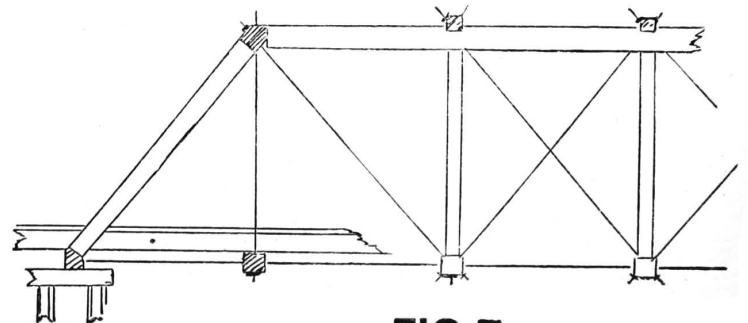


FIG. 7

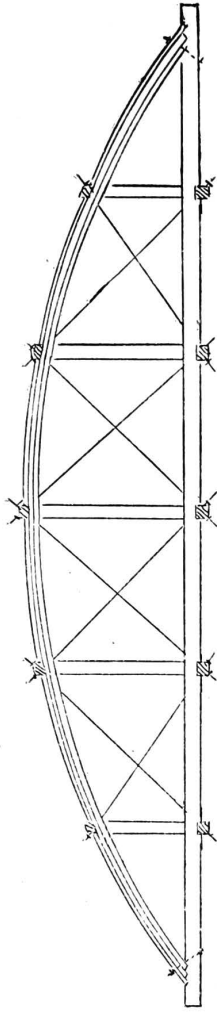
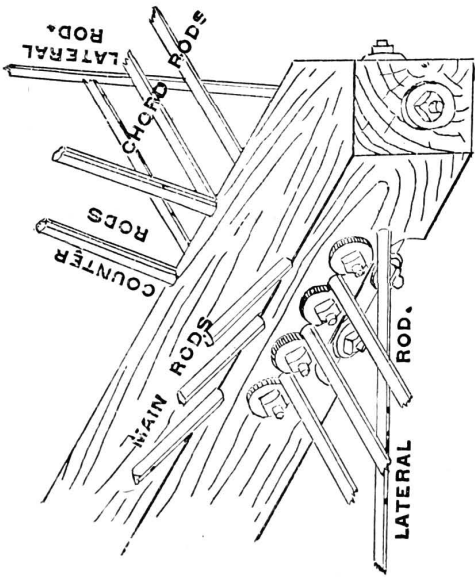


FIG. 8

FIG. 7A

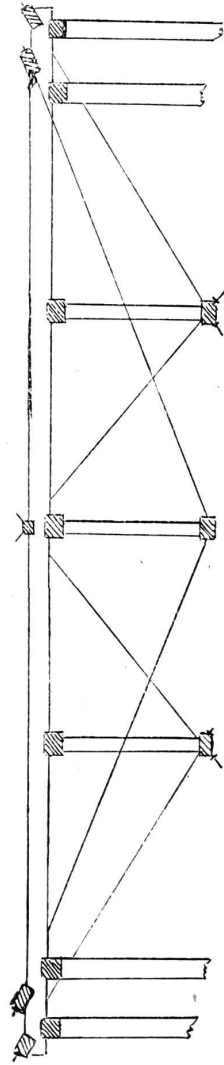
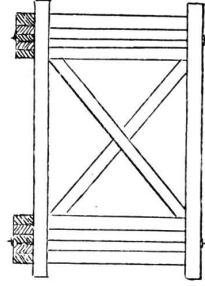
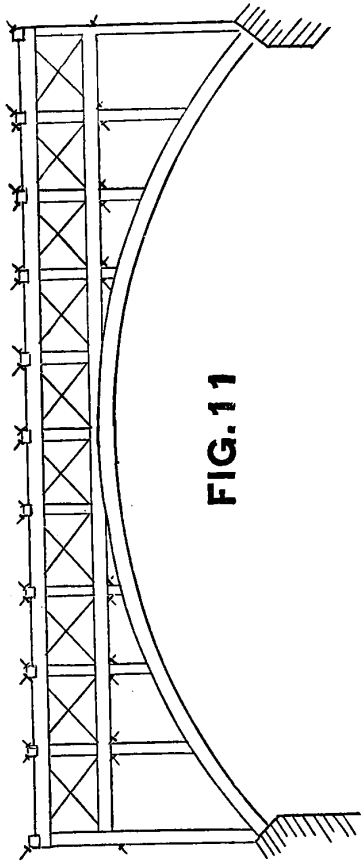
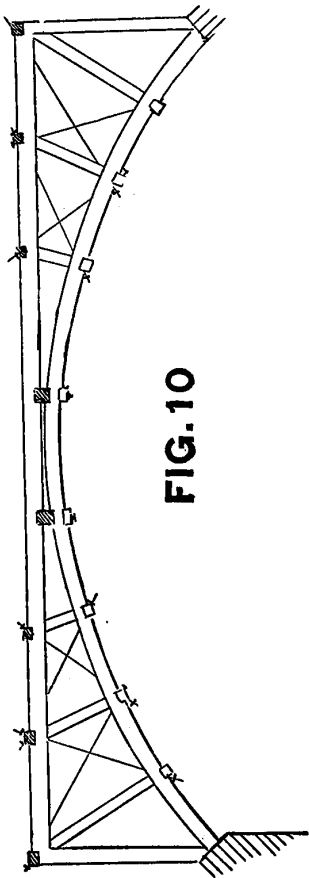


FIG. 9

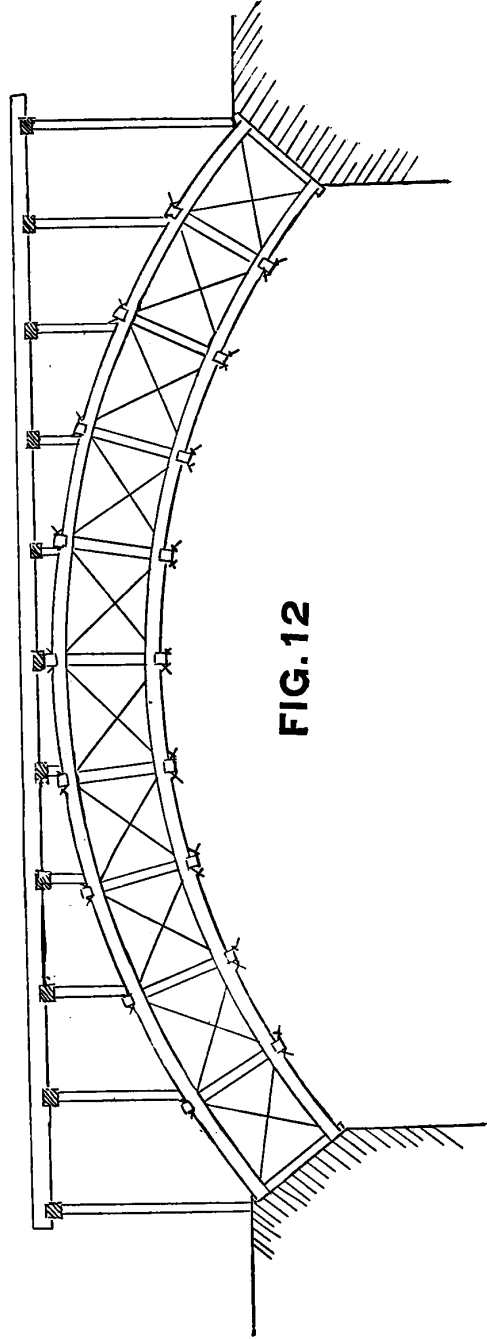




**FIG. 11**



**FIG. 10**



**FIG. 12**



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## WOODEN AND COMPOSITE BRIDGES.

By H. K. WICKSTEED, B.A.Sc.

---

I HAVE seen it stated more than once, and the idea seems to be gaining ground, that the wooden bridges, for railways at any rate, are a thing of the past—that their day is nearly over. This may be true, perhaps, of the older and more settled districts of Canada and the United States, but how about our backwoods regions in Muskoka and Algoma, in Eastern Quebec and British Columbia, where timber can be had often within a few yards of the bridge sites, and where it would cost a small fortune in transportation alone to erect iron structures? Wooden bridges are going up daily, and will continue to go up for many years to come; and perhaps in no department of engineering practice is there a better field for ingenuity and research than in the design and erection of these wooden structures. Haupt, Trautwine and Vose have given us examples and ideas on the subject in their books of ten years ago, but since then there has been little or nothing written about them, and little or no improvement in them. Either our best and most thoughtful engineers have accepted the above statement as true, or they think the subject of wooden-trussing not worth their attention. In my opinion, the old timber structures we see around us, and many of which have stood wonderfully the attacks of time and the heavy strains to which they have been subjected, and were undoubtedly fine creations for their day, are by no means as good as we can produce now. And yet we copy them time after time, and year after year, without trying to devise something better, utterly ignoring that mathematical investigation and iron working and production have all made great progress, and given us a new and different light by which to study out the true economy of design in composite bridges, just as the cheaper production of steel has revolutionized metal bridging, and rendering easy now feats which were out of the question ten years ago.

Some of the earlier railway bridges, for instance, were fastened together with wooden tree-nails, because iron was too costly at the time to be used, and great ingenuity was shown in devising a form of truss to suit the requirements and the material. The lattice truss was the result, giving an immense number of inter-sections, which could be pinned, and the aggregate was as strong as with a fewer number of metal fastenings. Being now able to obtain iron bolts and rods even in the backwoods, at moderate cost, it seems absurd to stick to the old designs, yet it is done much more frequently than would be sup-

posed; the copies being, however, much more timid in conception, owing to their being the production of servile imitators instead of bold and original thinkers, such as were the American engineers of the last generation. With iron growing still cheaper and timber dearer we are justified in putting in more of the former and less of the latter in our bridges than we could do ten years ago with economy, but, I think, in many cases we are by no means justified in jumping without any intervening step from the clumsy Howe truss of that time to the costly structure of steel of the present day. I propose in the present paper to discuss some of the forms of wooden and composite bridges in ordinary and rare use, and to point out the direction in which, I think, progress should tend. First, and perhaps the most common of all, is the king and queen post truss (Fig. 1), most often seen in road bridges of thirty or forty feet span. In its original form, as a roof truss with fairly equally distributed loading, it is excellent, but a careful analysis of the strains under a moving load will very often show that owing to the absence of counterbracing these trusses are often strained daily beyond the safe limit by the introduction of a cross-breaking stress on the bottom member in addition to the normal one of tension for which it is intended.

The designs, too, are often defective in the proper distribution of sectional and shearing area, and there is nearly always some one part of the structure which would give way long before the strain on others had approached the safe limit. It is common, too, to see sway-bracing inefficiently introduced or left out altogether, and I have in my mind's eye, at the present moment, a bridge in which the timbers are firm and sound, but which is going to ruin by the trusses falling over sideways, owing to its absence. One way of introducing this is by "gallows frames" overhead, and another and rather neater one by extending a couple of the floor beams outside the truss and staying the upper or compression member by diagonal braces from the end of these. (Figs. 2 and 3).

In the eastern townships a common form of truss is the lattice, formed of numerous diagonal pieces of timbers pinned together at their inter-sections. (Fig. 4). This was evidently copied from the older American bridges. Many of these have been roofed in and stood for a long term of years. Their great merit is the simplicity of the design and uniformity of parts, but the timber being used to take the tensile as well as compressive strains throughout, with only the bolts to transmit it to the chords or opposite diagonals, it is obvious that there must be a large amount of surplus material and useless weight somewhere. Another failing is the absence of any device for adjusting them, and they generally show more or less sag in the centre. The small amount of iron, and the readiness with which they may be put together, almost without tools, render them particularly applicable to some situations, and in extreme cases even the bolts may be done away with and oak treenails substituted.

The Howe truss (Fig. 5) shews a great advance in some ways. It is susceptible of a certain amount of adjustment, and is counter-braced throughout, and has been further perfected by the introduction of cast

iron prisms on which to rest the ends of the main and counter braces, having pipe-like attachments, or rather parts which run through between the chord pieces to take the strain of the vertical rods, and to do away with side compression on the former. Some excellent examples of this form of truss are given in Vose's "Manual for Railway Engineers," some of them being originally built or designed for highway bridges, and inserted in the book merely on account of the ingenuity displayed in the arrangement of details. It is the (in the opinion of the writer erroneous) custom to make the main braces and counters almost the same in section for every panel, although the strain on the main is of course greater in the ends than in the centre, and the reverse on the counters. The defence is that the heavier loads on the ends are more steady and more slowly applied than those on the centre, due to rolling load, and also the uniformity and interchangeability of posts. The last argument, certainly, has some weight, but the former certainly does not justify the centre pair of main braces, being succeeded in the next panel by a single counter, having to carry the most suddenly applied load of all. In my own practice I have always been accustomed to proportion the sectional area of the members to the actual strain with good results, and I can see no reason for treating an iron or steel bridge mathematically, and a wooden one by rule of thumb.

One great objection to the Howe truss for backwoods work is the amount of cast iron involved. Castings are often ugly things to transport, and very apt to be brittle and defective. Under a steady load, too, they may be very strong, while under the constant vibration to which a bridge is subjected they are apt to fail under very moderate strain. Wrought iron, on the contrary, in the form of rods and bars, is easily handled and almost indestructible, and in my own practice I have devoted much attention to the elimination of complicated castings. In scheming for this end I have found the Pratt or Whipple truss (Fig. 6) to lend itself far more readily than the Howe. In the Pratt the shorter or vertical members of the web are struts, and the longer diagonals ties. This is as it should be; the length of a tie rod does not affect its strength in any appreciable degree, while the length of a strut does, and many a compression member, whose sectional area is ample to resist crushing, will fail by cross-breaking if made too long. For this reason this system has become the most popular with modern builders of steel and iron bridges of long span in America, and it seems to me almost inexplicable that it should so long have been almost overlooked by builders of similar structures in wood in favour of the Howe. Not only for the reasons just given is the system a better one in general principle, but I have, as I said before, also found it much easier to work the details into a shape better adapted for use, in out-of-the-way places at any rate, and to the exclusion of intricate castings. In a highway bridge, designed for a locality near London, Ontario, with a span of one hundred feet, I introduced the somewhat uncommon feature of a wrought-iron lower chord formed merely of rods, multiplied in number in the different panels in proportion to the strain. The connections were made by the floor beam,

each set of rods extending only the length of its own panel, and those in the adjacent panel coming through the floor beam from the opposite side and alternating with the first lot. The diagonals came through the same beam, between these again; and the whole was managed without the introduction of a single piece of cast iron except the washers. This truss (Fig. 7) has now been standing three years or more, and as far as I can learn is giving good satisfaction. The upper chord pieces were spaced rather wider apart than is usual, and the posts were carried through between them to take the downward component of the strain induced by the diagonals on the oak block carrying their ends, thus doing away with the side compression of the chord before alluded to. I found also that the vertical posts enabled me to work in the sway and lateral bracing (which was on the same system) more simply and effectively than I could in the Howe. The inclined posts at the ends and the consequent shortening of the upper chords saved a considerable amount of material, without that I can see any loss in efficiency.

The "Bowstring" truss (Fig. 8) is almost too well known to need illustration, even if the term were not self-explanatory. Its characteristic of having a constant maximum compression in the bow and an equal tension in the string throughout their length, and the consequent possibility of making these of equal section all through without loss in strength or weight, makes it a very enticing form to the theorist. The objections are the practical ones that the braces in the web are constantly varying in length and the angle at which they meet the chord, and hence few pieces are alike in pattern, and, secondly, that the varying height and curved form of the bow make it difficult to bring in the sway and lateral bracing effectively. Consequently the type is seldom met with, except in old bridges where the objections I have mentioned are usually very apparent. In iron girders with a plate web; in which a great many of these objections do not apply, it is a very common and effective form, and as a roof truss, where the lateral and swaying strains are provided for by the stiffness of the roof skin itself, and where, owing to the permanency and uniformity of the load, the web members become scarcely more than a matter of form, the Bowstring is deservedly popular, not only on account of the economy in material, but also owing to the beauty of its form.

Passing over the Post, Warren and Bollman systems as having little to recommend them to our attention when building of wood or of wood and iron, we come to the last and perhaps the most perfect of all the truss systems for our materials, and yet except in its very simplest forms the least known and used. This is the Fink truss. As applied to a composite structure of moderate span it possesses so many and great advantages, that I must ask your patience for a little while to allow me to discuss it at greater length than I have any of the preceding types. Fig. 9 shows the general arrangement for a truss of eighty feet span, designed by the writer to carry a railway. The extreme simplicity of the design will be noticed at a glance, as also the readiness with which the strains may be calculated by a person possessed of very ordinary knowledge of the commonest principles of

mechanics and the resolution of forces. In fact, most of the latter work can be done graphically with a pencil, scale, straight edge and set square without the intervention of mathematics at all. All the wooden members are in compression and the iron in tension, doing away with all the keying and splicing necessary with the wooden lower chords in the preceding types, and with a uniform load we get the maximum strain which can come on any member. The lateral and sway bracing falls into its place naturally and economically, and the whole is extremely light and effective, so light that it can often be swung into its place without the intervention of false work and trestling. I remember on one occasion putting together a forty foot truss of this description, and being so well pleased with it that I thought it a pity to pull it to pieces again, so I mounted it on two railway trucks and sent it bodily one hundred miles by rail to its destination. It was skidded into its place immediately on its arrival, and in twenty-four hours the ties and rails were laid and the trains running over it.

From that day to this, some eight or ten years, it has not cost the company \$5 for repairs. One great reason for this is that the changes in the lengths of the rods, due to corresponding changes in temperature, do not rack and strain the structure as they do in the other systems, owing to the contraction and expansion being greater in the iron than in the wood. The only effect of them is to throw a little more camber into the truss in warm weather, and let it down again in cold, and to bend the chord piece to a quite un hurtful extent. For this reason, if for no other, it is peculiarly well adapted to our climate, with its excessive and often sudden changes from hot to cold and back again. Every bridge man and roadmaster knows the constant attention and screwing-up and slackening of nuts that is necessary in order to keep the ordinary Howe truss in order, how very difficult of access these nuts often are, and how grave are the consequences of inattention and carelessness. A cold day comes, the rods shorten and the braces are pressed against the prisms and the washers squeezed into the wood. If the thing goes too far the prism often breaks under the strain, and the vibration of a passing train, if not, the braces are compressed enough to be slack when the warm weather comes round again, and the whole structure is loose and rickety, and perhaps some of the brace-ends shake out of place altogether and are not "there" when the next train comes along.

I venture to say that many a truss has come down, and its failure been attributed to faulty design and insufficient strength, where it was really only due to want of attention and care. Either a prism has broken or a brace fallen out, or some of the nuts, under the vibration, have worked loose and left on one or two rods a strain which should have been borne by several in company. We cannot do away with occasional adjustment in the Fink, but we can place the nuts or swivels in places where they are readily accessible by the trackmen, and leave them no excuse for inattention; and we can render the effects of temperature innocuous. This is almost true also of Fig. 7, in which the only injurious effect of a sudden contraction or expansion

would be felt in the two centre counter-braced panels; the elasticity of the oak blocks would probably be sufficient to provide for this. A heavy rubber washer under the washer of the counter-brace rods would probably make things certain, as the strain on this last is never very great. One disadvantage the Fink truss has is that it is only applicable to a "deck" bridge, and where the headway underneath is limited we are debarred from using it. Where there is ample headway I know of no system so satisfactory and economical for moderate spans, say up to eighty feet for railways and one hundred feet for highway bridges, in ordinary everyday situations. Beyond these spans we have to multiply the panels and at the abutments get such a number of rods coming up at different angles that practical considerations of simplicity and uniformity of parts would probably make the Pratt the more acceptable.

The construction of the Forth and other large bridges has called much attention to the cantilever principle in bridging. It is seldom that the ordinary railway or road engineer meets with conditions which render such large spans desirable or necessary. And when he does he will probably call to his aid some expert and build of steel instead of wood. But there are often met with cases in which false work, owing to the depth of a ravine or the swiftness of the current in some river, is enormously expensive and difficult. In such cases it is well for the engineer to bear in mind that the cantilever principle is applicable to wooden trusses as well as to iron, and that we may make use of it temporarily in order to erect the bridge, or part of it, without being obliged to proportion and arrange the parts so as to bear the cantilever strains permanently; and further, that these strains will be those due only to the weight of the structure itself. Suppose, for example, a deep, rapid river, which can be spanned by a truss of 150 feet, and that the slopes of the gorge will admit economically of another pair of 150-foot spans, one on each side. By erecting the two side spans first, and providing for a temporary tension in the upper and compression in the lower chords, we may continue to build them on out towards the centre until they meet. The chords are cut over the piers and the trusses become simple ones. The Forth and other large cantilevers have been so much talked of that this application of the cantilever has been rather lost sight of. The Frazer River, St. John, Poughkeepsie and numerous other cantilevers were so designed, not because the span was enormous, but because, for one reason or another, false work was inexpedient or inadmissible. And the principle might be made use of perhaps in this connection much more frequently than it is to advantage and with economy.

Take away the string from the "bowstring" truss, and secure the ends of the bow to abutments capable of withstanding the thrust, and we have remaining a timber arch, capable of carrying quite a load, if that load be properly distributed. To prevent distortion under a rolling load, we may carry a horizontal beam over the crown and introduce spandril bracing, as in Fig. 10, or we may carry a light truss across from end to end, carried on vertical stays, as in Fig. 11. A very fine form of timber-arch is shown in Fig. 12, where it is formed

of two members united by trussing of Howe or Pratt type. This combination can be worked into graceful structures of very long span. A fine example in metal is Captain Ead's bridge over the Mississippi, at St. Louis, with arches of 520 feet span. If my memory serves me, a wooden bridge on this last principle stands, or was standing a few years ago, in one of the Eastern States of over 300 feet span. The usual method of forming the arch is by bending planks, one over the other, and spiking and bolting them together; but a better way is to cut each plank into segmental form and lay them side by side, making a stiffer construction, with the additional advantage that where bracing is introduced the prism block bears on all the component members, instead of being dependent on the spikes and bolts to transmit its thrust from the outside laminæ to the others. In the first case the stiffness of the whole is estimated by some eminent authority, Rankine, I think, to be to that of a solid beam of the same dimensions as 1 is to the number of laminæ, in the last to be equal to that of a solid beam having the same depth and the thickness reduced by that of one lamina.

In the Burr truss an attempt was made to combine the truss and arch, but it was found difficult to get the two systems to work in unison and the type is almost obsolete.

Distinct from the trusses themselves we have the bridge-seats and supports and sometimes the bridge approaches. Here we do find a great improvement of late years. Instead of great blocks of cribwork settling and rotting year by year, we find a casing of cribwork dropped for protection around a cluster of piles as a bearing seat. If the bridge be very high we find a neat, firmly braced trestle on top of this, or better still we have a pier or abutment of masonry rising to at least a little above high water mark. And in the trestle approaches a marked advance has been made in many things; in the substitution of cluster posts for large single ones rendering renewals easier, and of a number of overlapping parallel stringers for large single ones butt-jointed over the caps and requiring a clumsy corbel to fish the joint. In railway trestles we find the wide decking and closely laid ties displacing the old fashioned eight-foot decking with a two-foot space for a car wheel to drop into, and we find a substantial guard-rail notched over the ties and bolted down holding them firmly in their position instead of a simple plank spiked on to their ends. We see, too, more attention paid to foundations of trestles. Instead of dumping a sill into a trench we lay it on piles or on solid blocks of masonry. But in the wooden truss, as I said before, there is great field for improvement in proportion of parts to strain and in the perfection of little details; and still more room is there for the composite bridge, which, as Mr. Butler told you two years ago, is almost unknown, though he was wrong in saying it had not been introduced at all into the province. It appears from his remarks that I have been the first to introduce the system. Wood is an excellent material in compression and will stand a large amount of tension also, but the great difficulty is to get a grip of it—keys and notches weaken the member terribly, and when it is spliced the joints are always pulling open little by

little and letting the camber down. The difficulty in the way of the substitution of iron tension members is chiefly the different coefficient of expansion possessed by the two different materials. I have shewn that there is one form of truss in which this different coefficient works no harm, and I have pointed out a way in which it may be met in another. It is to be feared that many wooden bridges have failed and been replaced by iron and steel, not because of any fault in such structure inherent in the material or because the cost would not have been much less in wood, but because the design and erection and maintenance of the wooden structure were in the hands of unskilled and careless men. And whereas it is customary with men who are contemplating the erection of a costly piece of work, to call in to advise them a man of the highest attainments and knowledge, where the work is small and cheap they do not consider it worth while. This is to a certain extent natural and reasonable, yet the failure of the small bridge may cause the loss of just as many lives as that of the large, and from a pecuniary point of view it must be a very paltry piece of work indeed which it is not worth while to have studied out by some competent man and adapted to its locality and its loads. And it is well for us all, young and old, wise and otherwise, to remember that copying is not design, and that however able the man whose works we would imitate he is fallible like ourselves, and that the conditions under which he worked may have been different. Copy general principles if you will, and as a check upon your work observe all you can, but work out your strain and your areas for yourselves to suit the materials you are using ; and remember further, that good design is not shewn in a structure ten times stronger than it need be, even though the extra material may cost very little, nor on the other hand, by a cheap structure barely able to do the work it is intended for. Good design consists in making a structure to fully meet its requirements and in doing so at the least expenditure of money ; and such a structure will always have a beauty of its own even to the uninitiated. If a little more money is on hand use it not to pile unnecessary extra material into some one part, the weight of which will merely cause an extra strain on some other part, but to improve its appearance, to dress the surfaces or to put on an extra coat of paint or a few more cubic yards of riprap around the abutments.

“The whole is no stronger than its weakest part” is an axiom which should be kept in mind by every engineer in every class of work, but more especially is it applicable in bridge work, where an excess of strength means an excess of weight, and this excess of weight has to be carried to the abutments through other members. Hence it is not only as it would be in other works, a mere waste of material, having its justification perhaps in the increased dignity and massiveness of the work, it is a positive detriment and harm. If we had a cable stretched, so long that it would barely carry its own weight, and that of the traveller to run on it, we should consider it worse than useless to put in a few links or a short length of heavier and stronger line. Yet what I am speaking of is a precisely analogous course and one which is very common indeed.



If a fraction of the study and thought which has been bestowed by able professional men to devising formulæ for the determination of the exact thickness of the keystone of a stone arch, or the saving of a few pounds of metal in some enormous structure, such as not one engineer in one hundred ever gets a chance to build, were directed to the consideration of ordinary everyday problems in bridge work, we should see fewer enormities in wood and iron going up about us, schemed by ignorant mechanics without mathematical knowledge, by artistic architects without practical ability, or, worse still, copied by some man who has the knowledge and ability, but is too careless and indolent in many cases even to grasp the salient points in his copy, or to investigate for himself.

If wooden bridges were as well designed as the majority of iron, we should see less distrust on the part of railway men and the public at large of wood as a constructive element, we should be less often shocked on picking up our morning paper by the blood-curdling details of some fearful accident, and we should save money to equip our roads and our railways better in other respects. It is customary to say that it is better to put in an iron bridge at once if it is possible to raise the money, because the removal of the wooden bridge every few years will come to more than the extra cost of the iron. Suppose the iron one will last forever and that it will cost \$4,000, and the composite one, \$2,000 (not by any means an unfair assumption, I think) we have saved \$2,000. The composite one, according to Mr. Butler, will last at least twenty years, and I think he is quite right. Put this \$2,000 out at compound interest at 5 per cent., and what will it amount to in that time? I hate arithmetic, and I would gladly dodge the problem, but I make it something over \$5,000, enough to renew the bridge in iron then, and leave a good margin, or better, perhaps, to put the composite structure back again and put masonry under it.

I have no wish to overrate wood as a constructive element, or to underrate iron, I merely wish to give my reasons for the faith that is in me, that in good hands, and with careful study, wood might often be used to-day with perfect safety and sound economy in many places where mistaken prejudice is compelling iron and steel. I have given no formulæ, and few details. Of the former, the student can find all he needs in Trautwine, Vose, Haupt and other books, and in some others he will find enough to frighten him away from the subject altogether. Vose has reduced the calculations of Strains to a very simple tabulated form, which may be used by anyone with a knowledge of arithmetic, the algebraic signs, and a little trigonometry. For the true *raison d'être* of the formulæ and the power to do without them, or to frame them for himself, he must know something of mechanics besides, but not much.

For details, he will also find suggestions in Trautwine and Vose. And in both theory and detail he will get a great deal of valuable help from Mr. Campbell and Mr. Butler's excellent papers embodied in the transactions of the Society, in 1887 and 1888. I can add to Mr. Butler's list of authorities, Unwin's Iron Bridges and Roofs, Shield's Strains on Structures of Iron Work, and others; but why? He has

plenty to wade through, more than enough, if he takes an interest in the subject and reads understandingly, and I, for one, will let him alone, merely cautioning him, that in details, good white oak, helped, if necessary, by boiler plate, and wrought iron straps, can be worked into almost anything by the nearest carpenter and blacksmith, and will be generally found more reliable and satisfactory than complicated castings from a foundry one hundred miles away.

In answer to Mr. Galbraith's enquiry last year for a book on wooden highway bridges, I know of none wholly devoted to the subject, but he will find Vose's discussion of wooden bridging generally eminently plain and practical, and the examples, excellent. I have only one fault to find with Mr. Campbell's paper, which is, that the Howe truss he figures is very oldfashioned in style, and strikingly deficient in depth. I am afraid it was designed by some engineer of iron plate girder experience. The average of the best practice in wooden trussing will give a proportion of length to depth of between 5 and 6 to 1. The lower chord is the hardest part of the bridge to work in economically, consequently he should increase the depth, in order to lessen the strain on it and the upper chord, which is the next weakest part.

# AN EPHEMERIS OF STARS IN THE VERTICAL OF "POLARIS."

By F. L. BLAKE, P.L.S.,

*Astronomical Assistant, Toronto Observatory.*

THE compilation of an ephemeris of eighty-four fixed stars in the vertical of *Polaris* for the purpose of finding the time and azimuth more readily than by the old methods in use has occupied my attention some considerable time, and I think, by my method, I have succeeded in making the observation very simple, and the tables in as compact and concise a form as can be accomplished in this method of finding azimuths. The tables in the ephemeris are calculated for latitude 45, and the position of the stars are taken from the *Berliner Jahrbuch*. Of the few stars that are not in that almanac the positions are from the *American Nautical Almanac*.

In calculating the sidereal time when the *Time Stars* are in the vertical of *Polaris* the following formulæ of approximation by Chas. Carpmael, Esq., M.A., Director of the Observatory at Toronto, was used:

$\delta$  and  $\delta'$  declination of *Polaris* and *Time Star*.

$a$  and  $a'$  right ascensions of *Polaris* and *Time Star*.

$(a' - a)$  = angle  $A P B$ .

P = pole.

Z = Zenith.

$p$  = perpendicular from Pole on the Vertical  $C B$ .

$\theta$  = angle  $C P A$ .

$h$  = hour angle of *Polaris*  $A P Z$ .

$h'$  = hour angle of time star *Sirius*  $Z P B$ .

$\phi$  = latitude of place of observation.

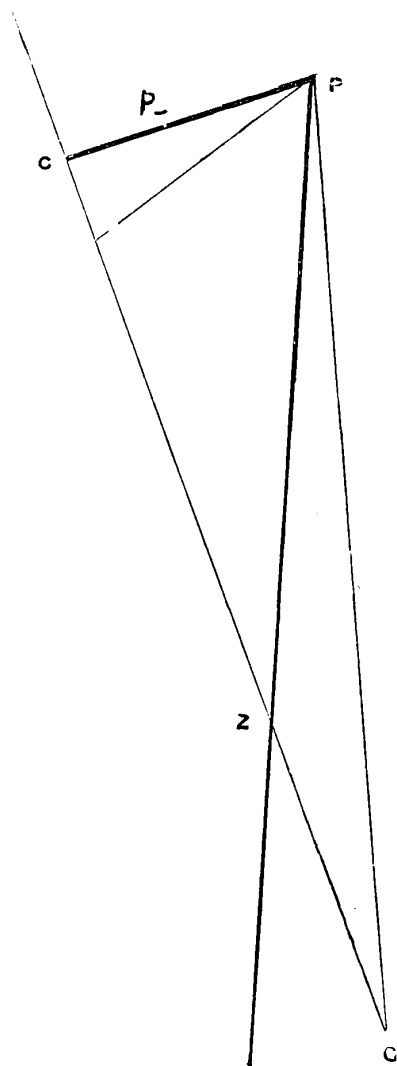
In triangle  $A P C$   $\cos \theta = \tan p \tan \delta$  (I).

In triangle  $C P B$   $\cos (a' - a + \theta) = \tan p \tan \delta'$  (II).  
 $= \tan \delta' \cot \delta \cos \theta$  (III.) by substituting value of  $\tan p$  in equation (I).

In triangle  $Z P C$   $\cos (h + \theta) = \tan p \tan \phi$  (IV).  
 $= \cot \delta \cos \theta \tan \phi$  (V).

Therefore  $h = (h + \theta) - \theta$  (VI).

$h' = (a' - a) - h$  (VII).



By assuming a value for  $\theta$  in equation (III) we can approximate its value to any degree of precision necessary by substituting the new values of  $\theta$  in each successive approximation, and generally speaking by mere inspection we can fix a value for  $\theta$  so that its true value may be found to the nearest second in two approximations; take the example given to illustrate the use of the tables we have  $T$  = Time interval of 150 seconds between the setting on *Polaris* and the transit of the time star *Sirius*.

The angle  $A P B = (a' - a - T)$

$$a' = 6^h.40^m.16^s.18$$

$$a = 1. 17. 62. 05$$

$$\begin{array}{r} (a' - a) = 5. 22. 14. 13 \\ T = \quad 2. 30. \end{array}$$

$$\text{Assume } \theta = 9^\circ 46' 20''$$

$$(a' - a - T) = 5. 19. 44. 13$$

$$79^\circ.56'. 2''$$

$$\cot \delta = 8.3489257$$

$$\tan \delta' = 9.4734726$$

$$7.8223983$$

$$\cos \theta = 9.9936524$$

$$\cos (a' - a - T + \theta) = 7.8160507 = 90.22.30$$

$$79.56. 2 = (a' - a - T)$$

$$10.26.28 = \theta \text{ 1st approx.}$$

$$\cos \theta \text{ (new value)} = 9.9927486$$

$$7.8151469 = 90.22.28$$

$$79.56. 2$$

$$10.26.26 = \theta \text{ 2nd approx.}$$

$$\cos (h + \theta) = \cot \delta \cos \theta \tan \phi$$

$$\cot \delta = 8.3489257$$

$$\cos \theta = 9.9927494$$

$$\tan \phi = 0.1165897$$

$$8.4582648 = 88^\circ.21'.14''$$

$$\theta = 10. 26. 26$$

$$h = 77. 54. 48$$

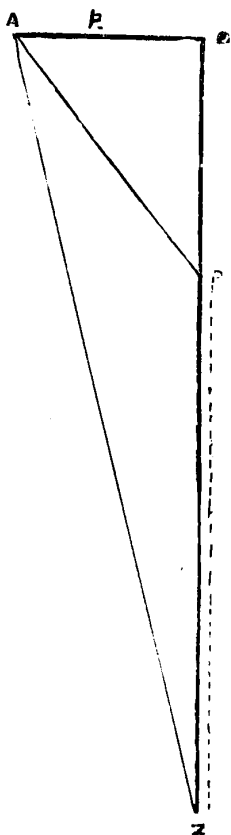
$$(a' - a - T) = 79. 56. 2$$

$$h' = 2. 1. 14$$

$$h' = 0^h.8^m.4^s.23$$

$$a' = 6.40.16.18$$

$$S T = 6 33.11.25$$



The azimuth formulæ is as follows :

$A$  = position of *Polaris*.

$P$  = pole.

$Z$  = Zenith.

$ZC$  = meridian.

$AC$  = perpendicular on meridian from *Polaris*.

$Az$  = Azimuth angle  $A Z C$ .

$h$  = hour angle  $A P C$ .

$p$  =  $A C$ .

$n$  = portion of meridian intercepted between  $P$  and foot of perpendicular  $p$  on meridian.

$\phi$  = latitude of place.

$\delta$  = declination of *Polaris*.

$\cos h = \tan n \tan \delta$  (I.),  $\sin p = \sin h \cos \delta$  (II.),  
 $\sin (\text{colat} + n) = \tan p \cot Az$ . (III.) from which the Azimuth is found.

The latitude corrections to the *S. T.* and *Az.* are based upon a mean position for each star and  $t$   $t'$   $a$  and  $a'$  are the necessary corrections for the other days and are applied directly to the *S. T.* and *Az.* columns by simply changing their signs which is already done in the tables ;  $b$  and  $c$  are corrections for the time interval and are simply direct interpolations.

#### EXPLANATIONS.

The Sidereal Times and Azimuths of *Polaris* are rigorously calculated to the nearest second of arc for every 20th day of the year for the 45th degree of north latitude, and the corrections for other latitudes are very close approximations, in fact sufficiently close for almost any kind of time and azimuth work ordinarily required of the surveyor or engineer.

In the first column, under  $Z$ , will be found the zenith distance of the time star followed by the dates.

$t$  and  $t'$  are corrections of decimals of a second of time for each degree of latitude differing from 45, and to be applied with its proper sign to the *S. T.* after multiplying by the difference in latitude. being used for latitudes south of 45 and  $t'$  for places north of 45.  $a$  and  $a'$  are similar corrections to be applied to the Azimuth.

#### LATITUDE CORRECTIONS:

Column  $L$  is for the latitude.

*S. T.* and *Az.* are corrections to be applied to the Sid. Time and Azimuth according to their signs.

$b$  contains the corrections to be applied for the interval of time between the observations on *Polaris* and the time star. They are decimals of a second and require to be multiplied by the interval in seconds.  $c$  are similar corrections for the Azimuth.

These corrections require the interval between the observations not to be extended much over two minutes.

METHOD OF OBSERVATION.

The best method of observing would be to select your stars beforehand and make the necessary interpolations, getting your instrument into position a few minutes before the time required, sight on *Polaris* and then swing the telescope to the time star and wait till it appears in the field of view, turn on to *Polaris* again, clamp and bisect accurately by means of tangent screw, noting the time by watch and again revolving the telescope to the time star, note the time of its crossing the wire. The observation is then complete, and the time interval corrections can then be applied and you have the *Sidereal Time* and *Azimuth* of *Polaris*, which may be used in determining the deviation of any line you may be running by noting the readings of the azimuth plate of the instrument at the time of observation.

EXAMPLE.

Jan. 20th, 1889.—At a place in latitude  $52^{\circ} 36'$  and longitude  $90^{\circ}$  west. *Polaris* was supposed to be observed at 10 33 30 watch time, and *Sirius* at 10 36 0 in the same vertical plane—require the watch error and azimuth of *Polaris*.

Time interval, 150 seconds.

Difference of latitude from 45 is  $7^{\circ}.6$ .

$$t' = +0.093 \times 7.6 = +0''.71$$

$$b = +0.007 \times 150 = +1.05$$

|                                            |         |    |    |       |
|--------------------------------------------|---------|----|----|-------|
| Jan. 20th, 1889 .....                      | S. T. = | 6  | 33 | 43.58 |
| Cor. S. T. for Lat. $52^{\circ} 36'$ ..... | =       | —  | —  | 93.93 |
| Cor. $t'$ .....                            | =       | +  | 0  | 0.71  |
| Time interval Cor. $b$ .....               | =       | +  | 1  | 1.05  |
| <hr/>                                      |         |    |    |       |
| Sidereal Time .....                        | =       | 6  | 32 | 11.41 |
| Sidereal Time, M. Noon, 20th Mer. ....     | =       | 20 | 1  | 12.25 |
| <hr/>                                      |         |    |    |       |
| Sidereal interval from Noon .....          | =       | 10 | 30 | 59.16 |
| Retardation Table IV. ....                 | =       | —  | 1  | 43.37 |
| <hr/>                                      |         |    |    |       |
| Standard Time, 20th Mer. ....              | =       | 10 | 29 | 15.79 |
| Watch Time .....                           | =       | 10 | 36 | 0     |
| <hr/>                                      |         |    |    |       |
| Watch Fast .....                           | =       | 6  | 44 | 21    |

AZIMUTH CALCULATION.

$$a' = -1.08 \times 7.6 = -8''.2$$

$$c = -0.102 \times 150 = -15.3$$

|                                          |   |   |     |        |
|------------------------------------------|---|---|-----|--------|
| Az. ....                                 | = | 1 | 47' | 0''    |
| Cor. Az. for Lat. $52^{\circ} 36'$ ..... | = | + | 17  | 43.0   |
| Cor. $a'$ .....                          | = | — | 0   | 8.2    |
| Time interval cor. $c$ .....             | = | — | 0   | 15.3   |
| <hr/>                                    |   |   |     |        |
| Az. <i>Polaris</i> .....                 | = | 2 | 4   | 19.5 W |

A rigid solution gives

$$S. T. \dots\dots\dots = 6^h. 32^m. 11.5^s.$$

$$Az. \dots\dots\dots = 2^\circ 4' 20'' W$$

| 1889.<br>Z.<br>61° 34' S. | a CANIS MAJORIS (Sirius).        |       |       |         |     |       |
|---------------------------|----------------------------------|-------|-------|---------|-----|-------|
|                           | S. T.                            |       |       | Az. W.  |     |       |
|                           | 6 <sup>h</sup> 33 <sup>m</sup> . |       |       | 1° 46'. |     |       |
|                           | t.                               | s.    | t'.   | a.      | "   | a.    |
| Jan. 0.....               | -.067                            | 43'46 | +.087 | + '60   | 60  | -1'00 |
| " 20.....                 | '067                             | 43'58 | '093  | '60     | 60  | 1.08  |
| Feb. 9.....               | '060                             | 43'13 | '080  | '54     | 64  | '93   |
| Mar 1.....                | '047                             | 42'38 | '073  | '42     | 70  | '85   |
| " 21.....                 | '033                             | 41'41 | '053  | '30     | 79  | '62   |
| Apr. 10.....              | '027                             | 40'62 | '040  | '24     | 87  | '46   |
| " 30.....                 | '020                             | 39'82 | '013  | '18     | 95  | '15   |
| May 20.....               | '013                             | 39'36 | '007  | '12     | 101 | '08   |
| June 9.....               | '007                             | 39'04 | '000  | '06     | 104 | '00   |
| " 29.....                 | '000                             | 39'14 | '000  | '00     | 103 | '00   |
| July 19.....              | '007                             | 39'60 | '013  | '06     | 100 | '15   |
| Aug 8.....                | '020                             | 40'45 | '020  | '18     | 93  | '23   |
| " 28.....                 | '027                             | 41'46 | '040  | '24     | 84  | '46   |
| Sep. 17.....              | '040                             | 42'60 | '060  | '36     | 75  | '70   |
| Oct. 7.....               | '060                             | 43'85 | '080  | '54     | 64  | '93   |
| " 27.....                 | '073                             | 45'04 | '107  | '66     | 54  | 1'24  |
| Nov. 16.....              | '087                             | 46'18 | '120  | '78     | 44  | 1'39  |
| Dec. 6.....               | '093                             | 47'09 | '140  | '84     | 37  | 1'62  |
| " 26.....                 | -100                             | 47'60 | +147  | + 90    | 32  | -1'70 |

LATITUDE CORRECTIONS.

| L. | b.     | S. T.   | Az.   | c.    | L. | b.     | S. T.   | Az.   | c.    |
|----|--------|---------|-------|-------|----|--------|---------|-------|-------|
| °  |        | s.      | "     |       | °  |        | s.      | "     |       |
| 28 | + '003 | +142'73 | -1287 | -.069 |    |        |         |       |       |
| 29 | '003   | 135'80  | 1238  | '070  |    |        |         |       |       |
| 30 | '003   | 128'80  | 1186  | '071  |    |        |         |       |       |
| 31 | '003   | 121'67  | 1131  | '072  | 45 | + '006 | - 0'00  | + 0   | -.083 |
| 32 | '003   | 114'33  | 1074  | '073  | 46 | '006   | 10'80   | 116   | '086  |
| 33 | '004   | 106'87  | 1014  | '073  | 47 | '006   | 22'07   | 238   | '088  |
| 34 | '004   | 99'20   | 951   | '074  | 48 | '006   | 33'33   | 367   | '091  |
| 35 | '004   | 91'40   | 884   | '075  | 49 | '006   | 45'80   | 503   | '093  |
| 36 | '004   | 83'34   | 815   | '076  | 50 | '007   | 58'47   | 647   | '096  |
| 37 | '004   | 75'14   | 741   | '077  | 51 | '007   | 71'60   | 799   | '098  |
| 38 | '004   | 66'68   | 664   | '078  | 52 | '007   | 85'33   | 961   | '101  |
| 39 | '005   | 58'00   | 583   | '078  | 53 | '007   | 99'67   | 1131  | '103  |
| 40 | '005   | 49'08   | 497   | '079  | 54 | '008   | 114'73  | 1313  | '106  |
| 41 | '005   | 39'87   | 407   | '080  | 55 | '008   | 130'53  | 1506  | '108  |
| 42 | '005   | 30'33   | 313   | '081  | 56 | + '008 | -147'07 | +1711 | -111  |
| 43 | '005   | 20'60   | 214   | '082  |    |        |         |       |       |
| 44 | + '005 | +10'47  | -110  | -.083 |    |        |         |       |       |

Polaris Z. Dist = 44° 45'.

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

## THE TRANSIT.

By JOHN McAREE, D.T.S.

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IT was thought that we should have a short paper on the surveyor's transit, and to me was assigned the duty of writing it. Though no better qualified than others, I cheerfully accepted the task, as being desirous of contributing something to the success of our annual meeting. I find a difficulty, however, in treating the subject. I do not know just what I should say. The transit now being universally the surveyor's instrument, with which every surveyor is of necessity familiarly acquainted, it seems almost an impertinence for me to stand up before this Association and gravely to offer a paper about it. Therefore, I do not propose to give a description of the instrument or to speak directly of its adjustments in a formal way, but rather to attempt to speak of the qualities of a good instrument, and enumerate the tests which it should stand. I propose thus to treat it as a *genus* rather than as a *species*, and I shall direct my attention especially to the ordinary surveyor's transit.

Much information about the transit, as about other surveying instruments, may be got from the descriptive catalogues of the instrument makers. I have seen only those of the American makers, and the best that I have seen are those of Buff & Berger, of Boston, and Fauth & Co., of Washington. The present paper is much indebted to the two mentioned, especially the first one, for the form, though in a lesser degree for the substance, of what it contains. I have to acknowledge my indebtedness to G. B. Abrey, P.L.S., also, for some valuable suggestions. We shall begin with the

### TELESCOPE.

The telescope should, without the aid of the clamp, and when equipped with the sunshade, and using the inverting eyepiece, balance itself in any position, and should reverse by revolving between the standards. It should come sharply into focus, and a very little movement either way of the focussing screw should cause the image to blur. When it is sharply focussed, covering any part of the object-glass without altering the focus should not alter the sharpness of definition, but merely cut off light; if it stands this test it shows that the object-glass is of the same form throughout, since all its parts have the same focal length. The image of a star should be a mere point of light, free from wings or spurs. The pencil of light which enters the object-glass should come out at the eye end. To ascertain this, see whether a pointer which you place just in contact with the edge of the object-



glass can be wholly seen in the small disc of light which you will notice at the eye end when you draw your head back some inches from the telescope when the latter is pointed towards the sky. If the pointer cannot be seen up to the very edge, then the maker has inserted a diaphragm to cut off the light transmitted by the outer part of the object-glass. The diaphragm is a device to remedy the imperfectly corrected spherical aberration of the object-glass, by intercepting the rays that traverse its rim, and which, having a different focus from the central rays, would, if not stopped, cause a blurring of the image. In this case the real aperture of the telescope found by moving the pointer over the object-glass until its point is just visible, and measuring from the inner edge of the brass cell, holding the object-glass, to the pointer; twice this distance subtracted from the distance between the two edges of the brass cell, will give the actual or clear aperture of the telescope. This clear aperture divided by the diameter of the small circle of light at the eye end when the telescope is focussed on a distant object, will give the magnifying power of the telescope. A glass is corrected for achromatism if on focussing on a bright object, and then pushing the eyepiece nearer to the objective, a ring of purple surrounds the image and a ring of green appears when the eyepiece is pulled out. Veins or striæ in a glass are very injurious. They can be detected by viewing a bright object, like the moon or a flame, without the eyepiece. If the glass is evenly illuminated it shows that there are no such veins, and that the glass is homogeneous.

The best eyepieces are the Kellner and the Steinheil; they are achromatic combinations and are preferable on account of the absence of colour and the greater flatness of field which they give. The Kellner consists of a plano-convex, or sometimes a crossed field lens and an achromatic eye lens. The Steinheil consists of two achromatic lenses; it gives a beautiful field of moderate size but absolute flatness.

For the following table and accompanying remarks I am indebted to Mr. Abrey:—

“ For average eyes the lowest powers available are = 5 × diameter of aperture of objective in inches, and generally the power should not be so low as this or nearly 5% greater. For the highest powers that are available under the most favourable circumstances for ast. purposes makers would not recommend greater than about 100 for a 2" aperture, and as the light is proportioned to the sq. of the dia., the power for smaller sizes will be nearly in the same proportion. Below is about the proportion:—

|        | lowest | highest |
|--------|--------|---------|
| 1"     | 7      | 41      |
| 1 1/8" | 8      | 45      |
| 1 1/4" | 9      | 51      |
| 1 3/8" | 10     | 57      |
| 1 1/2" | 11     | 64      |
| 1 5/8" | 12     | 71      |
| 1 3/4" | 13     | 79      |
| 1 7/8" | 14     | 88      |
| 2"     | 15     | 100."   |

The magnifying power of a telescope and the sensitiveness of its level should correspond to each other. The least motion of the level

bubble should be accompanied by a visible displacement of the cross wires on the field. For astronomical work the highest magnifying powers may be used, but for terrestrial work with the ordinary transit a magnifying power of from 24 to 30 is about right.

#### THE CENTRES.

The centres should fit each other exactly, so that the one may turn freely within the other without any lateral motion whatever. Both axes must be exactly concentric with the centre of the graduated horizontal circle and the centre of the horizontal axis of the telescope in any position of the instrument. The most sensitive level about the instrument should not shew any displacement during a complete revolution of the two plates—clamped together—round their vertical axis or while either one of the plates is held and the other revolved. In the case of instruments with a chamfered edge to the horizontal limb the vernier should have smooth and easy but close contact with the surface of the limb over which it moves, and the faces of the limb and vernier should form one continuous surface; and where the limb is not chamfered the vernier and limb should revolve in the same plane to avoid parallax when reading, and the space between the limb and vernier should have the appearance of a uniform fine black line. All graduation should be solid silver and the finer and cleaner cut they are, especially at the ends where contact is made between the limb and vernier the more perfect is the workmanship. For railway work it is convenient to have the graduations of the horizontal limb numbered both ways, right and left. The vernier should be the proper length, *i.e.*, the distance between the extreme lines should be equal exactly to a whole number of divisions on the limb. Every circle should be read by two verniers to eliminate the effect of eccentricity; the verniers should be lettered or numbered.

Graduations may be degrees divided sexagesimally or decimally. The former is in accord with custom but the latter is much more convenient when several verniers are read and the means required. Each vernier ought to be double, graduated both ways from its centre.

#### SPIRIT LEVEL.

The spirit levels as regards their sensitiveness need not be in strict keeping with the optical power and the graduations of the instruments, but the quality should be the best. The surface under which the bubble moves should be of continuous curvature so that as the level is gradually inclined to the horizon the bubble moves uniformly from end to end without jerking at any point, and no matter what its length it should move quickly without any of the hitching which is usually caused by a little dirt introduced when it is filled; in change of temperature the bubble should lengthen symmetrically each way from the centre. A first-class level should not only have the curve regular, but it should be perfectly symmetrical, that is, one end of it should have the same width as the other, otherwise the length of the

bubble in changes of temperature will change unequally at the ends. The longer the bubble the more sensitive the level, hence in the best levels there is a chamber at one end which acts as a reservoir in regulating the quantity of the fluid in the phial at any time, and consequently regulates the length of the bubble.

The level attached to the telescope should be sensitive enough for ordinary levelling, such as good railway work. Of the two levels on the alidade plate the one perpendicular to the plane of collimation should be the longer. The test of fitness of the various levels for the capacity of the instrument should lie in this—that after carefully bisecting an object in the field of view in such a position of the instrument that all the levels can be read and then throwing them all slightly out of level by means of the levelling screws the bisection shall be accurately regained by restoring the bubbles to the exact position they before occupied by the levelling screws alone.

Level bubbles should be ground throughout on their internal surface and when mounted in their tubes should be graduated on their upper surface so as to read easily to at least to one-half of the smallest arc shown by the vernier or micrometer for vertical angles.

#### LEVELLING SCREWS.

The levelling screws should fit closely in their sheaths; the heads should be of large diameter and coarsely milled so as to admit of manipulation when mittens are worn. As to the fineness of the thread thirty-two to the inch is perhaps about right; they should not be finer than this for ordinary instruments and not much coarser.

There are certain accessories, as they may be called, with which a complete transit is provided. There should be an eyepiece for observing stars of small zenith distance; a prism is better than a mirror for this; the telescope should have a sunshade. Some would consider a hollow axis for illumination of the field at night to be indispensable. Buff & Berger say:—"A rain and dust guard for the object slide is now furnished with all of our telescopes, and the graduations of the horizontal circle, the centre and such other important parts, that are liable to injury by the action of dust and water in the field use of our instruments are entirely protected." Reflecting shades attached to the verniers to throw an even light on the graduations are a great convenience. Stadia wires in the telescope are very useful in some branches of surveying. An American maker, Mr. J. Holmes, places the stadia wires in his telescope at a different focus from the ordinary cross-wires so that the two sets cannot be confounded.

Tangent screws should work against an opposing spring to avoid all lost motion; the spring should "follow" the tangent screw as far as it is likely to be screwed out in actual use.

The dark glasses used for the solar work should fit easy to admit of being put on and taken off without deranging the instrument. All instruments that may be used for astronomical work should have a striding level which should be so constructed as to remain on the instrument while an observation is made.

A compass on a transit is sometimes a convenience; the box should be water-tight and the covering glass should be made of homogenous plate or ground glass.

English instruments are as a rule more highly finished and are heavier than American; they are cheaper too. Some of the special features of American instruments would improve the English instruments if adopted on them.

In the writer's opinion the best transit is that whose line of collimation can be made the most nearly to trace out a vertical plane; this is the most important operation and at the same time the most difficult which has to be performed by the instrument. In the majority of ordinary instruments the readings of the graduated circle as to accuracy and precision are of a quality much superior to that of the manner in which the instrument is mounted upon the tripod and of the character of the tripod itself. It is an absurdity to have a circle reading to twenty seconds say, standing on the narrow base which usually accompanies the use of four levelling screws, and the ordinary unframed tripod. A circle reading to less than a single minute should stand on the broad base which can be obtained by the use of the three levelling screws and should have a framed tripod. The most difficult property to obtain in perfection in a transit is stiffness. A tripod needs frequently to be overhauled—always after a journey—to see that all the screws and bolt heads are tight; the shoes, especially on instruments that have been long in use, need to be looked after to see that they are firmly attached to the wood.

In conclusion I would say that in seeking a good instrument the safest way is to get one that has been made by a reputable maker.

#### DISCUSSION.

The Chairman—I am sure we have all been very much interested with the practical points brought out in this paper. I should like very much to have a discussion on this paper.

Mr. Abrey then explained what he considered the best kind of tripod and the one he generally used. He explained that symmetry was a very important element in this instrument.

Mr. Chipman—I have discarded the round tripod; the truss tripod is much better. If you tighten it once every six months it is quite sufficient.

Mr. Abrey—These framed tripods I have carried over the rocks, and they have been none the worse. It can be made smaller and so be more easily carried. Small object glasses are the best. In the North-West I used 10, 15 and 20 diameters and had no trouble with refraction. When you have higher parts you cannot use them well in the light.

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## DECIMAL vs. DUODECIMAL MEASUREMENTS.

By VILLIERS SANKEY, P.L.S.,

*City Surveyor, Toronto.*

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IN all things it is necessary now-a-days to look for what is useful, convenient and practical. This is more especially the case in things that require accuracy. It is no longer now an argument of any weight to say, "I was taught so," or, "My father did things thus." In matters such as I am going to refer to, no sentimental notion can be permitted to interfere, when common sense points out what is the most useful means to attain a desired end. For a long time I have been considering the question of the great advantage it would be, not only to surveyors and engineers, but also to the community at large, if some convenient method of expressing measurements similar to the system at present in use in the matter of our currency were adopted.

At our last annual meeting I determined to bring the matter before this Association, and to urge it to use all its influence in bringing about the necessary change. You may imagine, therefore, how greatly pleased I was, on reading the valuable paper on this subject by J. P. Bates, C.E. in our exchange of the *Arkansas Society of Engineers, Surveyors, etc.*, vol. 1, November, 1887.

I need not dwell at length, when addressing an Association like this, upon the great benefits to be derived by such a change. They are so self-evident that I will merely state the proposals I would suggest, and discuss a few of the results which are likely to follow. Simply stated then, I desire to express all measures of length, breadth and thickness in terms of feet and decimals. Probably the best way to bring this before you is, first, to draw your attention to the regulations which now govern us. And, for a reason which I will refer to later on, I will first take up the subject of the Dominion standards of measures.

49 Vic., chap. 104, sect. 3, enacts that the bronze bar and the platinum weights as thereafter described shall be the Dominion standards of measure of weight.

Sections 9, 10 and 11 read as follows:—

### DOMINION MEASURES-OF LENGTH.

9. "The straight line or distance between the centres of the two gold plugs or pins (as mentioned in the first schedule to this Act) in the bronze bar, by this Act declared to be the Dominion standard for determining Standard yard defined.

the Dominion standard yard, measured when the bar is at a temperature of sixty-one degrees and ninety-one hundredths of Fahrenheit's thermometer, and when it is supported on bronze rollers, placed under it in such manner as best to avoid flexure of the bar, and to facilitate its free expansion and contraction from varying temperatures, shall be the legal standard measure of length, and shall be called the Dominion standard yard, and shall be the only unit or standard measure of extension from which all other measures of extension, whether line or superficial or solid, shall be ascertained." 42 Vic., chap. 16, sect. 10.

Standard foot,  
inch, rod,  
chain, link,  
furlong, and  
mile.

10. "One third part of the Dominion yard shall be a foot, and the twelfth part of such foot shall be an inch; and the rod, pole or perch, in length, shall contain five such yards and a half; and the chain shall contain twenty-two such yards, and the link shall be the one-hundredth part of the chain; the furlong shall contain two hundred and twenty such yards; and the mile, one thousand seven hundred and sixty such yards." 42 Vic., chap. 16, sec. 11.

Standard rood  
and acre.

11. "The rood of land shall contain one thousand two hundred and ten square yards, according to the Dominion standard yard; and the acre of land shall contain one hundred thousand square links, being four thousand eight hundred and forty such square yards, or one hundred and sixty square rods, poles or perches." 42 Vic., chap. 16, sect. 12.

With regard to section 9, I do not propose to make any alteration. I, for one, am satisfied to retain the one described as the standard. I cordially endorse what Mr. Bates, in his paper, says about running after false gods. Our standard will answer fully as well for all practical purposes as though it were derived from a quadrant of the meridian of the earth. No doubt, in fact, it is derived from either the proverbial barley-corn or from the length of the feet of the first sixteen men coming out of church on a Sunday morning.

Sections 10 and 11 are the ones in which I should suggest a change. The first I would make to read thus:—"The third part of a Dominion standard yard shall be a foot, the 10th part of such foot shall be a tenth, and the 100th part of said foot shall be a hundredth, and so on for thousandths, etc. The mile shall contain 2,580 feet, equal to 1,760 yards."

Section 11, I would change thus:—"The acre of land shall contain 43,560 square feet, equal to 4,840 square yards." Thus, I would practically make the foot the unit of measurement, as by doing this, little difficulty will be experienced in adapting this method to the existing system.

Let us now consider some of the results which will follow this change. 1st. What effect will it have on surveyors, engineers, etc. ?

They will simply go on using the chains or tapes they now have, but express the results of their measurements in feet and decimals, and when they are worn out or broken get a new one divided into tenths and hundredths. With regard to our scales, they are now decimally divided, and no difficulty will arise in plotting surveys made in feet and hundredths with them. Of course, as they wear out or break, supply their places with ones divided in tenths instead of inches. We would then use the expression on our plans, "1 tenth equals 50 feet," or as the case may be. The surveyor who is also an engineer should welcome the change with rapture, from the fact that all measurements for length are now made in feet and tenths, so he will not have to carry two tape-lines with him.

We now come to the subject of calculations under this system. First, as to measures of length now expressed in inches, etc., it may be said that mechanics generally use inches and eighths, and to convert them into feet and hundredths would be too much trouble. The following rule I have found to be quite close enough for practice:— "First express the inches and eighths in eighths. Place this number to the right of the decimal point. In the tenths or hundredths place according as the number of eighths is tens or units. Multiply the number by four and place the product below in the hundredths, thousandths, or tens of thousandths, place as the case may be. The sum will be the required decimal of a foot."

Thus, express  $6\frac{1}{8}$  inches in decimals of a foot:—

$$\begin{array}{r} 6\frac{1}{8} \text{ inches} = \frac{49}{8} \qquad \qquad \qquad \cdot 49 \\ 49 \times 4 = \qquad \qquad \qquad \qquad \qquad \qquad \underline{196} \\ \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \qquad \cdot 5096 \end{array}$$

Should be .5104.

Again, as to converting square feet into acres and hundredths, 43,560 is a big divisor. But the figures are easily multiplied, and for ordinary purposes, where a few acres only are in question, multiplying square feet by 23 and cutting off the last six figures will give a sufficiently close result.

I cannot think that any difficulty will arise when foot-rulés, divided as I suggest, are placed in the hands of the workmen. The reason that I have taken up the Dominion standard before the standard which we, as Ontario surveyors, are bound to verify our chains by, is this:—That, in my opinion, the Ontario standard is only binding on us when making surveys under the authority of the Commissioner of Crown Lands. But when making surveys for private individuals, who are selling their land by the acre or by the foot, the Dominion standard is the one by which we are governed. Another reason is this:—The Dominion standard is very much more accurate. The changes due to temperature have been carefully observed, and means for making these observations are provided for, whereas, in the Provincial standard the means are not so accurate. Let me read to you the legal description of the former:

## PART I.—DOMINION STANDARDS.

“The Dominion standard for determining the length of the Dominion standard yard is a solid square bar, thirty-eight inches long and one inch square in transverse section, the bar being of bronze or gun metal (known as Baily’s metal) ; near to each end a cylindrical hole is sunk (the distance between the centres of the two holes being thirty-six inches) to the depth of half an inch ; at the bottom of each hole is inserted in a smaller hole a gold plug or pin, about one-tenth of an inch diameter, and upon the surface of each pin are cut a fine line transverse to the axis of the bars, and two lines at an interval of about one-hundredth of an inch parallel to the axis of the bar ; the measure of length of the Dominion standard yard is given by the interval between the transverse line at one end and the transverse line at the other end, the part of each line which is employed being the point midway between the longitudinal lines ; and the said points are in this Act referred to as the centres of the said gold plugs or pins, and such bar is marked “ Mr. Baily’s Metal,” standard yard, “ A,” “ Troughton & Simms, London.” There are also on the upper side of the bar, two holes for the insertion of the bulbs of suitable thermometers for the determination of the temperature.”

This bar is standard at a temperature of 61°.91 Fahrenheit.

The Ontario standard may be described thus:—A metal bar of rectangular form and about a yard in length, across which lines are cut to denote feet and links. There is no provision for inserting thermometers, and the divisions are coarse. It is supposed to be standard at about 60° Fahr. I will not discuss the subject of deriving a standard for weights and measures from the lineal standard, though I think the connection would be most advisable. With regard to angular measurements, the benefit of dividing the degree decimally, and having our instruments similarly divided, needs no comment. In conclusion I hope this paper will have the effect of inducing this Association to take the matter up with such energy that the matter may become an actual fact and not remain a visionary theory.

## DISCUSSION.

Mr. Gibson—What steps do you suggest we should take ?

Mr. Sankey—I think we would not require legislation. The way is to go slow. If all the surveyors would start to make their measurements in hundredths I think there would be no difficulty in carrying the matter out. The public would soon understand it, there would be no difficulty in that. The advantages would be so great and the disadvantages so small. The metric system is law in Canada. Mr. Bates, of Arkansas, advocates that system. The metric system would be difficult to bring into common use. The only way would be for some fairy to obliterate the feet and inches and for us to waken up some morning and find the metric system in vogue.



Mr. Abrey—That same question came up in the meeting in Ottawa. I think the way we are now fixed the decimal system is the best.

Mr. Gibson—I use the system Mr. Sankey talks of. In length measures I reduce them at once to decimals, and the same in acres. In using this system on the construction of a viaduct I had some difficulty; the trouble was, all the mechanics had their rules divided into 1 inch,  $\frac{1}{8}$  inch,  $\frac{1}{4}$  inch,  $\frac{1}{2}$  inch, etc.; they did not understand the hundredths. It required the greatest accuracy in building a viaduct. When you hand your profile to the foreman it is in tenths, and you have to reduce it to sixteenths. There are tables prepared by Buchanan for finding areas. We all use the decimal system. If we could get the mechanics to use the decimal system we would not have so much trouble. We ought to have it taught in schools.

Mr. Sankey—In answer I would say the mechanics are just as well educated in dollars and cents, and when you put the new rule in their hands they will easily learn it. This matter is one of public importance, and as manufacturers are generally the first people to move in such a matter I think it would be advisable to send round a little treatise to the manufacturers, etc.

Mr. Aylsworth—I have had some experience. Good mechanics have used the rule divided into eighths and you cannot make them use tenths.

---

# APPENDIX.

## LIST OF EXHIBITS.

V. Sankey, Esq., P.L.S., showed some samples of Keuffel and Esser's new process of photographing from tracings, called the Nigroine Process. It differs from the Blue Process, in giving black lines on white ground. In their circular, Keuffel and Esser say of it :—  
“ This process is nearly as simple as the Blue Process, but differs from it chiefly in that it requires a chemical developer added to the water bath. The great advantages of this process are, that it gives a permanent *facsimile* of the original drawing, permanent black lines on a permanent white ground, and the half tones as such. This also overcomes the drawback of shaded blue prints, which always show light, and shade reversed.” For prices, etc. address Keuffel & Esser, 127 Fulton Street and 42 Ann Street, New York.

Messrs. Hart & Company, the well-known firm of stationers, had an interesting exhibit of materials necessary for the use of surveyors and civil engineers, consisting of tracing linen, tracing paper, Whatman's hand-made paper, profile and cross-section paper; also samples of transit, record, cross-section and field books, besides many other needful sundries, including a selection of the more useful grades of Faber's Siberian Graphite pencils, as well as those of cheaper qualities. There was also a collection of private and office stationery quite in keeping with the reputation of this firm, as fine and general stationers. Mention might also be made of the specimens of fine printing, engraving and embossing which were shown, as this class of work is receiving much more attention than formerly, both by professional and business men.

Mr. Sanderson exhibited a Calculating Machine. It was, he said, an improvement on all previous calculators. It was invented by Mr. Tate, and was called Tate's Patent Arithmometer. It is the latest calculator in existence, the older machines were more difficult to work. Mr. Sanderson then proceeded to show how the machine worked, and gave the following illustration :—

$$\begin{aligned} & P + 2 \quad 89987888 + 98998788 \\ & P - 2 \quad 89689 - 43642 \\ & P + 2 \quad R \quad 98998898 + 9897688 \times 654321 \\ & P - 2 \quad R \quad 9998999989998889 - 8998978 \times 65473 \\ & P \\ \hline & 2 \quad 898464 \div 5432 \\ & P \quad 2 \times R \quad S \times T \quad M \\ & \quad 898976 \times 4323 + 9878 \times 4365 + 78965 + 43231 \end{aligned}$$

Rice Lewis & Co., Toronto, exhibited some of Chesterman's steel band chains, which they keep in stock.

BIOGRAPHICAL SKETCH  
OF  
THE LATE THOMAS DEVINE, F.R.G.S.

---

MR. DEVINE entered the Department of Crown Lands July 11th, 1846, and was attached to the Upper Canada Surveys Branch, as Surveyor and Draughtsman. He had previously been admitted on June 11th, 1846, a Provincial Land Surveyor. In 1857, on the appointment of the late Andrew Russell to be Assistant Commissioner of Crown Lands, Mr. Devine was made Head of Surveys for Upper Canada. About the same time, on the resignation by Mr. Russell of his seat on the Board of Examiners of Land Surveyors, Mr. Devine was appointed to the vacant seat, which he held until his resignation in 1879. On the eve of his departure, the Board of Examiners passed the following resolution:—

OFFICE OF BOARD OF EXAMINERS OF  
LAND SURVEYORS FOR ONTARIO,

TORONTO, October 7th, 1879.

The members of the Board, in session assembled, desire to express to their Chairman, Thomas Devine, Esq., F.R.G.S., on the eve of his departure for Europe, their cordial good wishes for himself and family; they cannot but feel, that their labours have been lightened by his uniform urbanity, and the ability and zeal displayed by him in promoting the best interests of the profession, and in co-operating with them in the desire to elevate the standard of scientific acquirements.

(Signed) F. F. PASSMORE,  
*Chairman pro tem.*

HUGH WILSON,  
P. S. GIBSON,  
GEO. B. KIRKPATRICK,  
*Secretary of Board.*

Mr. Devine was a native of the County Westmeath, Ireland, studied his profession under the Royal Engineers, and was employed on the Ordnance Survey of Ireland. He then came to Canada, and, in 1846, was appointed to a position in the Survey Branch of the Crown Lands Department. In 1872, the Ontario Government conferred upon him the title of Deputy Surveyor-General, which position he held until the end of 1879, when, feeling the necessity of rest and

relaxation, he retired, after completing thirty-three years of faithful service.

While a resident in Toronto, he took an active interest in educational matters, was a member of the Toronto Separate School Board, and, during his last term of office, was chairman of that body.

On his resignation, he returned to his native country and spent several years there, residing principally in Dublin. He returned to Canada and settled in Montreal, where he continued to reside until his death. He was ill for only a few weeks, and his death was quite unexpected. He died in Montreal on Wednesday, the 14th November, 1888. A widow and two sons survive him.

As a topographer, Canada is much indebted to Mr. Devine for many valuable and beautiful maps which he brought out from time to time while in the employ of the Government. The principal ones, covering the whole of Canada, were published while the Hon. Messrs. Cauchon, Vankoughnet and Scott were in charge of the Department of Crown Lands, and were universally admired. His services in this line were recognized by the Royal Geographical Society of London, which elected him a Fellow. He was also a corresponding member of the Geographical Society of Berlin, and of the American Geographical and Statistical Society.

---

# LIST OF MEMBERS.



## ACTIVE MEMBERS.

| NAME.                                                  | OCCUPATION.                                                                                         | ADDRESS.                           |
|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------|
| Abrey, George Brockitt . . . . .                       | 17 Arcade, Yonge Street, Toronto.                                                                   |                                    |
| *Apsey, John Fletcher . . . . .                        | 47 Gloucester Street, Toronto.                                                                      |                                    |
| Aylsworth, Wm. Robert . . . . .                        | Deseronto.<br>Engineer for Tyendinaga, Engineer for Bay of Quinte Railway, etc.                     |                                    |
| Aylsworth, Charles Fraser, Jr. . . . .                 | Madoc.<br>Engineer for Madoc and Townships of Madoc, Rawdon & Hungerford.                           |                                    |
| Baird, Alexander . . . . .                             | Leamington.                                                                                         |                                    |
| *Bazett, Edward . . . . .                              | Midland.                                                                                            |                                    |
| Beatty, David . . . . .                                | Parry Sound.                                                                                        |                                    |
| *Bell, James Anthony . . . . .                         | St. Thomas.<br>City Engineer.                                                                       |                                    |
| Berryman, Edgar, M. Can. Soc. C.E. .                   | 17 Place d'Armes Hill, Montreal.<br>Chief Engineer Great Eastern Railway.                           |                                    |
| *Blake, Frank Lever . . . . .                          | Toronto.<br>Astronomical Assistant at Observatory.                                                  |                                    |
| *Bolger, Thomas Oliver . . . . .                       | Kingston.<br>City Engineer.                                                                         |                                    |
| Bolger, Francis . . . . .                              | Penetanguishene.                                                                                    |                                    |
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| *Bolton, Lewis . . . . .                               | Listowel.<br>Engineer for Townships of Elma, Grey, Morris, Town of Listowel and Village of Drayton. |                                    |
| *Booth, Charles Edward Stuart, A. M. Can. Soc. C.E.,   | 393 Division Street, Kingston.                                                                      |                                    |
| *Bowman, Arthur Meyer, Grad. S.P.C., Toronto . . . . . | Berlin.                                                                                             |                                    |
| Bowman, Clemens Dersteine . . . . .                    | West Montrose.                                                                                      |                                    |
| Bowman, Herbert Joseph, Grad. S.P. Sc. (Toronto);      | A.M. Can. Soc. C.E. . . . .                                                                         | Berlin.<br>Superintendent B. W. W. |

| NAME.                                                                             | OCCUPATION.                                               | ADDRESS.          |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------|
| *Bowman, Isaac Lucius . . . . .                                                   |                                                           | Berlin.           |
| Bray, Edgar . . . . .                                                             |                                                           | Oakville.         |
| Browne, Harry John . . . . .                                                      | 17 Toronto Street, Toronto.                               |                   |
| Browne, Wm. Albert . . . . .                                                      | 17 Toronto Street, Toronto.                               |                   |
| Burke, Wm. Robert . . . . .                                                       | Engineer for County of Oxford.                            | Ingersoll.        |
| *Burnet, Peter . . . . .                                                          |                                                           | Orillia.          |
| Burt, Frederick Percy . . . . .                                                   | Chief Draughtsman "Engineering News."                     | New York City.    |
| Campbell, Archibald Wm., A. M. Can. Soc. C.E. . . . .                             |                                                           | St. Thomas.       |
| Campbell, David Suter . . . . .                                                   | Engineer for five Townships.                              | Mitchell.         |
| Casgrain, Joseph Philip Baby, A. M. Can. Soc. C.E. . . . .                        |                                                           | Morrisburgh.      |
| Cavana, Allan George . . . . .                                                    | Engineer for Townships of Rama, Mara and Dalton.          | Orillia.          |
| Cheesman, Thos. . . . .                                                           |                                                           | Mitchell.         |
| Chipman, Willis, B.A.Sc. (McGill); M. Am. Soc. C.E.;<br>M. Can. Soc. C.E. . . . . | City Engineer.                                            | Brockville.       |
| Coad, Richard . . . . .                                                           |                                                           | Glencoe.          |
| *Coleman, Richard Herbert . . . . .                                               | Engineer for Canada Company.                              | Toronto.          |
| Cozens, Joseph . . . . .                                                          | Town Engineer, Sault Ste Marie.                           | Sault Ste. Marie. |
| Davidson, Walter Stanley . . . . .                                                |                                                           | Petrolea.         |
| Davis, John . . . . .                                                             | Engineer Guelph Junction Railway.                         | Guelph.           |
| Davis, Wm. Mahlon, Grad. R. M. C. (Kingston); A. M.<br>Can. Soc. C.E. . . . .     | Town Engineer, Woodstock.                                 | Woodstock.        |
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| Decker, Edwin Stanton . . . . .                                                   |                                                           | St. Thomas.       |
| De Morest Watson . . . . .                                                        | 136 N. Lisgar St., Toronto.                               |                   |
| De Gursé, Joseph . . . . .                                                        | Chief Engineer, Lake Erie, Essex & Detroit River Railway. | Windsor.          |

| NAME.                                                                         | OCCUPATION.                                                                                                            | ADDRESS.                          |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Dickson, James . . . . .                                                      | Inspector Crown Lands Surveys.                                                                                         | Fenelon Falls.                    |
| Doupe, Joseph, C.E. (McGill) . . . . .                                        |                                                                                                                        | 7 Princess Street, Winnipeg, Man. |
| *Drewry, Wm. Stewart, A. M. Can. Soc. C.E. . . . .                            | Engineer for Townships of Sidney and Thurlow.                                                                          | Box 386, Belleville.              |
| Ellis, Henry Disney . . . . .                                                 | Assistant Engineer O. & Q. Railway (Don Branch).                                                                       | 74½ St. Patrick Street, Toronto.  |
| Esten, Henry Lionel . . . . .                                                 |                                                                                                                        | 30 Adelaide Street East, Toronto. |
| Evans, John Dunlop M. C. Soc. C.E. . . . .                                    | Chief Engineer Central Ontario Railway, Engineer Weddell Bridge and Engine Works.<br>Engineer Canadian Copper Company. | Trenton.                          |
| Fawcett, Thomas, D.T.S. . . . .                                               | Dominion Government Surveys.                                                                                           | Gravenhurst.                      |
| Fitton, Charles Edward . . . . .                                              | Engineer Wahnapatæ Mining Company.                                                                                     | Orillia.                          |
| Flater, Frederick William . . . . .                                           |                                                                                                                        | Chatham.                          |
| Foster, Frederick Lucas . . . . .                                             |                                                                                                                        | 176 Argyle Street, Toronto.       |
| *Franks, Cecil Bushe, M. Can. Soc. C.E. . . . .                               | Assistant Engineer G. T. R.                                                                                            | Box 116, Hamilton.                |
| Galbraith, John, M.A.; Assoc. M. Inst. C.E., D.T.S. . . . .                   | Professor of Civil Engineering, School of Practical Science.                                                           | Toronto.                          |
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| *Gilliland, Thomas B. . . . .                                                 |                                                                                                                        | Eugenia:                          |
| Hanning, Clement George, C.E. (Trinity College, Dublin,<br>Ireland) . . . . . |                                                                                                                        | 135 Bloor Street East, Toronto.   |
| *Henderson, Eder Eli . . . . .                                                | Engineer on International Railway, Maine.                                                                              | Brownville, Me.                   |
| Johnston, R. T., 131 Wellington St. W. . . . .                                |                                                                                                                        | Toronto.                          |
| *Jones, Charles Albert . . . . .                                              | Engineer for Townships of London, Delaware and West Nissouri.                                                          | 215 Dundas Street, London.        |
| *Jones, Thomas Harry, B.A.Sc. (McGill) . . . . .                              | City Engineer, Engineer for Townships of Burford, Brantford and South Dumfries.                                        | Brantford.                        |

| NAME.                                                     | OCCUPATION.                                                                                    | ADDRESS.                           |
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| *Keefer, Thos. Coltrin,                                   | C.M.G.; M. Inst. C.E.; Pres. A.<br>Soc. C.E.; Can. Soc. C.E.                                   | Ottawa.                            |
| Kirk, Joseph.                                             | Engineer for Townships of Mornington, South Easthope, North Easthope and Village of Melverton. | Stratford.                         |
| Kirkpatrick, George Brownly                               | Chief Clerk Survey Branch, Department of Crown Lands.                                          | Toronto.                           |
| Klotz, Otto Julius, D.T.S.; C.E. (University of Michigan) | Astronomer for Department of Interior.                                                         | Preston.                           |
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| Low, Nathaniel E.                                         |                                                                                                | Wiarton.                           |
| Lumsden, Hugh David, M. Inst. C.E.; M. Can. Soc.<br>C.E.  | Engineer for Atlantic & North-West and International Railways.                                 | Sherbrooke, Q.                     |
| McAree, John, Grad. S.P.S.; D.T.S.                        |                                                                                                | ..237 Parliament St., Toronto.     |
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| *McDonell, Augustine.                                     |                                                                                                | Chatham.                           |
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| McGeorge, Wm. Graham                                      | Engineer County of Kent.                                                                       | Chatham.                           |
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| McKay, Owen                                               | Assistant Engineer L. E. E. & D. R. Ry.                                                        | Windsor.                           |
| McKenna, John Joseph                                      |                                                                                                | Dublin.                            |
| McPhillips, George                                        |                                                                                                | Windsor.                           |
| *Maddock, Junius Arthur                                   |                                                                                                | Gladstone, California.             |
| *Manigault, Wm. Mazyck                                    | Engineer for Townships of Caradoc, East Williams, Adelaide and Town of Strathroy.              | Strathroy.                         |
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| Moore, John McKenzie                                      | Engineer for four Townships.                                                                   | London.                            |



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| Murphy, Chas. Joseph.....                                                |                                                                   | 30 Adelaide Street East, Toronto. |
| Niven, Alexander .....                                                   | Outline Surveys, Crown Lands Department.                          | Haliburton.                       |
| Ogilvie, William, D.T.S.....                                             | Exploration Survey Alaskan Boundary.                              | Ottawa.                           |
| Patten, Thadeus James .....                                              |                                                                   | Little Current.                   |
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| *Ritchie, Nelson Thomas .....                                            |                                                                   | Kincardine.                       |
| Robertson, James, Grad. S. P. Sc. ....                                   | Engineer for several Townships.                                   | Glencoe.                          |
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| *Sankey, Villiers.....                                                   | City Surveyor.                                                    | City Hall, Toronto.               |
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| Sewell, Henry DeQuincy, Assoc. M. Inst. C.E.....                         |                                                                   | Port Arthur.                      |
| *Smith, Henry, M. Can. Soc. C.E. ....                                    | Superintendent of Colonization Roads in Ontario.                  | Toronto.                          |
| Speight, Thomas Bailey .....                                             |                                                                   | Arcade, Yonge Street, Toronto.    |
| *Sproatt, Charles, M. Can. Soc. C.E. ....                                | City Engineer.                                                    | Toronto.                          |

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|                                                             | Engineer for Townships of Egremont, Proton, Melancthon and Osprey. |                                |
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| Van Nostrand, Arthur Jabez .....                            |                                                                    | Arcade, Yonge Street, Toronto. |
| Vicars, John .....                                          |                                                                    | Cannington.                    |
|                                                             | Engineer for Township of Brock and Village of Cannington.          |                                |
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|                                                             | Engineer for the Townships of East Wawanosh, Ashfield and Culross. |                                |
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| Webb, Adam Clark .....                                      |                                                                    | Brighton.                      |
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| *Wheeler, Arthur Oliver .....                               |                                                                    | Ottawa.                        |
|                                                             | Department of Interior.                                            |                                |
| Wheelock, Chas. Richard .....                               |                                                                    | Orangeville.                   |
|                                                             | Engineer for Counties of Wellington, Dufferin and Peel.            |                                |
| *Whitson, James Francis .....                               |                                                                    | North Bay.                     |
|                                                             | Engineer for six Townships.                                        |                                |
| Wicksteed, Henry King, B.A.Sc. (McGill), M. C. Soc. C. E. . |                                                                    | Ottawa.                        |
|                                                             | Chief Engineer Brantford, Waterloo & Lake Erie Railway.            |                                |
| *Willson, Alfred .....                                      |                                                                    | Toronto.                       |
|                                                             | Chief Engineer Canada Company.                                     |                                |
| *Wilson, Hugh, F.G.S. ....                                  |                                                                    | 433 Carlton Street, Toronto.   |
| Yarnold, William Edward .....                               |                                                                    | Port Perry.                    |
|                                                             | Engineer for Townships of Reach, Scugog, Mariposa and Georgina.    |                                |

---

### JUNIOR MEMBERS.

|                                  |                                   |            |
|----------------------------------|-----------------------------------|------------|
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|                                  | Assistant Engineer N. T. & Q. Ry. |            |
| Sherman, Ruyter .....            |                                   | Brantford. |

---

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|                              |                                           |          |
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|                              | Superintendent of Meteorological Service. |          |

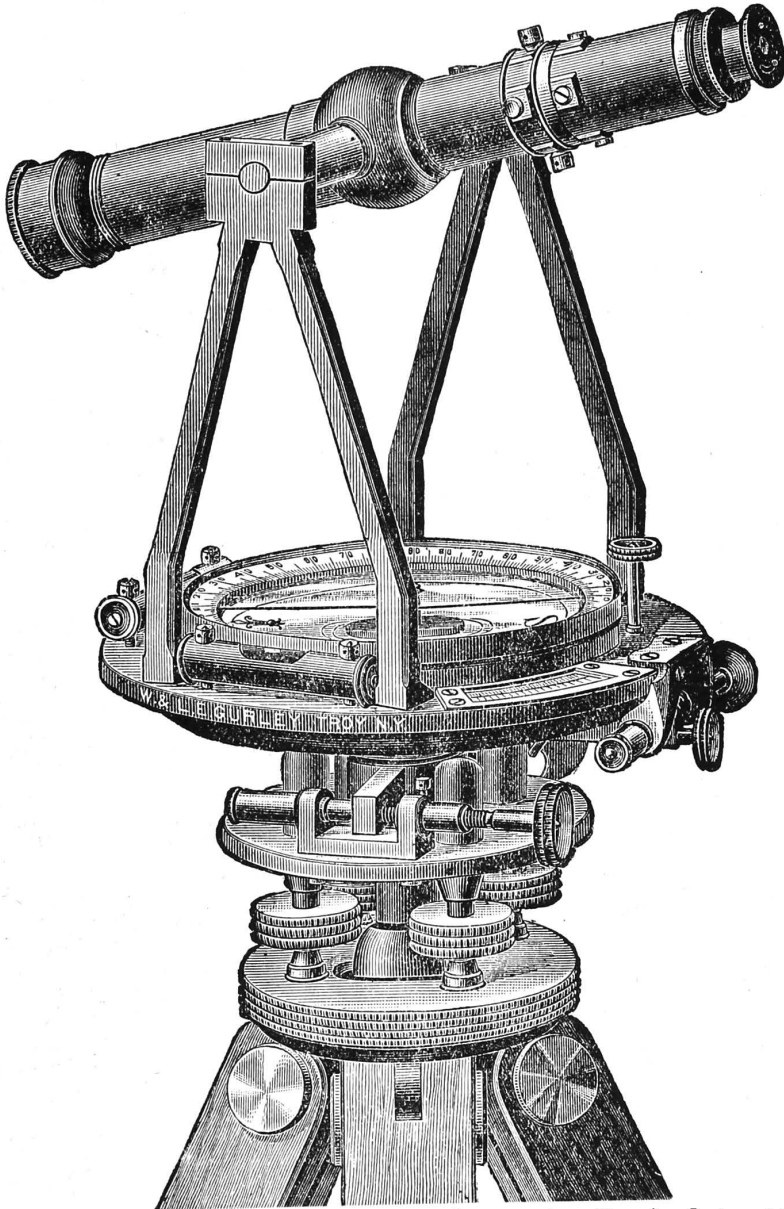
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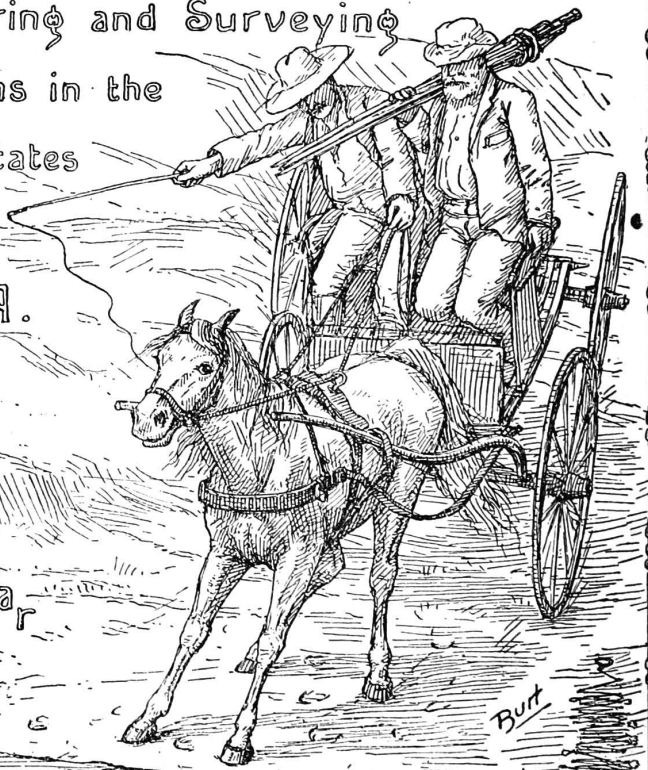
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PROCEEDINGS  
OF THE  
ASSOCIATION OF  
PROVINCIAL LAND SURVEYORS  
OF ONTARIO

AT ITS FIFTH ANNUAL MEETING, HELD AT TORONTO,  
ON FEBRUARY 25TH, 26TH AND 27TH,

1890.

---

*The Sixth Annual Meeting will be held in Toronto, on Tuesday,  
24th of February, 1891.*

---

PRINTED FOR THE ASSOCIATION  
BY  
C. BLACKETT ROBINSON, 5 JORDAN STREET,  
TORONTO.

## **PATRONIZE OUR ADVERTISERS.**

### NOTICES.

---

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

---

Each member is requested to add to his business card the following:  
*“Member of the Association of Provincial Land Surveyors of Ontario.”*

---

Members can be supplied with copies of the Proceedings for 1887, 1888 or 1889 by remitting fifty cents to the Secretary.

Copies of the Constitution will be sent upon receipt of three cent stamp.

## **PATRONIZE OUR ADVERTISERS.**

# PREFACE.

---

*To the Members of the Association of Provincial Land Surveyors of Ontario :*

THE following Report of the Proceedings of the Association at its Fifth Annual Meeting, held in Toronto, in February, 1890, is now brought before you.

The Papers read were full of instruction, and we feel that the thanks of the Association are due to the writers for their selection and treatment of the various subjects presented. Many points of value to the profession were discussed in connection with the "Question Drawer," the Land Surveying Committee having paid much attention to this feature.

Owing chiefly to the epidemic that prevailed at the time of meeting, the attendance was not quite so large as at the meeting of 1889.

Several new members have joined the Association during the past year.

We would impress on the members of the Association that it is desirable to have as large an attendance as possible at the Annual Meetings, in order to have full discussion on each of the subjects presented.

Respectfully submitted on behalf of the Executive Committee.

A. J. VANNOSTRAND,  
*Secretary.*

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ASSOCIATION OF  
PROVINCIAL LAND SURVEYORS  
OF ONTARIO.

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ORGANIZED 23RD FEBRUARY, 1886.

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**Officers for 1890=91.**

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PRESIDENT.

Villiers Sankey, P.L.S., City Hall, Toronto.

VICE-PRESIDENT.

Elihu Stewart, P.L.S., Collingwood.

SECRETARY-TREASURER.

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

COUNCILLORS.

H. B. Proudfoot, Toronto.

Maurice Gaviller, Barrie.

T. Harry Jones, Brantford

BANKERS.

Imperial Bank of Canada.

## STANDING COMMITTEES.

LAND SURVEYING.—A. Niven (Chairman); C. F. Miles, G. B. Kirkpatrick, M. Gaviller, P. S. Gibson, J. P. B. Casgrain, R. Coad.

DRAINAGE.—James Robertson (Chairman); A. W. Campbell, H. J. Bowman, J. C. McNabb, W. S. Davidson, H. W. Selby.

ENGINEERING.—Willis Chipman (Chairman); R. B. Rogers, G. B. Abrey, H. D. Ellis, Joseph Kirk, H. K. Wickstead.

LEGISLATION.—W. R. Aylsworth (Chairman); James Dickson, G. B. Kirkpatrick, Lewis Bolton, J. F. Whitson, Isaac Traynor.

ENTERTAINMENT.—F. L. Foster (Chairman); Chas. Murphy, H. D. Ellis, G. B. Abrey, T. B. Speight, H. B. Proudfoot, W. A. Browne.

PUBLICATION.—John McAree (Chairman); H. L. Esten, H. J. Browne, F. L. Foster, Willis Chipman.

INSTRUMENTS.—J. W. Tyrrell (Chairman); W. Ogilvie, B. J. Saunders, Thomas Fawcett.

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PROGRAMME OF THE  
ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO

AT ITS FIFTH ANNUAL MEETING HELD IN TORONTO,  
FEBRUARY 25TH, 26TH, AND 27TH, 1890.

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PROGRAMME.

*Tuesday, February 25th—Morning, 10 o'clock.*

Meeting of Executive Committee.  
Meeting of Standing Committees.

*Afternoon, 2 o'clock.*

Reading of Minutes of Previous Meeting.  
Reading of Correspondence.  
Report of Secretary-Treasurer.  
Appointment of Auditors.  
President's Address.  
Report of Committee on Land Surveying, M. Gaviller, P.L.S.,  
Chairman.  
Announcements by Entertainment Committee, A. J. VanNostrand,  
P.L.S., Chairman.

*Evening, 8 o'clock.*

Paper—"Harbour and Coast Surveys in Hudson Bay and Strait,"  
J. W. Tyrrell, P.L.S.  
Paper—"Township Boundary Lines in the District of Nipissing,"  
B. J. Saunders, P.L.S., Brockville.  
Report of Committee on Boundary Commissioners, Villiers Sankey,  
P.L.S., Chairman.  
Report of Committee on Affiliation of the different Associations of  
Land Surveyors in Canada.

*Wednesday, February 26th—Morning, 10 o'clock.*

Question Drawer—"Land Surveying and Legislation."  
Report of Committee on Drainage, James Robertson, P.L.S.,  
Chairman.

Paper—"Compiled Plans," P. S. Gibson, P.L.S.

Paper—"Tunnel Drain," J. C. McNabb, P.L.S.

Question Drawer—"Drainage and Engineering."

Paper—"Levelling," J. L. Morris, P.L.S.

*Afternoon, 2 o'clock.*

Report of Auditors.

Report of Committee on Engineering, W. M. Davis, P.L.S.,  
Chairman.

Paper—"Practical Working of the Ditches and Water Courses  
Act," Richard Coad, P.L.S.

Paper—"Draughting," F. L. Foster, P.L.S.

Paper—"Highway Bridges," A. W. Campbell, P.L.S.

Paper—"The Graphical Calculus," G. B. Abrey, P.L.S.

Paper—"Water Works for Towns and Villages," H. J. Bowman,  
P.L.S.

*Thursday, February 27th—Morning 10 o'clock.*

Report of Committee on Legislation, W. R. Aylsworth, P.L.S.,  
Chairman.

Report of Committee on Publication, H. L. Esten, P.L.S.,  
Chairman.

Report of Committee on Instruments, J. W. Tyrrell, P.L.S.,  
Chairman.

Report of Committee on Affiliation, President, Chairman.

Report of Committee on Decimal *vs.* Duodecimal Systems, T.  
Fawcett, D.T.S., Chairman.

Paper—"Extra Strains in Structures," G. B. Abrey, P.L.S.

Paper— — R. B. Rogers, P.L.S.

*Afternoon, 2 o'clock.*

Report of Committee on Entertainment, A. J. VanNostrand,  
P.L.S., Chairman.

Unfinished Business.

Election of Associate Members, Junior Members and Honorary  
Members.

Nomination of Officers.

Appointment of Scrutineers—Ballot of 1890.,

New Business.

Adjournment.

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Full discussion after each Paper and each Report.



ASSOCIATION OF  
PROVINCIAL LAND SURVEYORS  
OF ONTARIO.

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MINUTES OF THE FIFTH ANNUAL MEETING,  
FEBRUARY 25TH, 26TH AND 27TH, 1890.

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The Association met at 2 p.m., on February 25th, in the Library of the Canadian Institute, 46 Richmond Street East, Toronto.

The Association was called to order by the President, Alexander Niven, Esq.

Moved by Willis Chipman, seconded by H. B. Proudfoot: That the minutes of last meeting, as printed in the Proceedings, be confirmed as read. Carried.

The President read the resignation of Willis Chipman, Secretary-Treasurer.

Moved by James Dickson, seconded by W. R. Aylsworth: That the resignation of the Secretary-Treasurer be accepted. Carried.

Moved by E. Stewart, seconded by J. Dickson: That A. J. Van Nostrand, P.L.S., act as Secretary, *pro tem.* Carried.

The Secretary-Treasurer, Willis Chipman, then presented his Annual Report, which, upon motion, was received and adopted, and financial statement referred to the Auditors.

Moved by C. F. Miles, seconded by E. Stewart: That Messrs. D. S. Campbell and T. H. Jones be the Auditors for the current year. Carried.

The President then read his annual address. (See page 49.)

The Report of the Committee on Land Surveying was then presented by the Chairman, M. Gaviller, which, after discussion, was received and adopted. (See page 21.)

The Committee on Entertainment notified the meeting of the annual dinner, on Wednesday evening, at 8 o'clock.

Meeting adjourned at 5 p.m.

## EVENING SESSION, 8 P. M.

President in the Chair.

J. W. Tyrrell read his paper on "Harbour and Coast Surveys in Hudson's Bay and Strait."

Moved by Mr. Kirkpatrick, seconded by Mr. Cozens: That a vote of thanks be tendered to Mr. Tyrrell for his excellent paper. Carried.

Committee on Boundary Commission presented their report, through Mr. Sankey, Chairman. (See page 44.)

Moved by Mr. Gaviller, seconded by Mr. Ellis: That the President name a Committee to make a draft of the proposed amendments, and they be submitted for the consideration of the Association on Thursday. Carried.

The President named as that committee Messrs G. B. Kirkpatrick, C. F. Miles, V. Sankey, M. Gaviller and E. Stewart.

The President read report of Committee on Affiliation of the Different Associations of Land Surveyors in Canada, which was laid on the table until the last day of the meeting.

Meeting adjourned at 10 p.m.

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 WEDNESDAY, FEBRUARY 26TH, 10 A.M.

The President in the chair.

The Report of the Committee on Drainage was read by Mr Chipman in the absence of the chairman, James Robertson, P.L.S.

Moved by Mr. Selby, seconded by Mr. Campbell, that the Report of the Committee on Drainage be received and adopted. Carried.

Moved by Willis Chipman, seconded by T. J. Patten, that the Committee on Drainage for the ensuing year prepare a circular, as recommended in the Report of the Drainage Committee, and send a copy to such of the township clerks as they may select, and that the Secretary send copies to the members of this Association. Carried.

The paper on "Tunnel Drain" was read by Mr. Chipman, in the absence of the writer, J. C. McNabb, P.L.S. A resolution of thanks was passed to the author.

The paper on "Levelling" was read by Mr. Chipman in the absence of the writer, J. L. Morris, P.L.S.

Moved by Mr. Aylsworth, seconded by Mr. McAree: That this paper be received and referred to the Publication Committee, and the thanks of this Association be given to the author. Carried.

Moved by H. D. Ellis, seconded by C. F. Miles: That the President name a committee to revise the tariff of charges, and report to the meeting Thursday morning. Carried.

The President named the following committee: Messrs. E. Stewart, M. Gaviller, H. J. Browne, H. B. Proudfoot, T. B. Speight, C. F. Miles and Lewis Bolton.

Adjourned at 12.20 p.m.

AFTERNOON SESSION, 2 P.M.

The Report of Auditors was then received and adopted.

The Engineering Committee made no report.

F. L. Foster, P.L.S., read his paper on "Draughting."

Moved by Mr. Stewart, seconded by Mr. Dickson: That a vote of thanks be tendered to Mr. Foster for his excellent paper on draughting. Carried.

Mr. H. J. Bowman read his paper on "Water-works for Towns and Villages."

A vote of thanks was tendered Mr. Bowman for his paper.

Mr. G. B. Abrey read his paper on "The Graphical Calculus."

The thanks of the meeting were tendered to Mr. Abrey for his paper, one which must have cost a great deal of time and thought in its preparation.

Prof. Galbraith suggested that, in papers of this description, abstracts should be printed previous to first reading, to enable discussion on it.

Meeting adjourned at 5.15 p.m.

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THURSDAY, FEBRUARY 27TH, 10 A.M.

Report of Committee on Publication was then presented by the Secretary, in the absence of the Chairman, H. L. Esten, P.L.S.

Moved by Willis Chipman, seconded by A. J. Van Nostrand: That the report of the Publication Committee be received and adopted. Carried.

Report of Committee on Instruments was then presented by J. W. Tyrrell, P.L.S., Chairman.

Moved by Mr. T. H. Jones, seconded by R. B. Rogers: That the Report of Committee on Instruments be received and adopted. Carried.

The President, Chairman of the Committee on Affiliation, made the following remarks: This matter came up the first day, and I read all the correspondence, the matters submitted from the Dominion Association, and to the Committee appointed to report to the Execu-

tive, and the remarks of each member of the Executive. The whole thing was forwarded to the Dominion Association, in Ottawa, in time for their annual meeting, and although suggested that some of them should appear here and discuss the matter, we have not heard from them by letter or by any representative. I don't think there is any use of my saying anything more about it. The matter originated with them; they have our opinion and they have taken no action upon it. It might be proper under this head, if this meeting sees fit, to adopt the report of the Executive as the opinion of this meeting. That would dispose of it and the matter would stand.

Moved by John McAree, seconded by D. L. Sanderson: That the Report of the Special Committee on Affiliation be received and adopted. Carried.

P. S. Gibson then read his paper on "Compiled Plans."

Moved by Mr. Dickson, seconded by Mr. Abrey: That a vote of thanks be tendered to Mr. Gibson for his excellent paper. Carried.

#### AFTERNOON SESSION, 2 P.M.

G. B. Abrey read a paper on "Extra Strains in Structures."

Moved by M. Gaviller, seconded by Mr. Dickson: That a vote of thanks be tendered to Mr. Abrey. Carried.

Report of Committee on Entertainment was verbally presented by A. J. VanNostrand, Chairman, as follows: Prof. Galbraith mentioned last night at our dinner something about our taking quarters in his building at our next annual meeting. We have nothing to report but our dinner of last evening, but our written report will appear in the Proceedings.

The President: As to Prof. Galbraith's suggestion, we had better leave that to the Executive to deal with as the next session approaches.

Moved by John McAree, seconded by F. L. Foster: That the Report of Committee on Entertainment be taken as read, and be printed in the Proceedings. Carried.

Mr. Sankey: I have the Report here of the sub-Committee appointed yesterday *re* Boundary Commissioners. I suppose the proper thing would be to hand it over to the Legislative Committee to carry the thing further. The Committee did not think it necessary to bring in the several clauses that were in the first draft relative to improper acting on the part of the members of the Board. That is all covered in other ways, both as surveyors or judges, as the case may be. The law of arbitration seems to be well understood in the country. It is clearly set forth in the existing Acts. What the Committee thought was, that by having a court of this kind the parties could bring it into operation of their own free will, and the results of which can be made binding; that it will lessen litigation and have justice done in a more

proper and business-like way than at present. We think if a court of this kind is established, and the public get to know the powers of such a court, that it will be the way more often chosen.

Moved by Villiers Sankey, seconded by Mr. Dickson: That the Report of Committee on Boundary Commissioners be referred to the Committee on Legislation. Carried.

Mr. Aylsworth: The Committee on Legislation have nothing to report.

Mr. Stewart: The Committee on Tariff have put their report in the form of a resolution, as follows:—Moved by Mr. Stewart, seconded by Mr. Miles: That the Executive Committee be empowered and instructed to take such means as they may deem advisable to prevent unqualified persons from practising as surveyors. Carried.

The President: The idea is that this should be left in the hands of the Executive, and any member feeling aggrieved by such men practising may communicate the facts to the Secretary of the Association, with the evidence, and that will be laid before the Executive. If the Executive feel that from the state of the case laid before them a conviction could be made, they would be expected to proceed with it. However, the matter is left entirely in the hands of the Executive.

Mr. Sankey: I think the Executive ought to do a little more. If a reasonable case is made out, they ought to be at liberty to employ somebody to examine into the facts. It is putting the onus on the surveyor. It is of general importance to the whole profession. The Executive ought to be empowered to assist the surveyor hunting up the facts.

The President: I think the meeting would be willing to leave that to the judgment of the Executive.

Mr. Dickson: We are all interested in this, and if there is a case of the kind comes up, there should be an understanding that we all put our hands into our pockets to fight it.

A communication was read from David Boyle, Esq., curator of the Canadian Institute, inviting the members of the Association to visit the Archæological Museum of the Institute.

Moved by Mr. Chipman, seconded by Mr. Sanderson: That the invitation be accepted after the close of this meeting. Carried.

Report of Committee appointed last session on Exploratory Surveys was then presented by E. Stewart, Chairman.

Mr. Stewart: It was also thought wise that some lands should not be surveyed but left as timber reserves. Also that a Mining Engineer be allowed to accompany the party in order to find out where the best mineral land was, and find out something of the geology of the country. We all know that the Geological Survey is, and has been, for a great many years engaged in topographical surveying, in fact they are interfering with the work properly belonging to surveyors. There is one matter that I think would be wise to bring before the

Commissioner of Crown Lands, that we should have a traverse of the Canadian Pacific Railway right through the Province as a base for future work.

Mr. Cozens: I helped to make surveys north of the Canadian Pacific line to which I could get no tie line at all. They were accepted by the Department because it was not possible to get further information.

Moved by Mr. Stewart, seconded by Mr. McAree: That the report of the Special Committee on Exploratory Surveys be received and adopted. • Carried.

Moved by Willis Chipman, seconded by W. R. Aylsworth: That the meeting do now adjourn for an intermission of ten minutes. Carried.

(During intermission a photograph of the members present was taken by Mr. Chipman).

Moved by Willis Chipman, seconded by John McAree: That in the opinion of this Association an Act of Incorporation similar to the acts incorporating the other professions in this Province is desirable; that the Executive Committee of the Association to be elected during the month of March (proximo) be and are hereby instructed to submit to this Association at its next annual meeting a draft of a bill to incorporate this Association. Carried.

Moved by A. J. VanNostrand, seconded by V. Sankey: That any omissions or clerical errors in the Record of the Proceedings of this meeting, now in the hands of the Stenographer and the Secretary, be corrected by the Committee on Publication before being printed. Carried.

#### NOMINATIONS OF OFFICERS.

Mr. VanNostrand: I move that Mr. Villiers Sankey be appointed President. Carried.

Mr. Dickson: In this Association as in other public bodies, I think it is well to put members in positions of trust who are active working members of this Association. I have much pleasure in moving that Mr. E. Stewart be nominated as Vice-President of this Association.

Mr. McAree: I move that Mr. Aylsworth be nominated as Vice-President.

Mr. Aylsworth: My name has been proposed, but I hope the gentleman who proposed it will withdraw it. I could not consent to act as Vice-President. While I desire the Association to go on and prosper, I am too far removed from the centre of action, and I am not wholly occupied in land surveying and not so interested as I would have been twenty-five years ago.

Mr. Aylsworth's name is withdrawn and Mr. Stewart elected Vice-President.

Mr. Chipman: I beg to nominate Mr. A. J. VanNostrand as Secretary-Treasurer. I am certain we cannot get a man who will fill the

position better than Mr. VanNostrand. In proposing him I hope you will see your way to making it a unanimous nomination. Carried unanimously.

Mr. VanNostrand: If it is the desire of the Association that I take the position for a year, I will do my best, and if I can give anything like the satisfaction Mr. Chipman has given, I will feel highly rewarded.

The President: We want six Councillors.

Mr. Dickson nominates Mr. M. Gaviller, Mr. McAree nominates Mr. Jones, Mr. Gibson nominates Mr. Chipman (Mr. Chipman declines nomination), Mr. Sankey nominates J. W. Tyrrell, Mr. Gaviller nominates Mr. Proudfoot, Mr. Chipman nominates Mr. Robertson, Mr. Foster nominates Mr. Dickson, Mr. Cozens nominates Mr. Miles, Mr. VanNostrand nominates Mr. Gibson (Mr. Gibson declines).

Moved by Mr. Aylsworth, seconded by Mr. Selby: That Messrs. H. L. Esten and John McAree be scrutineers of ballots for the year 1890. Carried.

#### NEW BUSINESS.

Mr. Abrey: We have a good deal of bother here in the Registry Office about looking at plans, and paying a fee of ten cents. It creeps up every month or two that the Registrar wants sometimes \$1, and other prices. I would like to have the matter arranged. I think the surveyors ought to be entitled to see plans free. Half the people come to our office to look at plans, and we make no charge. I think a deputation should be appointed to wait on the Inspector of Registry Offices or other officer of the Government.

Mr. Cozens: In every Registry Office that I have gone to I have paid nothing whatever.

Mr. VanNostrand: Some years ago I wrote to the then Inspector of Registry Offices in the matter, and I received a short note from him to say that he had no authority to settle the fees; that they were all to be found in the Registry Act.

The President: I think it is perfectly right that a clear understanding should be had in this matter. The Registrar has a right to charge certain fees and no others. I think it would be a fit subject for the Executive to take up to wait on the Deputy Attorney General or the Inspector.

Moved by A. J. VanNostrand, seconded by G. B. Abrey: That the Executive Committee be instructed to confer with the Attorney-General or such officer as they may deem fit in order to reach an understanding as to fees to be charged by Registrars for inspecting or copying filed plans. Carried.

Mr. Sankey: I take this opportunity of returning my thanks for the unanimous election of myself as President. When the Association was first started I never supposed you would confer this honour on me. Although I have endeavoured to do what I could to further the

interest of the Association I certainly don't feel the work I have done has merited such honour from you. I hope during the coming year the Association will go on and prosper; and I would ask of you all to assist the Association in whatever way you may. I also ask, if any member of this Association has anything to bring up, not to wait until our annual meeting to start the idea, but to write a letter to myself or the Secretary. A great many points come up at our annual meeting when members have hardly time to discuss them, and in that way don't get the discussion they would if we had some previous notice of it.

Mr. Stewart: I beg to return my thanks for the honour you have conferred on me in making me Vice-President. At the last meeting we passed a resolution that any question coming up on Land Surveying should be sent to the Chairman of the Land Surveying Committee, and they would sit on that, and they have carried it out this year, and brought it before the Association. If it was done with the Engineering and Drainage Committee it would have the same effect. I think if every member will try to get some one near him to join the Association we could do a great deal to swell the membership, and have a better meeting than this year.

Moved by Mr. Jones, seconded by Mr. Gaviller: That the sum of \$40 be paid to the retiring Secretary-Treasurer, Mr. Chipman, from the funds of this Association. Carried.

Mr. Chipman: I don't think the Association can stand that expense.

Moved by Mr. Dickson, seconded by Mr. Chipman: That the President do now leave the chair, and that Mr. Aylsworth take it. Carried.

Moved by Mr. Dickson, seconded by Mr. McAree: That a hearty vote of thanks be tendered to the retiring President, Mr. Niven. Carried.

The Chairman: Mr. Niven, I have much pleasure in tendering you the hearty vote of thanks of this Association for your services as President during the past year, for the courteous and affable manner in which you have treated us all and conducted the business of the Association during the past few days.

Mr. Niven: I thank you very much, gentlemen, for the vote of thanks you have just given me. All I can say is, I have endeavoured to the best of my ability to discharge the duties incumbent upon the occupant of that office. I shall have just as much pleasure in acting as a full private in years to come as I have had in sitting at the head of this Association. As I have said before, I think that our Association is fairly launched, and as years go on I hope that the purpose for which we have been organized will be more fully seen and felt.

Mr. Dickson: I move we now adjourn.

Mr. Niven: I declare the Fifth Annual Meeting of the Land Surveyors' Association of Ontario closed, 4.20 p.m.



## MEMBERS IN ATTENDANCE AT THE TORONTO ANNUAL MEETING.

|                  |                    |                    |
|------------------|--------------------|--------------------|
| Abrey, Geo. B.   | Foster, F. L.      | Proudfoot, H. B.   |
| Aylsworth, W. R. | Galbraith, Jno.    | Rogers, R. B.      |
| Bolton, Lewis.   | Gaviller, M.       | Ross, Geo.         |
| Bowman, C. D.    | Gibson, P. S.      | Sankey, Villiers.  |
| Bowman, H. J.    | Jones, T. Harry.   | Sanderson, D. L.   |
| Browne, H. J.    | Kirkpatrick, G. B. | Selby, H. W.       |
| Browne, W. A.    | McAree, Jno.       | Sherman, Ruyter.   |
| Campbell, D. S.  | McEvoy, H. R.      | Speight, T. B.     |
| Chipman, Willis. | McKay, Owen.       | Stewart, Elihu.    |
| Cozens, Jos.     | Miles, C. F.       | Stewart, L. B.     |
| Dickson, Jas.    | Murphy, Chas. J.   | Tyrrell, J. W.     |
| Ellis, H. D.     | Niven, Alex.       | VanNostrand, A. J. |
| Esten, H. L.     | Patten, T. J.      | Wheelock, C. R.    |

## RESULT OF ELECTIONS.

*President* ..... Villiers Sankey ..... (by acclamation).  
*Vice-President* ..... Elihu Stewart ..... (by acclamation).  
*Secretary-Treasurer* ..... A. J. VanNostrand ..... (by acclamation).

*Councillors.*

|                 |    |                |    |
|-----------------|----|----------------|----|
| H. B. Proudfoot | 29 | J. W. Tyrrell  | 14 |
| M. Gaviller     | 26 | Jas. Dickson   | 8  |
| T. Harry Jones  | 21 | Jas. Robertson | 8  |
| C. F. Miles     | 18 |                |    |

I therefore declare the following Councillors elected:— H. B. Proudfoot, M. Gaviller and T. Harry Jones.

A. J. VANNOSTRAND,  
*Secretary-Treasurer.*

Examined and found correct.

(Signed) JOHN McAREE,  
 H. L. ESTEN,  
*Scrutineers of Ballots.*

## REPORT OF THE SECRETARY-TREASURER.

MR. PRESIDENT,—The following report is herewith submitted as the business of the Association for the year ending with this meeting :

Our membership remains about the same as during 1887 and 1888, but I regret to say that several of our members have not as yet remitted their fees for 1889, notwithstanding that they have had several opportunities to do so.

A very full meeting of the Executive and Standing Committees was held in Toronto on the 27th of December last at which several matters of importance were discussed.

The following circulars were issued by the Executive up to the present date since my last report :—

- No. 18—Proposed amendments to Surveyors' Act.
- No. 19—Programme of Fourth Annual Meeting, 1889.
- No. 20—Respecting annual dues (6th March, 1889).
- No. 21—Respecting land surveyors in active practice.
- No. 22—Result of election of Executive Committee, 1889.
- No. 23—Addressed to those Provincial land surveyors who are in active practice, but who are not members of the Association.
- No. 24—Minimum tariff in 1889.

The proposed amendments to the Survey Act were discussed at the last meeting of the Association and were referred to the committee on legislation.

The replies to circular number twenty-three show that there are many Provincial Land Surveyors in active practice who are not members of this Association, of which the following is a list :—

|                               |                                  |
|-------------------------------|----------------------------------|
| Allan, Jas., Renfrew.         | Fair, Jno., Brantford.           |
| Bakie, J. D., St. Thomas.     | Fitzgerald, J. W., Peterborough. |
| Beatty, W., Delta.            | Fowlie, Albert, Orillia.         |
| Burchill, Jno., Merrickville. | Gibson, Geo., St. Catharines.    |
| Brown, D. R., Cornwall.       | Gossage, B. W., St. Thomas.      |
| Brown, D. B., Cornwall.       | Hamilton, Robt., L'Orignal.      |
| Brown, Jno. S., Heckston.     | Hermon, R. W., Rednersville.     |
| Burnet, H., Peterborough.     | Hermon, Mr., Rednersville.       |
| Bell, Wm., Pembroke.          | Halford, A. J., Essex Centre.    |
| Bell, Andrew, Almonte.        | Howitt, Alfred, Gourock.         |
| Byrne, Thos., Sarnia.         | Hewson, T. R., Peterborough.     |
| Carre, Henry, Belleville.     | Jephson, R. J., Bracebridge.     |
| Cotton, A. F., Ottawa.        | James, Silas, Toronto.           |
| Creswick, Henry, Barrie.      | Johnston, W. O., Whitby.         |
| Cromwell, J. M. O., Perth.    | Jones, J. H., Sarnia.            |
| Chadwick, F. J., Guelph.      | Kennedy, R. O'Dowd, Caledonia.   |
| DeCew, E., DeCewville.        | Kennedy, J. H., St. Thomas.      |
|                               | Longhead, Aaron, Orillia.        |

|                                   |                               |
|-----------------------------------|-------------------------------|
| Ludgate, B. A., Peterborough.     | Reid, J. L., Port Hope.       |
| Laird, J. S., Essex Centre.       | Smith, Geo., Beaverton.       |
| Law, Henry, Dunnville.            | Smiley, Wm., Norwich.         |
| Malcolm, Sherman, Rondeau.        | Sing, J. G., Meaford.         |
| Marshall, Jas., Kincardine.       | Staunton, F. H. L., Hamilton. |
| McDougall, A. H., Port Arthur.    | Strange, Henry, Rockwood.     |
| McLean, J. K., Elora.             | Seager, Edmund, Rat Portage.  |
| O'Flynn, Edward, Windsor.         | Ure, F. J., Woodstock.        |
| Passmore, F. F., Toronto.         | Wilkins, F. W., Norwood.      |
| Reynolds, Samuel, St. Catharines. | VanBuskirk, W. F., Stratford. |
| Rombough, M. B., Durham.          |                               |

In addition to these 57 there are a few surveyors in the Province who practise occasionally, and several men who have passed their final Provincial Land Surveyors' examination during the year.

It may be of interest to the members to have for reference a statement of the number of Provincial Land Surveyors appointed since 1857:—

|            |    |            |    |
|------------|----|------------|----|
| 1857 ..... | 21 | 1873 ..... | 7  |
| 1858 ..... | 22 | 1874 ..... | 5  |
| 1859 ..... | 11 | 1875 ..... | 11 |
| 1860 ..... | 21 | 1876 ..... | 17 |
| 1861 ..... | 21 | 1878 ..... | 19 |
| 1862 ..... | 11 | 1879 ..... | 12 |
| 1863 ..... | 17 | 1880 ..... | 10 |
| 1864 ..... | 17 | 1881 ..... | 10 |
| 1865 ..... | 6  | 1882 ..... | 14 |
| 1866 ..... | 15 | 1883 ..... | 8  |
| 1867 ..... | 5  | 1884 ..... | 8  |
| 1868 ..... | 3  | 1885 ..... | 9  |
| 1869 ..... | 2  | 1886 ..... | 13 |
| 1870 ..... | 4  | 1887 ..... | 12 |
| 1871 ..... | 4  | 1889 ..... | 10 |
| 1872 ..... | 6  |            |    |

From 1856 to 1886—thirty years—341 surveyors were appointed, an average of over eleven per year, or nearly one new surveyor per month.

The Secretary again begs to acknowledge the great assistance rendered him by the members of the Committees on Entertainment and on Publication.

It is to be regretted that the railway companies have seen fit to so modify their regulations respecting reduced fares that members attending this meeting will secure little reduction.

The accompanying statement shows the financial condition of the Association. Although the expenditure has been less than last year, the cash balance at the end of 1889 was less than that at the end of 1888 by \$30 00, representing ten members in arrears.

All of which is respectfully submitted.

WILLIS CHIPMAN,  
*Secretary-Treasurer.*

STATEMENT OF RECEIPTS AND EXPENDITURES OF THE ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO FOR THE YEAR 1889.

| 1889.                                                |        | RECEIPTS.     |                 |
|------------------------------------------------------|--------|---------------|-----------------|
| To Balance from 1888.....                            |        |               | \$55 00         |
| " Fees, 1 Active Member for 1888 at \$3.....         | \$3 00 |               |                 |
| " " 94 Active Members for 1889 at \$3.....           | 282 00 |               |                 |
| " " 2 Junior Members for 1889 at \$3.....            | 6 00   |               |                 |
| " " D. Beatty, Balance for 1888.....                 | 1 00   |               |                 |
|                                                      |        |               | <u>292 00</u>   |
| " Advertisements, 1888.....                          | 6 00   |               |                 |
| " " 1889.....                                        | 81 00  |               |                 |
|                                                      |        |               | <u>87 00</u>    |
| " Proceedings sold.....                              |        |               | 50              |
|                                                      |        |               | <u>50</u>       |
| Total.....                                           |        |               | <u>\$434 50</u> |
|                                                      |        |               |                 |
| 1889.                                                |        | EXPENDITURES. |                 |
| By Postage and Telegrams.....                        |        |               | \$26 65         |
| " Stationery, etc.....                               |        |               | 11 15           |
| " Rental of Rooms for Annual Meeting.....            |        |               | 12 00           |
| " Printing Circulars, Programmes, etc.....           |        |               | 23 00           |
| " " Proceedings.....                                 |        |               | 171 90          |
| " " Azimuth Tables.....                              |        |               | 19 50           |
| " Engraving, etc.....                                |        |               | 44 75           |
| " Express, Cartage, Freight, etc., in Exchanges..... |        |               | 16 55           |
| " Amount granted to Stenographer.....                |        |               | 35 00           |
| " " " Secretary-Treasurer.....                       |        |               | 40 00           |
| " Balance, Dec. 31st, 1889.....                      |        |               | 34 00           |
|                                                      |        |               | <u>34 00</u>    |
| Total.....                                           |        |               | <u>\$434 50</u> |

SUPPLEMENTAL STATEMENT, FROM JAN. 1ST, 1890, TO FEB. 20TH, 1890.

| 1890.                                         |      | RECEIPTS.     |                |
|-----------------------------------------------|------|---------------|----------------|
| To Balance from 1889.....                     |      |               | \$34 00        |
| " Fees, 2 Active Members for 1889 at \$3..... | 6 00 |               |                |
|                                               |      |               | <u>6 00</u>    |
| Total.....                                    |      |               | <u>\$40 00</u> |
|                                               |      |               |                |
| 1890.                                         |      | EXPENDITURES. |                |
| By Postage.....                               |      |               | \$6 50         |
| " Printing Programmes, 1890.....              |      |               | 5 00           |
| " Express, etc., Ohio Reports, 1889.....      |      |               | 2 60           |
| " Cartage, etc.....                           |      |               | 90             |
| " Balance.....                                |      |               | 25 00          |
|                                               |      |               | <u>25 00</u>   |
| Total.....                                    |      |               | <u>\$40 00</u> |

Feb. 25th, 1890.

WILLIS CHIPMAN,  
Secretary-Treasurer

## REPORT OF AUDITORS.

The undersigned Auditors beg to report as follows:—That we have examined the books and accounts of the Secretary-Treasurer, Willis Chipman, Esq., for the year 1889, and to date of this year, and have annexed to this report a statement showing the amount of Receipts and Expenditures, which shows a balance on hand of Twenty-five dollars (\$25). We find vouchers for all accounts paid excepting about Fifty dollars (\$50), this amount being principally for postage, duties, freight and express.

D. S. CAMPBELL,  
T. HARRY JONES,  
*Auditors.*

Toronto, Feb. 26th, 1890.

## REPORT OF COMMITTEE ON LAND SURVEYING.

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

At the last annual meeting of our Association some subjects for consideration were referred.

1. That a recast of the Act relative to Town and Village Surveys seems to be a necessity.

This your Committee heartily endorses, but on account of the date of meeting of the Local Legislature, and probability of this session being the last of this Parliament, it was considered advisable not to submit any recommended changes for legislation. Also from papers expected to be read, and discussion thereon, considerable new light may be thrown upon the subject.

2. As to adaption of Cadastral Survey in Ontario, as now in use in the Province of Quebec, your Committee consider that, from measurements not being given on the plans filed and from the different manner in which lots in original surveys are laid out and numbered in this Province—the Cadastral System, whilst most useful in the Province of Quebec, would not be found so to any such extent in Ontario.

3. The use of the term “more or less,” as to the length of lines, we consider to be necessary in some descriptions. We should recommend the use of this expression to be limited to the greatest possible extent.

Bearings of lines should be shown on a plan and defined as astronomical or present magnetic.

4. Actual staking out of a sub-division is not called for by the Act, as at present worded.

Your Committee consider steps should be taken to render this compulsory, and recommend its consideration to the Legislative Committee.

5. We cordially agree with the remarks of Mr. H. D. Ellis at the close of his paper on Right of Way Surveys (Dominion Act), read at our last annual meeting. We regret that legislation has been passed placing in the hands of others the power to certify plans, draw up descriptions and define boundaries of properties, which are specially the duty of a land surveyor.

6. From all reports the working of the minimum tariff, adopted at our last annual meeting, has been satisfactory.

Your Committee would recommend, in addition, the adoption of a tariff by the hour, which would, in many cases, avoid difficulties.

In accordance with the recommendation of our last annual meeting, several questions have been sent in for the consideration of your Committee.

The questions and diagrams submitted, with answers attached, are appended to this Report.

Your Committee consider that questions intended to be submitted are to be those relating to field work and application of Surveyors' Act.

M. GAVILLER,  
*Chairman of Committee.*

#### DISCUSSION.

The President—I think the Chairman should read the queries, with the answers of the Committee, and let us deal with that before we pass on to anything else.

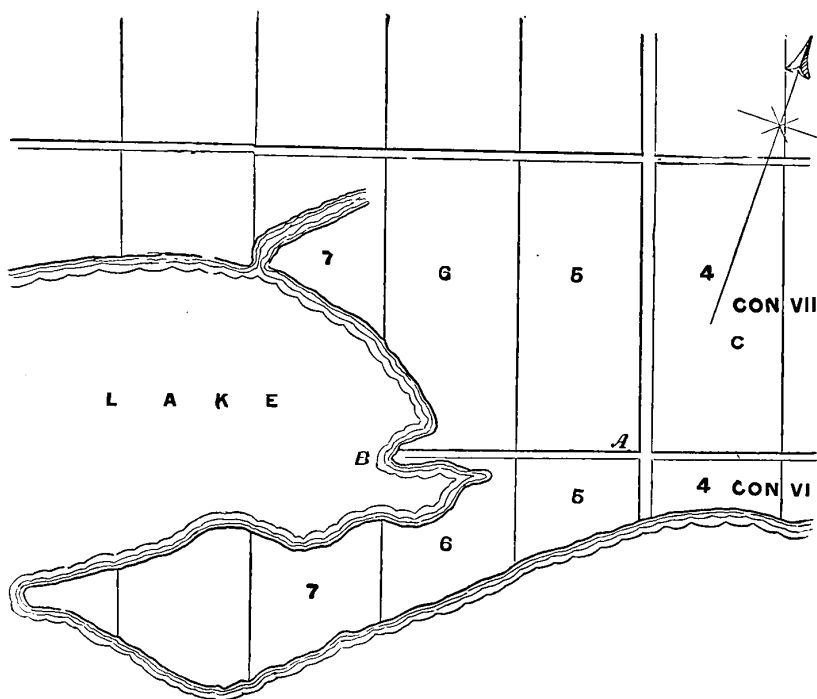
*Question "A."*—This diagram is part of a double-fronted township bordering on a lake. That part of the road allowance between the 6th and 7th concessions, extending from *a* to *b*, is entirely obliterated, not a blaze or mark is to be found of any description, and the corporation require it to be located and established to give access to the lake, and the parties owning the land on each side are bitterly opposed to it, and no evidence can be obtained as to any of the old trees or other marks. How can it be established; where is the law for such a case?

*Answer by Committee.*—Not sufficient data given. If broken distance is given between lots 5 and 6 from concession line vi. and vii. to lake, and width of con. vii.; on Government plan. Lay off cons. vii. and vi. by proportional division—if depth of con. vi. is not given as above, give con. vii. depth according to Government instructions for original survey of the township, and leave balance for con. vi. (less one chain for concession road allowance). Sec. 38, Survey Act.

Mr. Chipman—I have expressed my opinion before on questions similar to this, to this Association, but I repeat what I have said:

*The object of a re-survey is to reproduce the old line, whether that is the wording of the Act or not. I am of the opinion, the proper way to re-produce that line a to b, as it was run in the first place, is to take your bearing on line a to the east, and start from a and produce to the lake. That will be the nearest to the original line. That is the best way that you can re-produce the old line, or the line run in that way will be nearer the original line than any other line you will run.*

Mr. Aylsworth—The course that Mr. Chipman suggests is the best possible way to find if there were any marks. I am quite in accord with the finding of the Committee in that case, for the distance between lots 5 and 6 and con. vi. is not given.



Mr. Stewart—The variation, owing to local attraction, will be the same each year.

Mr. Chipman—The variation from one point to another will be the same.

Mr. Aylsworth—Two or more surveyors might go on the ground with their compasses, having the same opinion of the law and what they ought to do to run the line, as Mr. Chipman proposes, and run different lines, each of them. They take the variation and they run on the same magnetic course; they agree in the mind as to what should be done, but they get a different result on the ground; would that not be fatal? If we do as the Committee have found, they will all get the same line.

Mr. Chipman—That may be very true, but the difference between the different lines in that case would be slight as compared with the

difference of the line which would run from *a* to *b* by measuring the distance across con. vii. The line between may be ten chains in error—it may be 110 chains instead of 100. I have seen cases where the distance between the concessions was ten chains out. By the method I propose you may reasonably hope that your line will be within half a chain of the original line, whereas by the method proposed by measuring down on the line of 5 and 6, you will have perhaps the southern boundary of con. vii. a line at an angle of about seventy degrees, which would, of course, be absurd; which is not the original line at all.

Mr. Aylsworth—That is quite a reasonable ground. When the surveyor ran through to the lake on the magnetic course, he could not tell how much he had in any one lot, or where he was. The only point of difficulty is as to how the bearing is to be got at. Mr. Chipman proposes to pick up the line to the east and produce it on to the lake; if that line had been correctly run, that would be the best thing to do.

The President—I am rather inclined to agree with what Mr. Chipman has said. By taking the depth of this concession, it frequently happens that these concessions are short or long, and by measuring down there the depth you might be five chains either one side or the other. Now, the object that we have in view is to re-produce this line on the ground, and we want to get as near as we can where the original survey went.

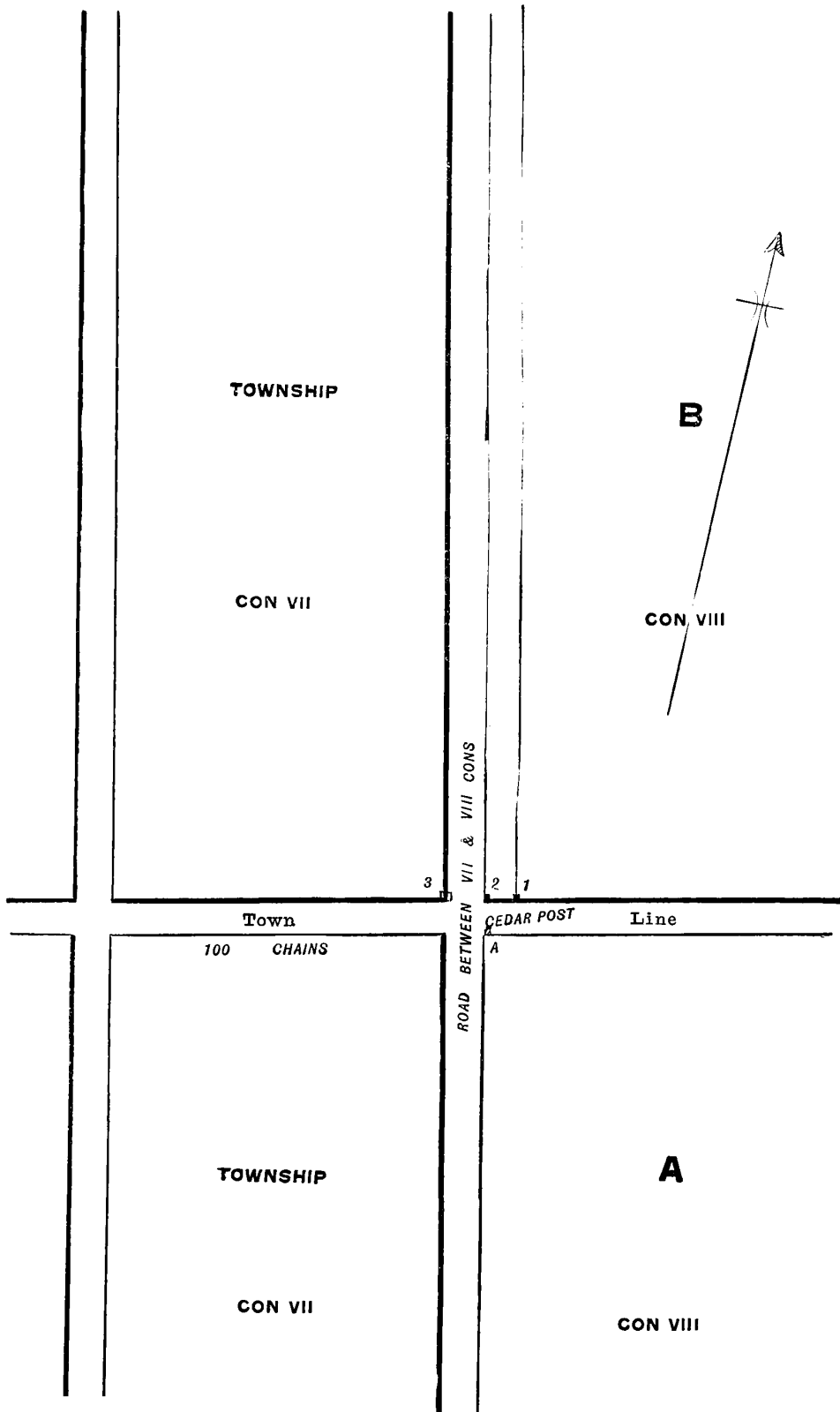
Mr. Gaviller—I think the Committee, in giving its decision, has simply to look to the Statute, and if the Statute says so and so, we should so word our answer, no matter what our opinion is. I think, as far as my judgment is concerned, that the answer of the Committee is in accordance with the law laid down; that is, that where a concession line is obliterated, it is to be divided according to the intention of original survey—unless you can find a point at each of the ends to fill up that obliterated space. In this case this concession line is obliterated.

*Question "B."*—When Township A was originally surveyed, the north boundary was chained and posts planted 100 chains apart, leaving the concessions 100 chains deep and then one chain for road as shown on diagram. Afterwards Township B was surveyed and the posts on the north boundary of A were used for starting points, so that the roads in each township are opposite.

Some years ago the lots in Township A, in the 8th concession from lot 16 to the north-west angle of lot 35, were surveyed under the C. L. Dept., and the surveyor then found, at the north-west angle of lot 35, a cedar stump, the remains of the original monument, and marked all his posts, taking the road off to the west.

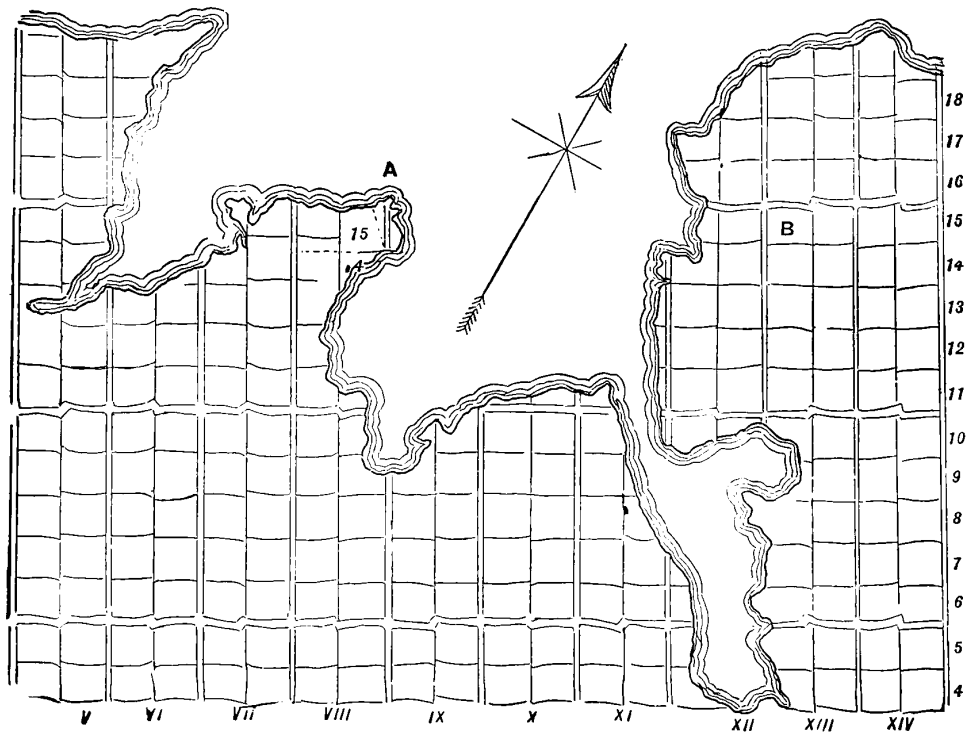
A short time after this survey was finished the south boundary of Township B was established under the C. L. Dept., and the monuments were all placed opposite those in Township A, with the exception of those between the 7th and 8th concessions, which were put down as shown in red marked 1 and 2, in this case making a jog and not corresponding with the line as previously surveyed in Township A, or as the cedar stump was marked.





In Township B the line between the 7th and 8th concessions was not run or located at the time of the original survey, but a few years ago the County Council applied by petition to have it surveyed under instructions from the C. L. Dept. When the surveyor went on to the ground to begin his survey, the owners of lots in the 8th concession objected to his starting from monument 1, as they contended it was not in the right place, and that it should stand where monument 2 is, and the road be taken off to the west, and No. 2 be moved one chain west to No. 3. That in order to prove that they were correct in so contending, two disinterested witnesses were produced, and they gave positive testimony that they saw the cedar tree when it was green and had not been defaced by fire, and that it was marked with the letter R on the west and north sides. The question is, how can this matter be remedied so that the monument can be placed in the proper position, and was the surveyor justified in starting from monument No. 2, and locating the line for the front of the 8th concession therefrom.

*Answer by Committee.*—Ascertain from the Crown Lands Department the evidence upon which both the municipal surveys were made; also Government instructions issued for the same. If reliable evidence can be found showing either of the municipal surveys to be incorrect, ignore that survey. More data should be given in this question.



*Question "C."*—The original concession line, marked *a* in the accompanying sketch, is now obliterated, the timber having been cut and burnt, and is now thickly overgrown with small wood of all sorts.

The original field notes give lot 15 as thirty chains from shore to shore across the point. How would you establish the original concession line? I might mention: 1st. The concession line produced from across the bay strikes as shown by dotted line, and makes the distance across the point about sixty chains—just double that given in the notes; and a sub-division across the lake to concession line marked *b* comes out in the water altogether. 2nd. If you measure the neat width of the concession given in the notes (66 chains,  $66\frac{2}{3}$  links) from the concession line to the west; easterly along the line between lots 14 and 15, produced and run northerly parallel to the original concession line between cons. 7 and 8, as found in the field, it agrees best with the original notes and will give lot 15 just about the thirty chains, as shown in the notes.

*Answer by Committee.*—Similar to Question “A.” More data should be given. Answer same as to Question No. “A.”

*Question “D.”*—In case of Township where original sub-section made under order in Council dated March 27th, 1829—each alternate concession line run, and each alternate side road run. If original post can be found at blind line on original side road, should bearing be used from said post or from the whole length of side road?

Also, should unequal division of said base line affect rest of section?

*Answer.*—The bearing should be taken of full length of the side road, proof line, across the two concessions.

Only as regard to the two lots adjacent to the side road, the widths of others to be of equal lengths—Secs. 56-57, Surveyor’s Act. (See also p. 96 Proceedings, 1888).

Mr. Dickson: When instructions are issued now we are instructed not to plant those posts. When a post has been planted by the surveyor, when he has had no instructions to do so, that should not govern. If he had instructions to do so I would use it as a governing post.

Mr. Abrey: I have received instructions to plant those posts like that from the Indian Department on the Manitoulin Island.

Mr. Stewart: I must say from looking over the Act that the finding of the Committee with regard to the bearings is the correct one.

The President: We all know as instructions are issued now we are told not to plant these posts. To go back to what was done some time ago, perhaps on the Huron tracts, I have seen posts planted at those places. I think if the surveyor was instructed to plant posts there and did so and returned them that would be all right. If he had no instructions in the matter as he did it and returned them I think that would bind. But if he had no instructions at all and did not return the posts, then I think we have no business to pay any attention to them further than simply as a centre tree, or a point indicating where the surveyor ran. As the instructions are issued nowadays, and as recent surveys have been made, a post planted there is manifestly wrong; it is planted there in defiance of the instructions and of

no account whatever. As regards the question of bearing I think it is imperative that it should be taken from end to end across the two concessions.

*Question "E."*—Should not some steps be taken to compel municipal corporations to have all governing lines established and to provide for the maintenance of original posts, etc. The law as it is at the present time is too easy, and leaves them to act as they like.

*Answer.*—Best to leave this to the discretion of each municipality. Query! This answer debatable.

*Question "F."*—If the boundary of Township from which the lots are numbered was not fully run in the original survey, and the boundary at the opposite end was fully run in said survey, which boundary should be used as governing line—in case of there being no other governing lines in said Township?

*Answer.*—Where boundary from which lots are numbered not fully run in the original survey extends across a full concession use it as governing line. For those concessions across which this boundary has not been run in the original survey use the boundary at the opposite end as governing line, if the east and west boundaries were intended to be parallel in the original.

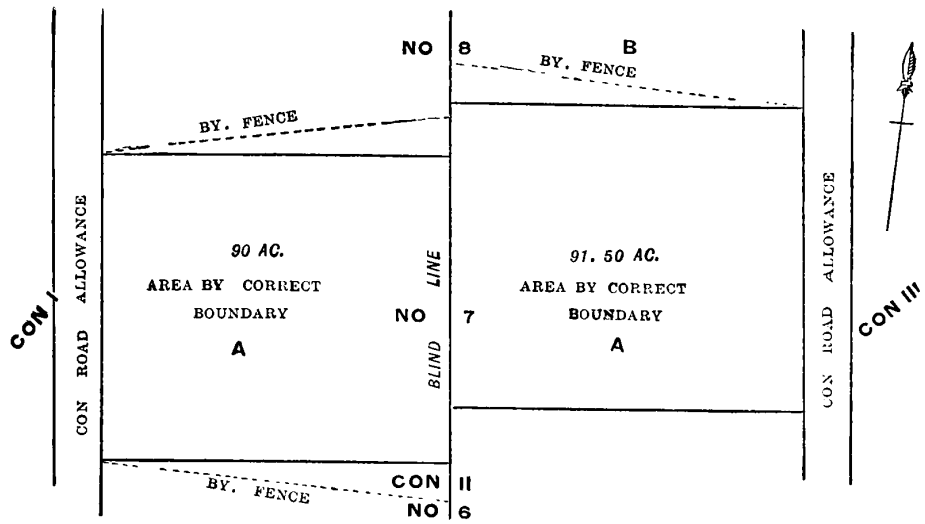
*Question "G."*—In case where the Government instructions for original survey of a Township showed that the concession lines should have been run wholly across the Township; making the concessions of equal width; and they are so shown on plan of original survey. On the ground the concession lines were only partly so run from one end of the Township but not completed up to the opposite boundary. Both boundaries being run in said original survey. What rule is there for completion of survey of said concession lines?

*Answer.*—Chain across from the concession lines nearest, on each side, run in original survey and divide proportionally for each side of each lot. Sec. 38, sub-sec. 2.

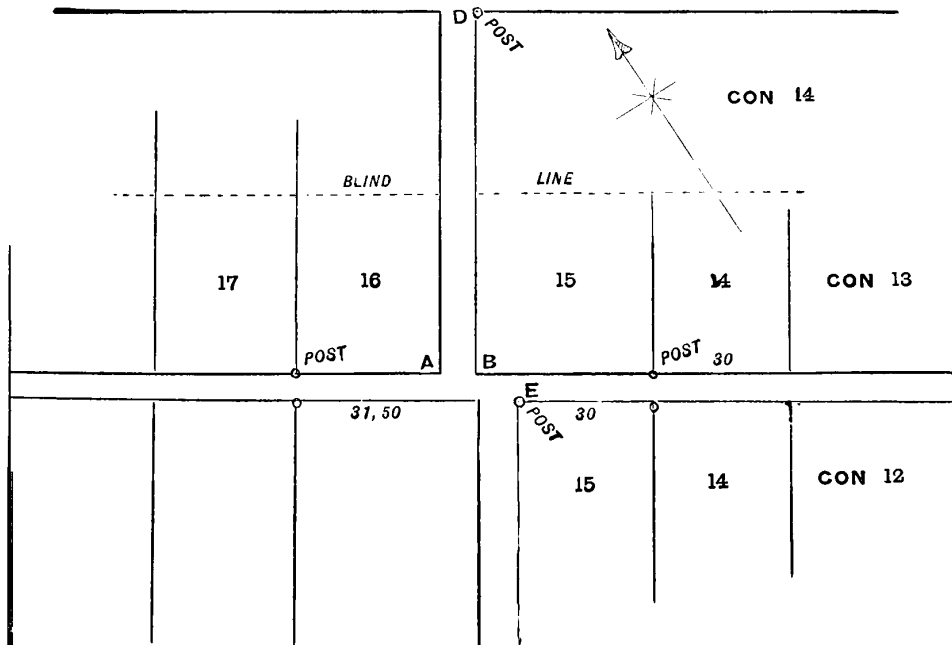
*Question "H."*—In a double front concession township, A sells to B part of a lot by following agreement:—The North-west quarter of Lot No. 7, Con. 11, containing 50 acres more or less, together with a right of way, two rods wide along the blind line from the East half of No. 8. At the time of sale A owns all Lot No. 7, and B the East half of Lot No. 8. The fences not on bearing of proper lot lines are established by possession. No dispute as to corners of the lot. The concession a narrow one. How would you lay out the sale?

*Answer.*—Use areas calculated from correct boundaries.

*Question "K."*—How would you establish the posts at A B? In this case there are posts where shown, but they are lost at A B. The frontages of the lots are 30 chains. In the original survey all the side



[SEE QUESTION "H."]



[SEE QUESTION "K."]

roads should run opposite each other, but in this case there is a jog—say of 1.50 from the old lines as blazed out; there is a post at 16 and 17, and 14 and 15. There is no doubt of the post E at 15; so there is no trouble in con. 12—but in con. 13 the posts are missing—and the side road B D is a governing side road, according to statute, and it is of great importance to establish the posts at A and B.

*Answer.*—If original blazed line can be located it must govern.

*Question “L.”*—In some townships double fronts, alternate concession lines run, there were posts planted for the centre or blind line, but they seldom are in the centre, and of course are then not according to the Act; when the posts are there as on the sketch and the concessions measure—as noted—one concession being wider than the other by one chain. This post at A was not planted by authority or direct instruction—but was planted by the surveyor. Can that old post be taken to run the blind line from, or must the two concessions be equally divided B C? And how would you run the blind line if it has to be run from the old post A?

*Answer.*—If old post at blind line is not on record at C. L. Department it cannot be used for any purpose of survey. If on record in C. L. Department it (old post) governs blind line at the point where it is located. Blind line must be drawn from old post at S. Road to point of proportional division from concession line to concession line for blind line or lines between the other lots of the two adjacent sections. (See answer to Question D).

*Question “M.”*—In laying off lands, show that in a rectangle of given perimeter, the area will be a maximum when the figure is a square (section).

*Answer.*—Let A B C D be a given rectilinear figure.  $x, x - m =$  opposite sides.

Required to prove that the area is a maximum when square.

Perimeter =  $2(x + x - m)$ .

Side of square of equal perimeter =  $\frac{2x - m}{2}$ .

Area of given rectangle =  $x^2 - mx$ .

Square of equal perimeter =  $\frac{4x^2 - 4mx + m^2}{4}$ .

$\therefore \frac{4x^2 - 4mx + m^2}{4} > \frac{x^2 - mx}{1}$   
by  $\frac{m^2}{4}$

Which was to be proved.

*Question “N.”*—Give an ideal plan for an inland city? What is intended to bring out specially in this is, the size of business and residence lots; the width of streets in various parts of the city, and of lanes; public squares; whether it is desirable to have all the streets

at right angles to each other, or some radiating or otherwise running obliquely, forming gore lots; whether business lots can be so laid out as to conform with subsequent numbering of the business houses; what system of naming of streets; where monuments to be placed for reference in future survey of any lot or street?

*Answer.*—1. For location where ground is sufficiently level so as not to cause heavy grades on straight streets. Streets to be at right angles to each other in all cases practicable. No street to be less than 66 ft. wide near centre of town plot have two streets at right angles to each other 99 ft. wide. Lanes to be avoided as much as possible—no lane to be less than 10 ft. wide. Streets to be ten lots, and 300 feet apart. Lots to be 60 x 150 feet in all cases. Numbering of houses to be independent of sub-division of blocks. Public squares 300 x 240 every fifth block on main 99 feet wide streets. Name streets—1st, 2nd, 3rd, and so on, that run in one direction, and 1st, 2nd, 3rd, 4th, etc., avenue, those running at right angles.

2. For location on hilly ground make careful topographical survey of location. Arrange streets so as to avoid heavy cuttings for grade to as great an extent possible. Subdivide lots so as to make nearly as possible even frontages and square corners. Locate public squares at highest elevations. Where navigable river runs through the town plot have streets not less than 66 feet wide on each side of said river following bends of same. If situated on a lake have 99 feet street along shore of the lake—and public squares every fifth block fronting on this street. If entrance of railways to river or lake fronts are required arrange to allow for docks, yard, freight and passenger depot accommodation. Adopt high level viaduct system—allow access by all streets possible to lake and river front by under crossing.

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## REPORT OF COMMITTEE ON DRAINAGE.

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MR. PRESIDENT AND MEMBERS OF THE PROVINCIAL LAND SURVEYORS' ASSOCIATION OF ONTARIO,—Your Drainage Committee beg to submit the following report:—

In pursuance of a notice from the Secretary of the Association the Committee held a meeting at the Crown Lands office in Toronto on Friday the 27th day of December, 1889, the following members being present: Messrs Joseph Kirk, Stratford; D. S. Campbell, Mitchell; H. W. Selby, Stayner; and James Robertson, Chairman.

We have no statistics as to the amount of drainage having been done during the past year as none have been collected; but from general observation, and information obtained from coming in contact with those who are more or less interested in matters of drainage, and from the experience of your Committee, it is safe to say that the very

wet spring of last year, succeeding several successive dry seasons, has shown the farming community generally that their lands are not as yet all high and dry, and as a consequence gave a most marked impetus to the carrying out of drainage schemes both large and small, and the drainage work of the past season has been much in advance of that of several previous seasons.

We would suggest and would like to have the opinion of the Association as to the advisability of attempting to collect statistics from year to year as to the amount of draining being done throughout the Province. We are of opinion that could this be done with any degree of accuracy it would prove a source of much information and be of much interest to the profession generally. We made no attempt to collect any such statistics during the past year, preferring rather to bring the matter before the Association for an expression of opinion as to the advisability of doing so and as to the best method of carrying out the work.

We would suggest that a circular letter be sent to the clerk of each municipality in which drainage works are carried on asking for a statement as to the number of drains constructed in such municipality during the year, whether under the Municipal Act or the Ditches and Watercourses Act, with the length, acreage drained, estimated cost, etc. ; and he, as the officer in charge of the engineer's reports and awards on drains, will be most likely to comply and furnish the information which he could readily do with a small amount of trouble on his part. The information from these reports could readily be combined and presented to the Association at each meeting. Copies of this could again be sent to the different clerks when again asking for drainage information for the next year.

We would also bring before the notice of this Association the advisability of the preparation and adoption of some formulæ for the calculation of, and tables of sizes for drains of different lengths for the drainage of different areas of land under different circumstances which are met. We have now no recognized standard to which to refer, and each engineer of experience has probably adopted some table or means of his own for determining the size of a drain when called upon to lay it out, and frequently with unsatisfactory results.

The difference of opinion and results of calculation are sometimes forcibly shown in the case of lawsuits for damages by the flooding of land from a drain of insufficient size when there are often as many opinions as to the requisite size as there are engineers giving evidence. It is needless to say that this is not very creditable to the profession or satisfactory to the court ; while, if tables or formulæ adopted by the Association of Provincial Land Surveyors of Ontario and recognized by them as a standard from which to work could be pointed to, such differences would not exist between individual engineers, and their evidence would carry much more weight in such matters. This table if as at first adopted did not prove to give satisfactory results it might be amended as experience taught. We are of opinion that this matter should be taken up and something in this line for the general benefit of the profession.



We here give a list of important drainage cases under the Municipal Drainage Act decided in the years 1887, 1888 and 1889:—

| NAME OF CASE.                                   | WHERE REPORTED.                          | REMARKS.                                             |
|-------------------------------------------------|------------------------------------------|------------------------------------------------------|
| Chrysler <i>vs.</i> Sarnia . . . . .            | 15 Ontario Reports . . . . .             |                                                      |
| Robertson <i>vs.</i> North Easthope . . . . .   | 15 Ontario Rep'ts, p. 423                | Reversed in appeal ; see 16 Appeal [Reports, p. 214. |
| <i>Re</i> Romney <i>vs.</i> Mersea . . . . .    | 11 Appeal Rep'ts, p.712.                 |                                                      |
| <i>Re</i> Clark and Howard . . . . .            | 16 Appeal Reports, p.72.                 |                                                      |
| Dillon <i>vs.</i> Raleigh . . . . .             | 13 Appeal Reports, p. 53.                |                                                      |
| Pratt <i>vs.</i> Stratford . . . . .            | 16 Appeal Reports, p. 5.                 |                                                      |
| Alexander <i>vs.</i> Howard . . . . .           | 14 Ontario Reports, p.22.                |                                                      |
| Dover <i>vs.</i> Chatham . . . . .              | 11 Appeal Reports, p. 248                |                                                      |
|                                                 | 12 Supreme Court Rpts., p. 321 . . . . . |                                                      |
| Green <i>vs.</i> Orford . . . . .               | 15 Ontario Rpts., p. 506.                |                                                      |
| <i>Re</i> Bryne <i>vs.</i> Rochester . . . . .  | 17 Ontario Rpts., p. 354. |  | Reversed in appeal ; see 16 Appeal [Reports, p. 4. |
| Hodgson <i>vs.</i> Bosanquet . . . . .          | 17 Ontario Rpts., p. 589.                |                                                      |
| Nissouri <i>vs.</i> North Dorchester . . . . .  | 14 Ontario Rpts., p. 294.                |                                                      |
| Quantaince <i>vs.</i> Howard . . . . .          | 25 Law Journal, p. 545.                  | And subsequently tried, but judgment not yet given.  |
| <i>Re</i> McCormick <i>vs.</i> Howard . . . . . | 25 Can. Law J'rn'l, p.616                |                                                      |

We also give cases under the Ditches and Watercourses Act:—

|                                                     |                           |                                                                                                                                                                                                  |
|-----------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| In <i>re</i> Ditches and Watercourses Act . . . . . | 25 Can. Law J'rn'l, p 64. | Deciding that it is the duty of the Clerk and Engineer to satisfy themselves that proper notices, etc., were given in compliance with the Act. The Engineer need not adopt the course asked for. |
| <i>Re</i> Hilborn <i>vs.</i> Pickering . . . . .    | 23 Can. Law J'rn'l, p.194 | If interested parties not notified, award will be set aside.                                                                                                                                     |
| Bryne <i>vs.</i> Campbell . . . . .                 | 15 Ontario Rpts., p. 339. | As to right to sue the Engineer.                                                                                                                                                                 |

We would suggest that when appeals are heard before the County Judge from the award of the Engineer under the Ditches and Watercourses Act, that the Engineer who made the award send to the Secretary of this Association a brief statement of the case with the decision of the judge, etc., so that the Engineers engaged in this class of work would the better know the opinions of the different judges, and would be able to govern themselves accordingly. These might be read along with the Report of the Drainage Committee at the annual meeting, and when new and important points were involved, the case

might be recorded in the printed Annual Report. These appeals are few and would not occupy much space, and would no doubt be of much service. We would also call your attention to the following sections of the Ditches and Watercourses Act, which we are of opinion might be simplified to some extent, improved and amended, and would ask the views of the Association in the matter.

In section 4 and succeeding sections where *ditch* and *drain* occurs throughout the Act, we would suggest that "ditch and" be omitted, and only the word "drain" used, as in our opinion it expresses all that is required.

We notice that Mr. Proudfoot, at the end of his paper on "Drainage," in the report of the meeting of 1886 (page 39), refers to these two terms, and asks the opinion of the Association with regard to the meaning of the words, but we do not notice that any discussion took place on the subject.

Sec. 4 also requires that such ditches or drains shall be kept and maintained so, opened, deepened, or widened by the said owners respectively and their successors in such ownership, *in such proportions as they have been so opened, deepened, or widened*, unless in consequence, etc.

This, we are of opinion, is not always just, and we think the Engineer should have power to say in his award by whom the drain should be maintained, instead of the statute fixing it upon the person opening, etc., any particular part.

Sec. 8, sub-sec. 3, we are of opinion, gives the Engineer power only when making his award to state therein that any portion of such ditch or drain *may* be constructed as a covered drain, but that the Engineer has no authority to say that any portion *shall* be constructed as a covered drain, and to have power to enforce such award. We believe, however, many Engineers claim they *have* power by this section to award that any portion of a drain shall be covered, and do award it so, but we think this meaning would not be upheld in case of appeal. We think, however, the Engineer should have such power, and that the section might be amended by inserting in the second line after the word "may," *or shall*; so as to read: "Any portion of such ditch or drain *may or shall* be constructed as a covered drain," etc.

Sec. 9, sub-sec. 2, we think would be somewhat difficult to put in operation in its present form, as it authorizes the Engineer by his award to determine the sum which shall be paid by each of the persons benefited by rock cutting, while the sum to be paid for rock cutting can only be determined by the letting of the work at some time subsequent to the making of the award, as required by a former part of the section. The Engineer might by his award determine *the proportion of the cost* of such rock cutting which shall be paid by each of such persons, etc., and we would recommend that this section be amended by inserting in the place of the word "sum" in the 6th line, "proportion of the cost of such rock cutting," etc.

Section 11 and sub-sections was dealt with at considerable length by the Drainage Committee of 1888, which Committee proposed, in

short, to have two courts of appeal; the first to the council of the municipality, and from them to three competent persons (one of whom is to be a provincial land surveyor) appointed by the judge of the County Court, whose award should be final.

While in the opinion of your Committee such amendment might serve some useful ends, yet we think that as this Act is designed only for small drainage schemes that one Court of Appeal should be final; and as the ruling in the case may depend as frequently upon some legal point—as shown by all the cases decided and mentioned previously in this report—as upon any injustice or seeming injustice done the appellant, we would, therefore, not at present recommend the changing of the Court of Appeal from the County Judge.

We might further say that the farmers generally, the Engineers and the judges, are all becoming better acquainted with the Act, and fewer appeals take place than formerly, and when such do take place more satisfactory (to the Engineer) decisions are given than in the earlier history of the Act. More particularly is this the case where the judge inspects the premises, which he is at liberty to do by subsection 4, and perhaps holds his court at some house in the locality. Some judges have been doing this, and were it done in each case where necessary, we are of opinion more general satisfaction would be given than by changing the Court of Appeal. Section 15 requires the Engineer to inspect the drain at the expiration of the time limited by the award for its completion, *if required in writing so to do by any of the parties interested.*

We think many of the drains under this Act are never completed in accordance with the Engineer's award, and the parties, or some of them, do not receive the full benefit intended by the award, and consequently an injustice is done, and frequently the Engineer is blamed for laying out an insufficient.

It is our opinion, therefore, that an inspection by the Engineer of the work should be compulsory, and if the work is complete he should certify so to the clerk, and if not, he should proceed to have it completed as provided by the Act.

This section might be amended by inserting in the first line after the word "shall," the words "within thirty days after," and by leaving out of the third and fourth lines: "if required in writing so to do by any of the parties interested."

Your Committee have not suggested any amendments to the Municipal Drainage Act, it being more perfect than the Ditches and Water-courses Act, but we are of opinion that a statutory form of petition, somewhat similar to that suggested by the Drainage Committee of 1888, would be of much service, and would facilitate the originating of drainage schemes by the farmers and others interested.

All of which is respectfully submitted.

Signed on behalf of the Committee by

JAMES ROBERTSON,  
*Chairman.*

### REPORT ON ENGINEERING.

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MR. PRESIDENT,—I regret that beyond the papers on engineering subjects, which will be read before the Association, the Engineering Committee has nothing to show for work done during the year. I only learned of my appointment to the chairmanship of the Committee late last year, and since then my time and that of the other members of the Committee has been so occupied it has been impossible to have a meeting. I had hoped till the last moment to be with you at the annual meeting, but now find that impossible.

Trusting the meeting will be successful,

I remain very truly yours,

W. M. DAVIS,  
*Chairman of Committee.*

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### REPORT OF SPECIAL COMMITTEE ON EXPLORATORY SURVEYS.

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MR. PRESIDENT,—Your Committee beg to report that they carried out your instructions without delay by meeting the Commissioner of Crown Lands and urging on him the desirability of instituting a regular system of exploratory surveys in our new and unexplored territory. The honourable gentleman discussed the matter with the different members of the Committee present, and expressed himself as interested in the idea. Of course, it was not expected that any direct results would follow. It is our opinion that the matter should not be allowed to drop, but that the Committee be empowered to continue to further the object aimed at, by any legitimate means that they may see fit to use.

All of which is respectfully submitted,

E. STEWART.

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### REPORT OF COMMITTEE ON INSTRUMENTS.

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MR. PRESIDENT AND GENTLEMEN,—As Chairman of your Committee on Instruments, I am sorry to have to say that I have very little to report.

Having been unable to convene a meeting of the Committee, I have not seen any of the members since last year at this time, and

have not received any communications. As I believe has been the custom in former years, I invited several prominent dealers of this city to make exhibits of instruments, stationery, etc., at our meetings, but none of them seem to have responded.

As Chairman of the Committee I wrote a letter to N. C. Wallace, Esq., M.P., with reference to securing a reduction in the import duty on mathematical instruments.

My letter was forwarded to the Minister of Customs, and the following is the reply which was received:—

OTTAWA, 4th Feb., 1890.

N. C. WALLACE, ESQ., M.P.  
House of Commons.

DEAR SIR,—Referring to the letter written you by Mr. J. W. Tyrrell, of Hamilton, respecting the duty on mathematical instruments, to which you called my attention: I will see that this matter is brought under the notice of my colleagues when tariff matters are considered.

Yours truly,

M. BOWELL.

It seems to me that an effort should now be made by this Association, before the tariff question is dealt with at Ottawa, to secure this very desirable change.

We have now to pay a duty of 30 per cent. on all our brass instruments, and considering that there are no instrument makers in Canada requiring protection by such a duty, this seems to be unreasonably high. I think if we could secure the co-operation of some of our sister associations, there is a strong probability that we would soon have cheaper and better instruments.

I would therefore strongly recommend that some steps be taken by this Association to secure the assistance of the sister associations in the Dominion, and the appointment of a deputation to wait on the Minister of Customs.

Feb. 27th, 1890.

J. W. TYRRELL,  
*Chairman.*

#### DISCUSSION.

Mr. Gaviller—I think the suggestion that a deputation be appointed to wait on the Minister might be composed of some of our men, members of the Dominion Association resident in Ottawa, and we could avoid the double expense of travelling connected with it, and also have a proper representative on the spot.

Mr. Gibson—I go in for a revenue tariff, but you cannot make a revenue tariff out of one or two things. I think \$70 or \$80 on an instrument is rather too steep; still, at the same time, the surplus funds that the Government secured through its National Policy is laid

out to a very great extent for our special benefit, especially to railway engineers. See the money spent in public works. Let the duties stay where they are.

Mr. McAree—If we combine with the Dominion Association, the Quebec, the Manitoba, and the Engineering Association, I think we could get the tariff reduced. The duty should be taken off the larger instruments, and reduced on the others to about fifteen per cent. I don't think our instrument makers would feel aggrieved. They would sell more instruments and make more money.

Mr. Chipman—I read very carefully the report of the Committee on Instruments last year. I do not think there would be any prospect of getting the duty decreased by all the deputations we might send there. It will demand some energy to be put forth to do this work, to draft a proper petition to the Government. And I think our energies would be extended in securing for ourselves incorporation, as the other learned professions are incorporated, to deal with the examinations. I don't say that they should have controlling power altogether at first, but if we had a voice in the conducting of the examinations for Provincial Land Surveyors, and had the same powers as the other professional bodies have, we then may move in the direction suggested in the report.

Mr. Stewart—There is one objection. There are certain mathematical instrument makers in the Province, and they feel interested in having the duty kept on. If you take it off surveying instruments the telegraph operators would have just as good a chance of representing a grievance as we have. I do not think there is much chance to get the duty off surveying instruments unless taken off other instruments that are not manufactured in the Province.

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## REPORT OF THE PUBLICATION COMMITTEE.

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MR. PRESIDENT,—We had printed 900 copies of the Report of Proceedings of the Fourth Annual Meeting. To the Michigan Society we sent 135 copies; Illinois, 100 copies; Iowa, 50 copies; Arkansas, 90 copies; Indiana, 75 copies; and Ohio, 110 copies.

We received in exchange from each of the above societies about 100 copies of each of their reports, except from Indiana, where the secretary, from severe illness, was not able last year to attend to the publication, but has informed us that they will print the reports of 1889 and 1890 in one volume, which will be sent us at an early date.

Copies of our Report were also sent to different libraries, editors of newspapers, and such persons or societies as take an interest in our proceedings or have given us their assistance.

We now have about 200 copies of the 1889 Report on hand. If any members have not received any of their exchange Reports, they will be at once forwarded, if supply is not exhausted, upon notifying the Secretary.

H. L. ESTEN.

*Chairman.*

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## REPORT OF COMMITTEE ON ENTERTAINMENT.

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MR. PRESIDENT,—Your Committee on Entertainment for the Association, year 1889-90, beg to report as follows:—

Arrangements, similar to those of last year, were made with the Canadian Institute for the use of hall for the meeting this year, and the accommodation given us was everything that could be desired.

A kind invitation was tendered our Association by the Canadian Institute to inspect their collection of Indian and other relics, and was much appreciated by those who were enabled to accept it.

The annual dinner took place this year at Harry Webb's restaurant, and seemed to form a pleasant and attractive part of the annual programme. Among the guests of the Association present were Mr. Aubrey White, Assistant Commissioner of Crown Lands; Mr. Edmund Wragge, C. E.; Mr. W. T. Jennings, C. E.; Mr. Wm. Armstrong, C. E., and Mr. H. Neilson, manager Bell Telephone Co., Toronto. Due appreciation having been shown the toothsome substitutes for pork and beans, and the usual toasts having been proposed and responded to, an interesting programme followed. This consisted of vocal and instrumental music, recitations, etc., from members and guests, after which the party separated, apparently well satisfied with the result of our fourth annual dinner.

We, your Committee, beg to thank the Toronto surveyors for the interest and support they have given the Entertainment Committee when called upon.

All of which is respectfully submitted,

A. J. VANNOSTRAND,

*Chairman.*

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REPORT OF COMMITTEE ON PROPOSED SCHEME FOR  
AFFILIATION OF ASSOCIATIONS OF LAND SUR-  
VEYORS IN THE DOMINION.

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Your Committee begs to report as follows:—

1. That in the opinion of your Committee the scheme, as proposed, would not be a success; as very few surveyors would go to the expense of travelling, for instance, from Winnipeg to Montreal, or from Quebec, Montreal, Ottawa or Toronto, to Winnipeg, to attend an annual convention.

2. The time suggested (two days) would be too short to get through with the business of the different associations and also of the general convention; it having been found that the business of our Association usually occupies from two to three days.

3. During the limited time that the different associations would have for the transaction of their business, there would be no time for the discussion of topics in which members of these associations are most interested, and the result would be that many surveyors would see no object in belonging to an association that had not time to give special attention to the work in which they were particularly interested.

Your Committee would suggest, however, that affiliation might take place in some such way as the following:—

*a.* That one joint tri-ennial meeting of all the associations be held alternately in each of the Provinces of Ontario, Quebec and Manitoba, at say Toronto, Montreal and Winnipeg, to be called the Tri-ennial Convention of Canadian Land Surveyors.

*b.* That the different associations continue to hold their meetings annually, as at present, but that in every third year they meet where the tri-ennial convention is to be held, and on the day previous to said convention.

*c.* That the proceedings of the convention take some such form as suggested in the memorandum of Mr. Dennis.

February 1, 1890.

Sgd. A. NIVEN,  
FRED. L. FOSTER, } *Committee.*  
H. B. PROUDFOOT.

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OTTAWA, ONT., Nov. 26th, 1889.

WILLIS CHIPMAN, ESQ., P.L.S.,  
Sec. Asso. of P.L.S. of Ontario, Brockville, Ont.

DEAR SIR,—The Executive Committee of this Association have had under consideration a scheme for the affiliation of the different associations of land surveyors in the Dominion, which has been submitted by Mr. J. S. Dennis.



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

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

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

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

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

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

Yours faithfully,

ARTHUR O. WHEELER,  
*Sec.-Treas.*

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*Memorandum.*

PROPOSED SCHEME FOR THE AFFILIATION OF THE DIFFERENT ASSOCIATIONS OF LAND SURVEYORS IN THE DOMINION.

At the present time there are four associations of land surveyors in Canada, viz: The provincial associations of the Provinces of Quebec, Ontario and Manitoba, and the Association of Dominion Land Surveyors.

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

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

*1st.* That one joint annual meeting of all the associations should be held, instead of each association holding its own meeting, as at present, and that this joint meeting be called, "The Annual Convention of Canadian Land Surveyors."

2nd. That the annual convention be held alternately at a point in the different provinces most central for the members of the association of that province.

3rd. That each association maintain its own individuality, and issue its own annual report, containing papers contributed by its members, as at present; the report of each association containing only a short account of the proceedings of the annual convention.

4th. That the annual convention be conducted as follows :

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

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

c. The joint annual convention to be presided over by the president of the different associations in turn.

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

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

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

(Sgd.) J. S. DENNIS,  
Pres. Asso. D.L.S.

OTTAWA, Ont., Aug. 15th, 1889.

BROCKVILLE, Ont., 4th February, 1890.

I concur in Report of our sub-committee, but would extend an invitation to members of the Dominion Land Surveyors' Association who have given this matter consideration to attend our next meeting on the 25th, 26th and 27th instants.

WILLIS CHIPMAN.

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TORONTO, February 5th, 1890.

I also concur in the opinion put forth in the Report of the sub-committee, that it would not be feasible to hold the meetings of the proposed Association of Canadian Land Surveyors *annually*; once in three years would, perhaps, be as often as a good attendance could be hoped for. In these years I think the suggestion contained in section *b* of the Report, that the provincial association should hold their annual meeting for that year at the place where the general meeting is held, and immediately antecedent to it in time, is a good one.

The question of the frequency of the meetings of the new association appears to be the only point in which the Report of our sub-committee differs from the memorandum of Mr. Dennis, and I beg most strongly to endorse Mr. Chipman's proposal that members of the Dominion Land Surveyors' Association who have given this subject consideration should be invited to our annual meeting about to be held in Toronto. It is most desirable that the subject should be discussed at a personal gathering of the members of the several associations concerned.

JOHN McAREE, P.L.S.

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COLLINGWOOD, Feb'y 10th, 1890.

I think the proposal worthy of consideration, but amended as suggested by our sub-committee; and heartily agree with Mr. Chipman's proposal to invite members of the Dominion Association to attend our next annual meeting.

E. STEWART.

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SURVEY DEPARTMENT, CITY HALL,  
TORONTO, Feb. 5th, 1890.

I agree with Mr. Chipman's ideas.

VILLIERS SANKEY.

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WILLOWDALE, 7th Feb'y, 1890.

I am of the same opinion as Mr. Chipman.

PETER S. GIBSON.

## REPORT OF THE COMMITTEE ON BOUNDARY COMMISSIONERS.

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The Committee on Mr. Ogilvie's Boundary Commissioners' Bill beg to suggest the following amendments:—

1. Every Provincial Land Surveyor shall act as a "Boundary Commissioner" when called upon to do so.

2. Whenever the parties to any disputed boundary case shall so agree, they may refer the adjustment of such disputed boundary to a court of arbitrators composed of two Boundary Commissioners as above and the County Judge of the county in which the disputed boundary is situated or some legal practitioner appointed by him.

3. The arbitrators so chosen and appointed shall within . . . . . days after receiving notice of their appointment to the said duty of arbitration give ample notice to the parties to such disputed boundary of their intention to proceed on the day set forth in such notice to the place of the boundary in dispute, and to adjudicate upon the case; and the arbitrators shall, on the day appointed, proceed to the scene of the disputed boundary, and shall then examine all witnesses in the matter on the ground to which their evidence relates, and shall perform any operations as surveyors which they may deem necessary to a proper understanding of the matter in hand.

4. Upon the completion of the examination of all evidence submitted to them in the case, and such measurements and operations as they may deem advisable, the arbitrators shall make their award in the case.

5. The court of arbitration which has tried any case of disputed boundary shall award the costs of such trial and the proportion to be paid by each of the disputants in a manner that shall be deemed just and equitable by the arbitrators.

6. Each arbitrator shall be entitled to the fees as at present provided by law, together with travelling and living expenses, while engaged in the trial of any disputed boundary case submitted to them as hereinbefore set forth; such fees and expenses to be a part of the costs of the trial.

7. Before proceeding to the trial of any suit or question submitted to them, the Commissioners, as above chosen, shall make an affidavit before the County Judge, or before some Justice of the Peace or commissioner for taking legal affidavits, that he has not any personal interest in the suit at issue, and that he has not in any way been engaged professionally as a surveyor on it. Such affidavits to be filed along with the rest of the documents connected with the case with the Clerk of the County Court of the county in which the dispute is located.

V. SANKEY,  
*Chairman.*

## DISCUSSION.

Mr. Sankey—(Explains the amendments by the Committee to the draft bill by Mr. Ogilvie). The question is, whether the surveyors of best practice, and men who are doing the largest amount of work in any particular county would likely take the position of Boundary Commissioner. These men would have the greatest amount of experience, and that being so, the fact of their being commissioners would interfere with their getting work. I think the question to decide is whether it would not be better to leave every surveyor eligible to be called upon, when required, to act as Boundary Commissioner. We should decide whether it would be necessary to make one surveyor in each county a commissioner. It would limit the choice of parties. The proposition of this Committee gives the choice to the parties of one out of twenty, assuming there are twenty counties. Why not leave it open? That is the most important point, except one, in the whole matter as to whether the first clause in Mr. Ogilvie's draft shall stand, or whether it should not be read, "that all surveyors shall be eligible to act when called upon to do so."

Mr. Dickson—Is it the cheapening the cost of those things suggested, or do you think justice might be got more readily? I think something should be done to cheapen the cost of these suits.

Mr. Sankey—A surveyor going on the ground to make a survey, evidence is tendered him; gets evidence on the ground—perhaps takes an affidavit—and the matter then comes before the Assize Court. In cases of back townships these men are brought down to the front and put into the witness box, and a clever lawyer gets hold of them, and the evidence that he gave him is knocked into a cocked hat, and the surveyor is blamed. Cases of this kind are appealed, and the Court of Appeal ask if so and so was done by the surveyor, and if not the court sends the case back.

It is supposed the expense of bringing a great number of witnesses many miles will be greatly lessened and justice will be more perfect, the chances of appeal will be less, and people will have their boundaries adjusted in a more professional and business-like way.

Mr. Cozens—Would the report of the commissioner be final?

Mr. Sankey—The Government would decide that themselves. The Court of Assize and the Divisional Court is not final. In this case it is, whenever any of the parties to the dispute in boundary cases shall agree. If two neighbours get fighting over a boundary line, and they take this way of settling it, that may be made final by agreement, on the idea that everything goes regularly and no impartiality or unfair dealing, the matter would be final, and might be made the award of a court of proper jurisdiction. If this Boundary Commission be established and one or two cases settled before them in a professional way, in a very short time we would have every case settled in that way.

Mr. Dickson—It is simply creating a board of arbitrators, if the people take advantage of it.

Mr. Sankey—Certainly. The first point is as to whether every surveyor should not be eligible. The one difficulty is, as I have suggested, about getting the best man in every township to act, owing to its interfering with their practice.

It was thought, generally speaking, that the clauses with reference to misconduct and that sort of thing might be left out of this Act. Surveyors are bound under oath as such to do their duty properly, and the Surveyors' Act lays down a rule whereby they can be deposed from their office. The Committee thought the one court would be sufficient to try a surveyor. That was the next alteration.

The third alteration was as to substituting the County Judge instead of one of the surveyors.

With those three alterations the Committee are of the opinion that this scheme might be brought before the attention of the Government, and they be urged to bring in such legislation as may be necessary to confirm it.

Mr. Speight—Is it intended to exclude lawyers ?

Mr. Sankey—At almost all of these courts it is usual for people to be represented by their legal advisers, and if it is going to be a court of final jurisdiction, it is right that lawyers should be there. The public at large do not feel they have had all the fair play they ought to have unless they have a lawyer to assist them. I do not think it would be advisable to exclude lawyers.

Mr. Speight—In adjusting the boundaries by the arbitrators it would make it more expensive, but of course might be more satisfactory—it is practically three judges.

Mr. Sankey—There would be the County Judge and two surveyors to pay. I don't suppose it would be much greater than the cost at an Assize Court. The trial would commence the day the court would sit, whereas at an Assize Court you sometimes have to wait for days until the case is reached.

Mr. Dickson—I think the only thing in favour of that scheme is by taking the court to the place, instead of taking the parties to the court.

Mr. Stewart—Speaking of the County Judge being appointed as one, I think it would be very difficult to get him to attend; for the draft bill provides that the surveyors should go on the ground and make such inquiries, and the County Court Judge would have to wait for several days before the real examination commenced. Then, as to the expense, you will have other surveyors besides the Commissioners—perhaps two or three. The difficulty with regard to the County Court Judge could be got over in this way, by saying, “the County Court Judge, or somebody deputed by him”—and it might be said that a legal gentleman would be best for that purpose. I think it should be final to save expense. In the one case you take the wit-

nesses to the court, and in the other you take the judge and surveyors away to try the one case. I certainly think it is moving in the right direction.

Mr. Sankey—With regard to the objection as to the County Court Judge, unquestionably some lawyer would be better than a surveyor. As to the expenses of the surveyors, they would be there in any case. No extra expense incurred in bringing the surveyors to the ground, than taking them to the court of trial.

Mr. Kirkpatrick—I think something in this direction is wanted. Something is needed to make a finality of these municipal surveys. A surveyor performs the municipal survey, and if there is a petition against that, there is great difficulty in confirming that survey. He may have done it right, but one or two parties petitioning against it, the Department does not like to take the initiative and say we will confirm the survey.

I think a Commissioner should be appointed, but not for life. I would have him appointed by the Lieutenant-Governor for that object alone, and his office would cease as soon as that was done.

Mr. Sankey—That is the view of the Committee.

Mr. Kirkpatrick—I would make it compulsory on the parties asking for this Commission, and I certainly would have the County Judge on it too. If parties want to go to the courts, let them go there first. In these petitions for municipal surveys the parties don't really know what they want. Each party thinks the surveyor is going to run it in his way; they want it on the road and he does not put it there, and because of that they petition that the Crown should not confirm it in any way, and it hangs on. There were the roads, but the line may be north or south of the road, and when everyone dies the stone monuments will remain, and what are these for?

If we could have a court which should be final, I would not make it compulsory. Let it be a voluntary choice. I think if there were a few good decisions by these Commissioners, the public would soon find and realize where their true safety lay. I believe this would be the greatest move in cheapening litigation.

Mr. Gaviller—Cannot the Crown Lands Department send out an inspector to inspect a municipal survey?

Mr. Kirkpatrick—The Department could easily send a man out, but why should the public have to pay him? In the proposed case the idea would be that the parties would agree to pay the expense.

The President—There would be no guarantee that the inspector sent out knew any more about it than the surveyor who made the survey—perhaps not as much. Upon the question of the Boundary Commission, I think it is a step in the right direction, and if we can get a court established it will be time well spent, even though it is extended from session to session. If we can accomplish something in the end that will cheapen these matters and make them final, I think it will be time well spent. With reference to the surveys made under

the authority of the Crown Lands Department, I can point you to two surveys that were made when I was an apprentice, the lines were run and the monuments are standing there yet, but the fences have never been moved; there is no finality to it. I think if there can be any way of having a tribunal to which parties may go and have it settled once for all, it would be far better. I think, at all events, that people should have the option of taking the natural way through the courts, or taking this.

Mr. Sankey—My idea would be to get the proposals, if the Association think the amendments in Mr. Ogilvie's scheme are advisable to adopt, brought before the Attorney-General asking him, if necessary, to get further information on the subject and take the thing up.

Mr. Browne—I fully agree that this is a move in the right direction, and I think Mr. Kirkpatrick's suggestion a good one; that it should be optional. If it was made final I know that a great many cases would be brought before the surveyors and settled in that way, speaking particularly of the city.

Mr. Gaviller—I think it would be advisable to go over this matter clause by clause, and if we determine to have it brought before the Attorney-General, to have a committee appointed or a person appointed to present it to the Attorney-General, and let it take its chances. Supposing the Committee make a draft of the proposed amendments and submit it to-morrow?

Mr. Sankey—I think it better to adopt Mr. Gaviller's suggestion to have a committee named to put this in workable shape, and bring it up to-morrow or next day and let it be discussed clause by clause, and then brought up before the Government.



PRESIDENT'S ADDRESS.  

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GENTLEMEN OF THE ASSOCIATION OF PROVINCIAL LAND SURVEYORS OF ONTARIO,—I have much pleasure in extending to you a hearty welcome to our Fifth Annual Meeting.

We have reason for gratitude to the Giver of all good that our membership has suffered no loss by death since last we met together in this place.

We come together to-day to talk over the past, and to prepare for greater usefulness in the future.

It is now four years since we met in the Parliament Buildings for organization, and I think I can safely say that our society has been a success, and that the outlook is still very favourable.

The young surveyor of the present day has many advantages that were not enjoyed by those who came out 25 and 30 years ago. The benefit of organizations like ours can scarcely be estimated.

In those days there were no associations to which we could belong and have the privilege of acquiring information from his brother members, or by an exchange of reports with other societies gain a knowledge of what was going on in other parts of the continent.

All these advantages the members of our association now enjoy, and he will be a dull man indeed who does not profit by our meetings and discussion of matters pertaining to our profession, and who can derive no advantage from reading the many excellent papers published in our exchanges.

In no other way can a surveyor get the same information for five times the money that it costs him to belong to our Association.

A man may think he knows all that is necessary in his business, but when he comes in contact with others he finds that he has a great deal still to learn.

Associations like ours, in which practical men meet to discuss practical questions, form a necessary part of professional education, which no live man can afford to do without. It is surprising, therefore, that all members of our profession do not avail themselves of the advantages of belonging to our Association.

I trust we may be able during the present year to count among our members many who have hitherto not cast in their lot with us.

Our membership remains at about the same number as last year.

As to what we have been doing during the year, you are referred to the reports of the various committees.

A communication from the Association of Dominion Land Surveyors, regarding affiliation of the different associations of land surveyors in the Dominion, with the action taken thereon by the Executive, will be laid before you for consideration.

It appears to me that the tariff of charges framed at our last meeting should be amended in some respects. I think that a surveyor should get a dollar an hour for his services, or a minimum of \$8 per

day, and that the working of the tariff during the past year should be enquired into.

I have frequently been asked during the past year as to the best means of preventing unlicensed persons in many parts of the country practicing surveying; or, as it is generally termed, "running lines," and this matter should, I think, be dealt with by the Association.

Other matters will, no doubt, come before you from the different Committees.

By reference to the programme it will be seen that a number of papers upon subjects of interest will be submitted to the meeting. A full discussion on each paper submitted is very desirable, and I trust that any one present will have no hesitation in expressing his views upon any matter coming before the meeting, and also that any member wishing information upon any matter in which he may be interested will not shrink from bringing it under the notice of the Association.

I now ask your consideration of the further business of the meeting.

A. NIVEN,  
*President.*

*February 25th, 1890.*

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# PLAN OF CHURCHILL HARBOUR

By LIEUT. A. R. GORDON, R.N.

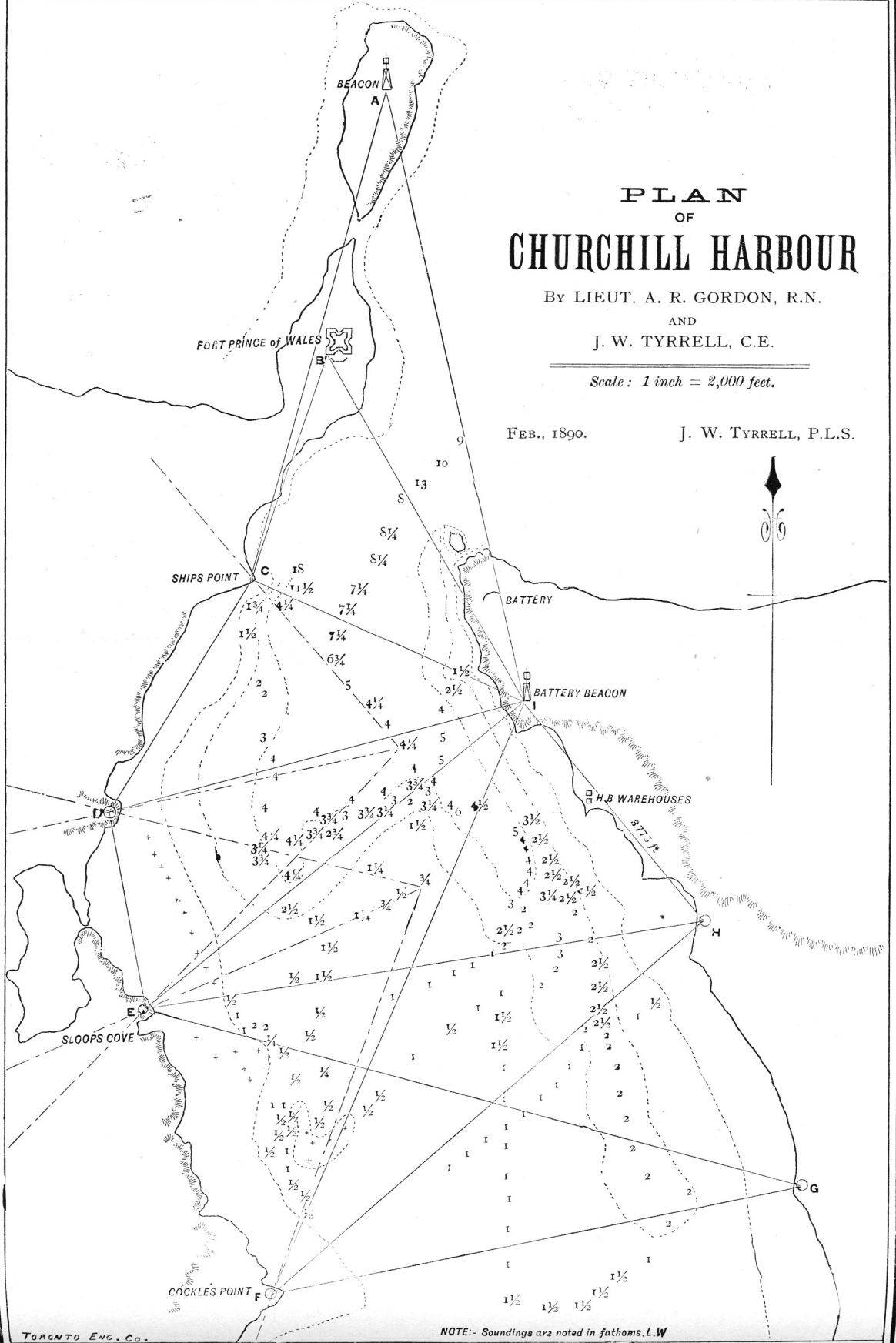
AND

J. W. TYRRELL, C.E.

Scale: 1 inch = 2,000 feet.

FEB., 1890.

J. W. TYRRELL, P.L.S.



# PAPERS.

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

## COAST AND HARBOUR SURVEYS IN HUDSON BAY AND STRAIT.

By J. W. TYRRELL, C E., P.L.S.

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IN this paper I propose briefly to present an account of the principal surveys performed, by the recent Hudson's Bay expedition—of which the writer was a member—sent out under the command of Lieutenant A. R. Gordon, by the Dominion Government during the years 1884, 1885 and 1886.

Before taking up my subject proper, however, I think it will be interesting just to note the names of some of the early explorers who visited in years gone by the field of our observations.

Hudson Strait was first discovered in the year 1517 by Sebastian Cabot, who was sent out by Henry VIII. in charge of an expedition to search for a north-west passage to India. In the year 1610 Henry Hudson sailed in a barque called the *Discovery*, and re-discovered the strait now called by his name, passed through it, keeping along the south shore, and entered the bay, in the southern part of which he wintered. The next summer, becoming short of provisions, he had trouble with his crew, who finally mutinied, and one night bound Hudson, his son and several of his officers, and sent them adrift in an open boat. At this time they were supposed to be near the west end of the strait. The remainder of the crew, after undergoing great privations, reached home with the ship; but nothing was ever afterwards heard of the unfortunate navigator and his party.

In the year 1821 Captains Parry—afterwards Sir William E. Parry—and Lyon, in command of H.M. ships *Fury* and *Hecla*, conducted an expedition into Hudson Strait and Bay, and obtained some valuable information in the neighbourhood of the upper Savage Islands and elsewhere; and three years later Captain Lyon, in command of H.M. S. *Gripper*, again visited the same waters.

In 1836 and '37 Captain G. Black, in command of H.M.S. *Terror*, also made a voyage of discovery into Hudson Strait and Bay, and since the year 1847, when the ill-fated Franklin expedition was lost, several other exploring parties have gone to that region, but few of their searches extended into the fields of our labours.

However, notwithstanding all these expeditions (besides the annual voyages of the Hudson Bay Company's ships, which have for several centuries visited the shores of Hudson Strait and Bay) it was found a short time ago, when the question of the practicability of navigating Hudson Strait became a matter of discussion, that very little reliable information of any value was available, and in order to thoroughly look into the feasibility of the proposition to establish a steamboat route between the Eastern world and our Canadian Northwest, the Dominion Government thought it well to send out an expedition to collect such information as might be required to determine the question.

Accordingly, in 1884 the steamer *Neptune*, and in 1885 and '86 the *Alert*, having been procured for the work, Lieutenant Gordon, R.N., under instructions from the Honourable Minister of Marine, proceeded to Hudson Strait to establish observing stations, and to collect as much valuable information as possible.

Naturally, surveying formed an important part of the work of the expedition, as it was very desirable to know something of the character of the coast, and to locate and survey harbours wherever they might be useful.

I have here a small map of Hudson Strait and Bay on which I have shown in red the portions of coast line added to the chart from our surveys.

The principal places where work was done are as follows:—First, at the entrance to the strait north of Cape Chidly, the Buttons, a group of eleven or twelve islands were surveyed. This work was done from the deck of the ship as she was steaming slowly past the islands, upon the extremities of which rounds of compass bearings were taken at intervals. As each round of bearings were taken, the reading of the patent log was also noted, and the distances passed through the water by the ship, as indicated by the log, were used as bases. As these islands are situated not far from the cape, their positions relatively to it were determined by the same means, and near the cape on the main land a series of observations were taken both to determine the latitude and longitude. A snug little harbour which was called Port Burwell was also discovered just inside the cape, and a sketch survey made of it and soundings taken. A prolonged attempt was made to discover a harbour along the coast of Resolution Island, which forms the northern limit of the great gateway into the interior of our country, but nothing in the shape of an inlet or bay fitted to afford protection and an anchorage for a ship could be found. The whole coast presents an unbroken front of solid rock, and towards the interior of the island attains elevations of about one thousand feet.

On the south shore of the strait, near Cape Prince of Wales, a fairly good harbour was discovered and called Stupart Bay, after the first observer who was stationed there. Series of observations were taken at this place to determine its geographical position; the instruments used for the observations being two Hadley sextants and six chronometers, whose rates were compared daily with a standard. Then, from Stupart Bay as a starting point, the writer with a small

party was sent out in one of the ship's whale-boats to make a track survey of the coast toward the south-east.

This was accomplished, and about twenty miles of hitherto unknown coast-line added with a fair degree of accuracy to the chart, besides forty more determined approximately by ship's bearings upon prominent points.

Considerable difficulty was met with in carrying on this survey, for the compass, which is very sluggish in all this region, was found in some places to be of no use whatever on account of the occurrence of great masses of magnetite. As the only instruments furnished me for making the survey were a boat's compass and patent log, it seemed to me at first difficult to know how to proceed, but by adopting the principle of table surveying from points on the shore when the compass was unreliable, I managed to get along fairly well. Wherever the compass worked satisfactorily, bearings were taken from point to point along the shore, and the distance measured with the log.

It is worth noting just here that, at a point about ten miles south of Stupart Bay, four small iron cannon (one of which may now be seen in this hall) and a large anchor were discovered by Mr. Payne, who was the observer situated at Stupart Bay. They were lying upon the rocks, and some distance above high water mark. As appears evident from the cannon now on exhibition here they must have been lying there a great number of years.

There were no signs of buildings or other wreckage about, and it is a matter of some curiosity to know where they came from; but I must not get too far from my subject. On the shore of Big Island, near the north shore of the straits and directly opposite Stupart's Bay, a large harbour was discovered and named Ashe Inlet, after Mr. Ashe, D.L.S., of Quebec, who was the observer placed in charge of a station at this point the first year of the expedition. Considerable track surveying was done at this place, during the winter of 1885-86, by the writer.

Proceeding westward we come to Charles Island, which, as shown on the chart, we found to be considerably out of place in longitude. Observations were taken to correct its position, and, as we steamed along the north shore, bearings were taken to determine the general shape of the coast line. The next place in order as we proceed westward, where considerable work was done, is in the vicinity of the Digs Islands and Cape Wolstenholm. Here again, in the more westerly of the Digs Islands, an excellent harbour was found and christened Port Laperrier.

The position of this port was also carefully determined, and the track surveys which were afterwards made in the vicinity were tied on to this fixed point. At one time, while Lieut. Gordon was taking a series of observations, Doctor Bell, the scientist of the expedition, and the writer, were sent out in a boat with two or three men to make a traverse, or perhaps more properly called a running or track survey of the islands. The shooting in this neighbourhood we had reason to believe was very fair, but the instructions we received were not to

take our rifles, as we would have no time for sport. One of the party, however, disobeyed the commander's orders, and, along with the rest of our outfit, smuggled aboard our boat his Remington rifle.

A boat's compass, a prismatic and a patent log, were, as usual, our surveying instruments, and we proceeded from point to point taking our bearings and measuring the distance in the usual way. When we had traversed a short distance—not more than two miles—along the north shore of the outer island, and were about to enter a little cove in the shore, our attention was diverted by the appearance, a few yards ahead of us, of two polars swimming in the water—a large she bear and her cub. They did not appear to take much notice of us until we got between them and the shore, hoping to cut off their escape by land. But things did not seem to work that way, for the old bear, seeing our move, headed for the boat and in a moment disappeared below the water.

Our rifleman had taken up his position at the bow of the boat, and the writer, having along with him a 38 cal. S. & W. revolver, took a position beside him and waited for the reappearance of the bear. Presently she appeared, but at the stern of the boat, where the doctor was seated steering, and immediately she proceeded to climb in. We in the bow dare not fire as two sailors and the doctor were standing in front of us; but some way or other, through the assistance of a pike pole and the motion of the boat—for besides it being under considerable headway, the water at the time was very rough—we managed to part with our new acquaintance. It was about here that the track surveying proper came in. Several parting shots were fired as the bears were swimming ashore, and afterwards as we saw them disappearing among the rocky hills, but on account of the roughness of the water and the tossing of our boat they were without effect. About fifteen minutes after leaving the site of the above encounter, we came upon two other large male bears, and had a hard fight with them, in which conflict, however, we were more successful. These little incidents, though not exactly coming under the head of surveying, were some of the difficulties we had to overcome, and so I consider it quite proper that they should be mentioned. If any of our friends here should have occasion to make surveys in the same district, it would be to their advantage to know what instruments would be found most suited to that particular locality.

The traverse of the coast was continued for about seven miles, when the eastern extremity of the outer island was reached, where a fine, deep, but narrow channel, was found to separate it from the inner island. The shores were chiefly high, and in some places were found perpendicular cliffs of rock standing up from five hundred to one thousand feet out of the water.

At these places thousands of sea-fowls were seen flying about and resting on the ledges along the face of the cliffs. The birds were not so numerous as to prevent us from getting clear sights from point to point; but just here our progress was again interfered with by the occurrence of local attraction in the shape of a herd of about thirty walrus. We did some clearing here, but nothing very extensive, and



then pushed on, passing the eastern end of the island and then turning shipward along the south shore. The rest of our trip, extending over about five or six miles, was comparatively plain sailing, the only obstacles met with being one small herd of walrus and one more polar bear. In some respects this eighteen or twenty miles of coast survey was the most difficult that I have had to deal with in my experience.

Just to the south of the Digs Islands a group of twenty-five or thirty small islands were also surveyed, and the main shore for a distance of about twenty miles south-west of Cape Wolstenholm. Near the south-eastern extremity of Nottingham Island a harbour was discovered, and called Port De Boucherville in honour of the observer left in charge of the station placed there.

The positions of the eastern coast of Mansell Island and the southern end of Southampton Islands were corrected in longitude.

A portion of Marble Island, in the north-west of the bay, was surveyed, and its geographical position determined. Then, arriving at the west coast of the bay, it was found according to the chart to be half a degree out of position for about one hundred miles south of Cape Esquimo. The true position of this coast having been ascertained, we passed southward and arrived at Fort Churchill, a place, for various reasons, the most interesting yet spoken of in connection with our voyage. For over two hundred years it has been one of the most important trading posts of the Hudson Bay Company. More than that, it was their chief stronghold against invaders, being protected by the massive stone fort Prince of Wales until about the year 1775, when it was taken by the French admiral, La Pérouse, and destroyed. At the present time it is an important trading station, and possesses the only harbour on the west coast of Hudson Bay, and lastly it is destined to be the future terminus of the Hudson Bay railway, and the Liverpool of Manitoba and the North-west Territories.

I have here a chart of this very excellent harbour, prepared from an accurate survey made by Lieut. Gordon and myself. I will briefly describe the methods adopted in performing this work. The first step taken was to erect a number of signals or small beacons at prominent points on both sides of the river and at intervals of about half a mile. Then a level stretch of shore was chosen between two beacons (I and H on chart) and the distance carefully measured; this distance was used as a base line, and from the extremities of it sextant angles were taken to the other points (with the exception of one or two, which were fixed by taking angles from other more suitable points, which had been fixed by the other sites). The shore line was then traversed by the compass and fitted in between the points fixed by triangulation. Having now obtained a correct plan of the shore line, the next work was to get a plan of the bottom of the river. The difficulty we met with in performing this part of the work was, not to take the soundings, but to locate them correctly; for, on account of the ebb and flow of the tides and the currents of the river, it was impossible to keep any kind of a straight line with a boat. In getting over the difficulty our beacons came into use again. At every cast of the lead,

by the use of two sextants, double angles were taken simultaneously from the centre of the boat to some three beacons on the shore, one beacon always being common to the two angles. Thus every sounding was an absolute fix, and was plotted upon the chart by means of a station pointer. It was also necessary to note the time when each sounding was taken, in order to be able to make the proper reduction to low water, as at this place the rise and fall of the tide varies from eight to sixteen feet. As may be seen by this plan, the area of water in the harbour within a four-fathom line is approximately half a square mile, and with a very little dredging this area could be considerably increased.

The mouth of the Nelson River was also surveyed in a somewhat similar manner, but not so completely, on account of the much greater dimensions of the work—the river being fourteen miles wide at the mouth—our limited time, and the less necessity for the survey. Sufficient soundings were taken, however, to ascertain the limits of the channel of deepest water, and to give evidence of the impracticability of making a harbour at York. The *Alert* was obliged to anchor ten miles outside the mouth of the river altogether, where she was exposed to the full sweep of the gales from the north-west, and one night experienced such a heavy sea that it was found necessary to let oil tanks run to prevent the seas from breaking over her.

I had intended to give you an account of some track surveys made during the winter season by myself, when travelling about the country on a sled drawn by an Esquimo dog team; but am afraid that I have already taken up as much time and space as my subject will warrant me in doing.

#### DISCUSSION.

Mr. Chipman—Will you describe the log that was used on this survey?

Mr. Tyrrell—Massey's patent log was used chiefly. Part of the instrument containing a dial was attached to the stern of the boat, and was connected with the other part—a screw-shaped affair, which was trailed in the water,—by a stout, tightly plaited cord. The screw—which revolved because of its motion through the water—twisted the cord which moved the clock-work in the part attached to the boat, and caused the hands on the dial to indicate the number of miles passed through the water.

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

## COMPILED PLANS.

By P. S. GIBSON, P.L.S.

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To prepare a complete or entire plan of an incorporated city, town or village, or village not incorporated, or parts of townships, involves an amount of work and trouble that only those who have undertaken such a contract can understand.

The object of the statutes in that behalf is evidently to furnish a consolidation of plans and surveys of such places to certain dates, and to serve as a reference plan for the registrar and for lawyers and others searching titles of properties.

These plans, when carefully and properly prepared, are of great advantage for ordinary assessment, and a real necessity in allocating the cost of works under the local improvement system.

The statute does not appear to require the registrar to open an index of the lands shown on such plans, although in some cases where plans are of incorporated villages it is done.

Where, in conveyancing, reference is made to such plans, the registrar, if the reference is not to a certain number of a formerly registered plan shewn thereon, simply registers the instrument on the township lot.

An entire plan should show every governing plan registered to date, and every subdivision held by deed or other instrument not shown on a registered plan, and where there is a re-subdivision of a part of a registered plan, and such re-subdivision is registered, it should be shown on the plan, but where lots of a registered plan are only divided by deed they should not be shown.

It often occurs in looking up the titles to lots not shown on a registered plan that reference is made to a plan which after considerable trouble may be found, and, if so, should be registered under Sec. 85 of the Registry Act, if survey made before 4th March, 1868, or under Section 84 if after, and then entered on plan. Here, however, a formidable difficulty meets the unfortunate Provincial Land Surveyor who has entered into a contract to make an entire plan per Registry Act in consideration of a small sum of money which the corporation has, as a great favour, agreed to pay him.

In making his contract it is likely not stipulated that the corporation shall exercise any statutory powers they may have to enforce the registration of such plans, or that any extra expense the Provincial Land Surveyor may be put to in preparing such plans for registration will be allowed him as an extra.

In most of the older cities, towns and villages there are large numbers of lots sold under deeds by metes and bounds without reference to a plan by number or otherwise. There is clearly an obligation under the statute for the original owner or owners or their legal representatives to file a plan or plans of such subdivision to facilitate the making of the entire plan. In preparing such plans, or in entering such subdivisions upon the entire plan, when such previous registration is not made, difficulties arise continually. Lots often lap each other, or a space may be left between lots which were supposed to adjoin each other, thus leaving a remnant not conveyed. Lots supposed to be located on a particular street may by description be located a half mile away and covering a piece of land conveyed by another deed, thus causing a blank in one place and a duplicate in another. Again, a lot supposed to contain a quarter acre may by an erroneous description, cases of which I have known, cover from ten to twenty acres of the village. Again, the courses of adjoining lots present most formidable difficulties. On one side of the division line will be entered the old patent bearing, on the other side for the adjoining lot will be a late magnetic bearing, in both cases no explanation as to what kind they are. In another case there may be an astronomic bearing on the one side and likely a magnetic or conventional bearing on the other; or in some cases, in describing a lot, two or more of these bearings may be used, or the bearing of one or more sides, for some excellent reason, be left off entirely, and yet, at least under the Registry Act, you are required to enter them on your plan. Again, some of the courses and distances may follow a natural or artificial limit which has long ago disappeared, and often in such cases no bearing may be given, or the distance left out, or likely both. It often happens that the deeds of properties are not registered, and likely cannot be found. Many of the above difficulties occur when compiling the registered plans.

In all cases, rivers or streams should be traversed where not defined by registered plan or deed, and streets, where lands conveyed by deeds only or partly so, should be carefully measured, and frontages noted, and names of owners taken, and deeds of the lots copied as held by the owners, to save long and difficult searches in the registry office.

The principal streets should have the angles of intersection taken even if plans registered of them, and all original important monuments noted and properly marked by iron bars. This, of course, by special agreement with the corporation.

As to the surveyor's certificate for such entire plan, Section 87 of Registry Act provides that it shall have endorsed thereon the certificates of the clerk and head of the municipality and the surveyor that the same is prepared according to the directions of the municipality and in accordance with this Act, and to the map or plan the corporate seal of the municipality shall be attached.

This provision as to the surveyor's certificate is necessary, as it would not be possible for him to sign the usual certificate in the form of Schedule L of Registry Act.

This difference in the form of certificate is of importance, and may facilitate the making of an entire plan of a village, etc., as it will be noticed in said Section 87 that it is only specifically stated what scale it shall be made upon.

It is quite evident that the intention of the Act, with reference to entire plans of villages, etc., is good, but that the Act will require considerable amendments before the intention is fully realized.

#### DISCUSSION.

Mr. Gibson—The supposition is when a village is incorporated there shall be a plan at the date of incorporation, showing the outlines of the village referring to the by-law under which it is incorporated, and all plans registered up to that date should be shown on it, with the numbers.

In a great many of the old villages in Ontario two-thirds of the properties are described by metes and bounds, without reference to a plan. They may say according to Lots 1, 2, 3 and 4 on such a street, but no plan referred to, or if there is a plan it is not registered.

Under Sections 84 and 85 of the Registry Act provision is made to compel parties to register plans according to which they have sold properties.

If I can find the old plan I check it and put a certificate on it. My certificate is to the effect that it is made by such a surveyor and subsequently checked by myself and now to be registered under Section 85.

When you are asked by a village corporation to prepare these plans you are generally notified that it is a special favour on their part to give you the job, and as you are to get all the work you are expected to do it cheap. If you were just starting you would consider it perhaps an honour to get it. You get yourself into trouble if you want to make it in accordance with the Registry Act, as we understand it sometimes.

The fact is the pay you get is not sufficient for the first plan, and you are not prepared to enter into litigation in order to enforce this other plan, and there you are in a fix. Very few statutes passed by lawyers but what are pretty shaky and can be got through easily. The only proper way is that the statute should be printed and submitted to a committee of experts—I mean experts paid for it—and it would save a great deal of money.

I had an offer the other day to prepare a plan for a village in the county of York. I had tendered for the same job before, but another surveyor went lower, and the plan he made the registrar would not register. He did not go to the registry office, but took it out of his own brains. He made his plan, however, and got his pay too. That happened in two or three villages, and I would not discuss the matter with the councils until the surveyor had got his pay. The registrar would not register it, and I got a letter from the municipality to do

work. I said, "All right, but it will necessitate considerable expense." My father laid out the old village about 1830, and I have his plans, and they could not make it without them, and I didn't care about working it for nothing. I notified the surveyor. I said, "if you get your fees from the village for the work that I want you to do in getting proper plans in the way it should be done, or the intention was, and if the council will go into it in that way and facilitate the re-registering of the plans—which have been wrongfully registered without the proper judge's order—if they will take the responsibility of that, I will be adviser in the work; or will do the work, but they are to do their share." I made one bargain with a corporation that they pay my expenses at the hotel, furnish the assistance, and then I will do it for so much, or I will work for so much per day.

Mr. Chipman—In our county we have a very intelligent and enlightened registrar, who insists on every subdivision being put on the plan except subdivisions of lots which are registered, that is, ordinary building lots. In the subdivision of a large park lot, or a subdivision by deed, he insists on every one of them going on, and if they are not on he will not register the plan.

Mr. Gibson—There appears to be an obligation under the statute to do so, and especially under the Land Titles Act. If this matter were enforced more strictly, unlicensed people would do very little.

I remember a case in a village in the north part of the county of York, where I enquired of the man where his boundary was, and he said he had a proper deed of his property. I asked for the deed, and where his lot was. He says, "You are standing on it." After looking at the deed, I said, "You gave me the wrong deed; get me yours. The one you have given me locates your lot on top of the hill." I drew a sketch of it on the sidewalk, and got it into his head that it was misplaced confidence, as well as a wrong expenditure of money.

These "conventional bearings" have been introduced in the last few years, and are recommended and adopted under our Land Titles Act. If you are subdividing a property you take, for example, a patent bearing of the front of the concession, north 16° west, as the frontage line of the lots, and that you make the governing line of your survey, and lay off your angles entirely from that line, and refer to it, but sometimes the surveyor forgets to mention that it was done so. I laid out property in that way, and was careful to mark some points with iron bars, if using that class of conventional bearings. We have no right to vary the paper title of any title deed. I advise in all these cases a plan should be attached to the deed. Instead of making a formal plan for registration under the Registry Act, I make duplicate copies of my office plan and attach one to each deed, and it helps materially; and I give explanatory notes as to these things. Conventional bearings are not bearings properly speaking.

A man is living on a piece of property in the village, and you go to him and say, "Where is your deed?" He will say, "It is in the registry office." It is expensive to hunt that up, and you go there and cannot find it, but you find a memorial—which are so full of in-

formation, as you may know. Or when you get there you find neither deed nor memorial; what are you going to do about it? Are you going to hunt it up? The man says, "I have lived here long enough to hold it. There is no deed." I measure around the lot, and find so many feet, and govern it by the courses and distances of the properties around it. If the property has such a bearing, I put it on that property, and as I go around it I use the bearings of the adjoining lot.

Mr. Stewart—Do you not frequently use the word "parallel"?

Mr. Gibson—I always do when I use patent bearings.

It is almost impossible in one of these villages, where the properties have been conveyed by metes and bounds, to hunt up these title deeds and locate them in the right direction, because one wrong description upsets the whole thing.

In the United States they have plans prepared for the assessment commissioners, and they are exact plans of the properties. These plans are made to the decimal of an inch, showing every property as it is, and monuments put on corners of streets and other governing points. These assessment plans are very expensive, but still are of immense advantage. The assessment of cities and towns can be made without the least difficulty, and that is the class of plan we want here. What we have answers the purpose until something better is adopted. I never put on my own actual measurements when there are measurements on plans or in deeds; I have no authority.

Mr. McAree—You spoke about taking angles of the streets.

Mr. Gibson—My measurements of angles are for my use in plotting the plan.

Mr. Jones—Supposing the registered plan is very incomplete, and does not give the size of the lots, do you put it on as it is?

Mr. Gibson—Yes, generally.

Mr. Jones—Do you put on your own measurements at all?

Mr. Dickson—Not unless you make measurements in the field.

Mr. Jones—Suppose there is a registered plan of a whole city, and not a foot of measurement given on such plan, but drawn to a scale, there would be nothing to do but to duplicate it; is that your opinion?

Mr. Gibson—No; I always put a note on that such and such work has been done so and so. I don't take the responsibility at all, one way or the other. No corporation has any right to establish public roads except by by-law. You are ordered by a municipality to go and make a plan of certain property; that plan is to be the correct one; if you can get the individuals who own the property to sign that plan, all right.

Mr. Ross—In this case the lots are divided up wrongly, and plan does not answer the purpose.

Mr. Gibson—They should have a plan made and a statute passed to confirm it.

Mr. Gaviller—Get a judge's order.

Mr. Ross—Supposing he refuses to sign an order?

Mr. Gibson—He has no right to refuse if plan and procedure are as per statute.

Mr. Ross—There was a plan prepared under the Act, but containing many mistakes that made it useless, and the corporation had another plan made, but the registrar refused to register it.

Mr. Gibson—Rightly enough, if wrong likely. Did they get the County Judge to interfere, who has nothing to do with it?

Mr. Ross—Yes, but he would not look at it.

Mr. Chipman—I have compiled plans for several towns. Brockville was the largest, and at least two-thirds of the properties were held by deed, one tied on to the other, with no plan whatever; some of the plans dated back to 1816. I found plans in the registry office that were destroyed by mice and rats, or worn out, and of little use, and could not tell whether they had ever been signed either by a surveyor or by the owners. I also found plans scattered through the records of the Court of Chancery. I did not do as Mr. Gibson does altogether. I put on my own measurements, and I did not state on the plan that they were my own measurements. If the deeds placed the lot, as some of them did, on the wrong street, I was not governed by the deed, as some of them were wrong by hundreds of feet.

Mr. McAree—What kind of a certificate did you place on the plan?

Mr. Chipman—It was before this present certificate was added to the Act.

In Prescott I compiled a plan, and I found a plan in the registry office giving between certain streets, I think, eight or ten lots—ten lots, we will say, numbered and divided out; looked all right. They had been selling the lots according to this plan. In measuring up the town I found there was only room for nine lots for the same width as given on that plan. I demanded a new plan from the representatives of the estate, and I got it without any trouble through a judge's order. I have done that in several cases.

Mr. McAree—Did you divide that up into ten parts then?

Mr. Chipman—No; we dropped the one lot. The lots had been fenced, and houses built on almost half of them.

Mr. Gibson—When you started this plan, had you a contract for certain money?

Mr. Chipman—Yes, according to the Registry Act, but I was paid additional by representatives of the estate for drawing up new plans.

Mr. Gibson—Did the council assist you in attending to these things?

Mr. Chipman—I always stipulate that the town solicitor shall aid me wherever it is necessary, and I generally have it understood that



they pay the registrar's fees. There is one question I would like to submit to Mr. Gibson, as he is an expert in compiling plans. I now have a plan to make of a village that twenty years ago was in its palmiest days, but now degenerated. It was a manufacturing place, but everything has gone to ruin. I found quite a large tract was subdivided, whether by surveyor or not I don't know; at least I found, after I had ransacked the registry office, reference to certain lots by number that were not shown on any registered plan in the registry office and on no plan that I had seen. I investigated it as far as I could in the registry office, and at last discovered in the office of the Clerk of the Peace a copy of a plan, made by himself, of the whole village as it was then, with this section subdivided into lots. About one-half of these lots had dimensions on along the main road, those back of them had no dimensions given whatever, and they are the most irregular lots I ever saw. All the front lots have been conveyed and built upon and held by different owners. The representatives of that estate are in the grave; I don't think there is a representative living. What to do under the circumstances I scarcely knew, but I concluded at last I would merely put on the front lots as they are held by deed, with the dimensions, so far as they are on the old plan, and leave the others blank. There were no numbers, in fact, on the rear lots. I afterwards found another tracing, in which there were some alterations from the first; the dimensions appeared to be the same, but the numbering was different. I found also in this case, in measuring along the frontages for some little distance, the lots, as held by the owners, agreed with the plans. After going over a blank space where there was no subdivision at all on the ground, I found a man who had bought Lot 17 according to this plan and had it fenced, and he was at least fifty feet misplaced. He has held it for fifteen or twenty years. After we reach the limit of this property we find there is a surplus in the whole parcel of about that much. I cannot plot that according to the original plan at all; it is half a lot in excess.

Another matter connected with this same plan: I found a plan showing the subdivision of the property back from the main street, where they had a court-house square, a lot of public parks, and the lots were laid out regularly, dimensions on some of them, and the others were evidently intended to be the same. Now, that plan I don't believe was ever registered, as I cannot find any trace of it. I concluded to throw that plan out altogether, as none of the lots had been sold according to it, as far as I can ascertain, a number of streets being shown on it where it is now a commons.

Mr. Gibson—That is right. Suppose you find a plan registered, and another one registered on top of it without a county judge's order, what are you going to do about it? The intention of the statute was good, but it wants to be rearranged.

Mr. Ross—When you make a re-subdivision, do you require a judge's order, or should the judge give an order?

Mr. Gibson—Not unless you are changing roads.

Mr. Ross—When you are changing roads. Suppose there was a plan made of quite a large piece of property, and one or two lots sold and perhaps the rest changed hands, the new owner wants to make a new plan; should he secure a judge's order?

Mr. Gibson—Yes.

Mr. Gaviller—If it makes a re-arrangement of the whole subdivision?

Mr. Gibson—When you begin to change roads or re-arrange it the registrar won't register unless they get a judge's order.

Mr. Ross—Where the judge does not give an order would that plan hold?

Mr. Gibson—Not if you change the streets. If you get the judge's order it will require a proper petition, with affidavits.

Mr. Gaviller—Signed by the owners adjacent?

Mr. Gibson—Yes.

Mr. Abrey—If no lots had been sold?

Mr. Gaviller—No.

Mr. Gibson—Say no lots sold, and you want to make a new plan, changing roads, the registrar won't register it unless you get a county judge's order.

Mr. Abrey—Suppose I register a plan to-day, and to-morrow I change my mind and make the plan in a different shape, have I to get a county judge's order?

Mr. Gibson—If you are going to change the streets.

Mr. Selby—I think the judge's order will be required even if you only change the names of the streets, and not the location of them. If you make a plan to-day, and change the names of streets, you would have to get a judge's order to do that.

Mr. Gaviller—The corporation of Toronto does not do that.

Mr. Ross—In case where a plan is registered without the judge's order, would that affect the title of the lots?

Mr. Gibson—They would make you do it; some of the lawyers would be after you.

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## THE ROMNEY TUNNEL DRAIN.

By J. C. McNABB, P.L.S.

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IN bringing before you the drainage scheme known as the "Romney Tunnel Drain," it is not proposed to introduce any new ideas, but rather to give a short sketch of the work involved, together with its attendant incidents, so that some conception may be formed of the drainage question which is of such vital interest to the agricultural community of the Western District of Ontario.

The Township of Romney, situated at the south-westerly angle of the County of Kent, on the shore of Lake Erie, has presented a vexed question to its ratepayers as to the course to be pursued to secure to the people effective and economical drainage. From a general view of its situation, as shown on the maps, one would naturally suppose that with Lake Erie as one of its boundaries, the drainage question should be easily solved; such, however, is far from the true state of affairs, as in its consideration the surveyor was confronted by two serious obstacles to overcome: one, the natural ridge of drift formation which extends across the whole face of the township skirting the lake, and the other the unnatural rigidity of political formation found extending across the whole face of the community, and which expressed itself by the unremitting opposition of one party to whatever was advocated by the other. This latter difficulty was the hardest one to reconcile so that actual work might be prosecuted. Survey after survey had been made by different engineers, and the plans submitted to the Council, yet nothing was decided upon. In the meantime, however, the adjacent municipalities were moving in the matter of drainage, and were prepared to assess the township liberally and conduct the waters of it to Lake St. Clair, and past their own doors again *via* Detroit River and Lake Erie. A portion of the township lying to the north was so assessed, and became party to drains in Tilbury leading into Lake St. Clair; the westerly portion drained into two creeks, leaving the southerly and easterly portion unprovided for. Such is an outline of the position of the township as to drainage when the Council issued instructions for a survey and report, having for its object an outlet for the unprovided for territory within their own municipality. This action was taken owing to the acute sensitiveness displayed by the interested ratepayers at the prospect of a heavy assessment for drainage to Lake St. Clair, as rumours were afloat to the effect that large dredge cuts were about to be made in Tilbury West, in which the waters from Romney would be conducted through

the marshes to Lake St. Clair, and the township assessed accordingly. This work would necessitate the construction of levees, and the assessment therefor would be heavy on the townships using the dredge cuts as outlets. To obviate this, all interests were united for a "home" outlet. Two routes of altogether different characteristics presented themselves. One along the third concession from side road 30 and 31, traversing the submerged area westerly to Yellow Creek on Lot No. 15, and along the creek to Lake Erie; the other was the route as shown on the accompanying plan, running east along the third concession to line between lots 21 and 22, thence southerly to the second concession, and along side road 198 and 199, under the ridge, to Lake Erie—an expensive operation for a township of so small an area and so sparsely settled as this. Still, owing to the objectionable features met with in the proposed Yellow Creek outlet, in the shape of very heavy cutting through light sand for more than a mile, that route was abandoned, and it was deemed advisable to recommend the adoption of the second route, and the construction of a tunnel under the ridge as being the most direct, permanent and economical, and a report to that effect was made to the Council, and on its meeting with their approval a by-law was prepared to meet the expenditure proposed. The Bucolic mind was a little slow in absorbing the idea, and the "kicking" from those parties assessed was decidedly vigorous. After the Court of Revision and the County Judge had modified the assessment to their satisfaction the by-law reached its second reading, and no further action taken in the matter for two years, when it was again brought to the surface to offset an assessment of 80 cents per acre which Tilbury West had imposed on *all* the lands of Romney for three miles of dredging to be done at the northerly part of Tilbury, and from which Romney appealed, stating that on the completion of the tunnel drain they would not require any increased outlet through Tilbury West. Thus it was that the work was decided to be gone on with. The contract was let at the estimate as follows:—

## BRANCHES.

|                                             |            |
|---------------------------------------------|------------|
| Stn. 0 to 140 = 8,234 yards @ 14 cents..... | \$1,152.76 |
| Stn. 140 to 225 = 12,580 " @ 14 cents.....  | 1,761.20   |
| Stn. 230 to 250 = 2,247 " @ 14 cents.....   | 314.58     |
| Stn. 225 to 230 = 862 " @ 14 cents.....     | 120.68     |
| Stn. 250 to 283 = 1,881 " @ 14 cents.....   | 263.34     |
| Clearing 23.7a @ \$25.00.....               | 592.50     |
| Culverts—2 @ \$15.00.....                   | 30.00      |
| Spoil bank—3a @ \$40.00.....                | 120.00     |
| Expenses.....                               | 400.00     |

## OUTLET.

|                                                         |            |
|---------------------------------------------------------|------------|
| Stn. 0 to 13 = 17,494 cubic yards @ 17 cents.....       | \$2,973.98 |
| Stn. 13 to 28 = 1,500 feet tunnel @ \$4.00.....         | 6,000.00   |
| Stn. 28 to 60 = 24,058 cubic yards @ 16 cents.....      | 3,849.28   |
| Stn. 60 to Junction, 21,637 cubic yards @ 15 cents..... | 3,245.64   |
| Clearing 3.4a @ \$25.00.....                            | 85.00      |
| Spoil bank.....                                         | 60.00      |

Total estimate..... \$20,968.96

The work on the branches is the ordinary ditching, forming a 16 feet roadway in the middle of the concession road allowance. That on the outlet is heavier cutting than is usually met with and is being excavated by team work using the wheel scrapers, Nos. 2 and 3, which will hold half a yard and one-third of a yard respectively. The material is hard blue clay, and the heavy cutting is handled by "uncovering" a stretch ahead of the teams, which are kept working on an incline from the bottom of the cut to the uncovered portion. The tunnel is lined with a double ring of hard burned sewer brick, and is provided with portals at each end of rubble stone work, estimated and let at \$4 per yard. The work of tunneling will be done by sinking shafts at about 200 feet apart, and then working each way from them along the line of the work, which will be carefully ranged over the surface and plumbed down to the depth required at each shaft. During the winter the work has gone on intermittently, and sufficient excavation has been made to show that no quicksand, pockets of water, gas, or boulders, will likely be met with in tunneling, which was commenced this week, so that I cannot speak as to its being an assured fact. Trusting at some future meeting to be able to give an account of the completed work.

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NOTE.—Accompanying this paper was a plan showing the southerly portion of the Township of Romney, and a profile of the drain from the shore of Lake Erie for a length of 7,000 feet. For the first 1,300 feet of this distance the drain is an open ditch, the cut varying from 14 feet to 17½ feet, the bottom of ditch being level and 7 feet wide. From 1,300 to 2,800 is tunnelled, the grade being 0.066 per 100. From 2,800 to 3,200 the grade is 1 to 100, the cut being 17.7 to 13.1. From 3,200 to 7,000 the grade is 0.026 per 100, the cut varying from 13.1 to 8.7, the bottom width being 6 feet. The height of crest of the ridge over grade line of tunnel is 38 feet.

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## LEVELLING.

By J. L. MORRIS, P.L.S.

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MR. PRESIDENT,—Levelling is the art of determining the difference of the height of two or more points. Correct levelling depends upon a correct leveller, a correct level, a correct rod, and correct turning points.

The leveller, before starting out to run a line of levels between any two points, should, if accuracy is wanted, test the adjustments of his level, ascertain if his rod will stand the test of graduated scales, or the standard measure furnished by the Department of Crown Lands, and give his rodman, if not an expert one, a lecture as to holding the rod and carefulness in choosing turning points.

The fourteen-inch Dumpy level for general use is probably as good an instrument as one could desire. A solid tripod is a necessity, as in using light tripods the lightest breeze has an effect on the work. I have done very good work with a twelve-inch Dumpy level and light tripod, but not as satisfactory as with the larger telescope and stronger tripod.

Of levelling rods the speaking rod is much more accurate than the target rod, and will be found much more satisfactory to the leveller, who in using it will be depending entirely upon himself. Of these speaking rods there are numerous varieties, but the rod of most common use is Gravatt's, the divisions of which are in one-hundredths of a foot, marked with alternate black and white spaces, the figures being shown in some way to bring them out distinctly. The Gravatt rod is usually made of two lengths, fourteen and seventeen feet, in three pieces, which fit into one another. I have found great fault with this make of a rod for winter use, as snow and water would get into the inside and freeze, making it impossible sometimes to get it apart, not a very pleasant experience when working during cold weather. In order to have a rod which would not be affected in this way I had one made, the first two parts having open backs. In this way you can have a rod fitting very close at the front, and with no trouble to take the pieces apart. I used for a time the divided feet on paper, pasted on the front of the rod, but dampness and irregularity in some of it caused me to do away with it and paint on the wood, giving me a superior rod.

All levellers who have not been using their level for some time should be careful to have it adjusted, especially if starting out to run a line of levels of any length. I have been with men who could not adjust their own transit or level, and had no idea of how to begin to

do so. The different modes of adjustment for Y and Dumpy levels can be found in Gillespie's "Higher Surveying," but for the Dumpy level the three adjustments necessary are (1) To cause the bubble to remain in the centre of the tube when the telescope is turned around horizontally; (2 and 3) To adjust the line of collimation by the "Peg method" for long and short distances.

The different forms used for level books amount to the same thing, the placing of the different heads depending upon what suits the leveller best. When a leveller once starts his line of levels he must be certain of the ability of his rodman to understand what is wanted. In running through a rocky country the rodman is certain to take boulders for his turning points, and the leveller, after warning him about keeping his rod in the same place, may find that he has given it a turn on the corner of the rod and is holding it three or four inches away from the first point. When the soil will admit of it, I always have the rodman carry a plug made of hardwood, about six inches long and one and one-half inches in diameter, which he drives to near the surface of the ground, and holding his rod on this, when he waves it, knows that there is no danger of the corner at the foot of the rod being raised or lowered. It will be found that about 200 feet is as economical a distance for a sight as you can take. Accuracy should govern all work, but especially when you are employed to run a line of levels for five or six miles, knowing that your elevations at start and finish should not differ more than a few inches, from evidence of still water, for instance; it will not do to have cross hairs covering a tenth on the rod when reading, or any slackness in the work.

When the leveller is taken as evidence in a dispute, no questions are asked as to your instruments, rod, or rodman (except to know if you had sworn him), and all that is asked of you to prove is your levels. For a leveller to run a single line of levels, and expect the result to be taken as evidence, is absurd, but when he levels back again to his starting point, and finds in a distance of a few miles that he varies, say, one inch, then he can conclude that his levels are correct.

In the spring of 1887, I ran a line of levels for a distance of five miles on ice, and left a bench mark. A suit arising out of the flooding of land, in connection with which these first levels were run, I thought it advisable the following summer to check them by running levels between the same points, but overland. I found a difference of one and one-half inches, and considering the distance of five miles and the care which had been taken, I considered that my levels would stand an examination in the witness box. How often surveyors go into courts of justice only half prepared with information for which they were brought there, causing a feeling among the legal profession of want of confidence, to our undoubted injury. It may be of some interest to know how the one and one-half inches were got over, and the following questions and answers (only from memory) may explain:

*Q.*—How many setts of levels did you run?

*A.*—Two.

Q.—Did they differ any?

A.—Yes; about one and one-half inches.

Q.—Are these levels infallible?

A.—Yes.

Q.—Are the first levels absolutely correct?

A.—No.

Q.—Are the second levels absolutely correct?

A.—No.

Q.—Yet you say that these levels are correct?

A.—Yes.

This finished the cross-examination on this point. The examiner was questioning from a standpoint of perfectness; I was answering from a standpoint of the frailty of level, rod, and everything else. The court upheld the evidence as being quite logical, notwithstanding strong argument to the contrary. Another line of levels run between two water powers on the Mississippi River, county of Lanark, were checked to within one inch, being a distance of over one mile apart. Considering the evidence which I had from former work, and the kind of country which I had levelled over, I concluded that this check was very close; so that from our own experience we must form some estimate of the difference between mistake and error in our work. I consider that one-half inch in a mile between first and second set of levels is a small difference, with the instruments which are used at present by levellers in general. If levels are being run across a country rising for some distance and falling again, it may be observed that any error made in levelling up the hill will be balanced by the levels going down the same distance. This is due to little discrepancies in the rod, and the short and long sights becoming long and short sights. When the levels which are run by a leveller are to settle any dispute, extreme care should be taken to have permanent bench marks established in the close vicinity of the disputed points, and in a case where water is in the question, wherever possible, to have bench marks, at numerous points along the stretch of water, as it is very certain that more than one set of levels will be needed before your work is complete. Rubbish, change of channel, wind, and other causes have a tendency in short times to cause the heights of the water in a stream to vary, which is the case when mill owners have the privilege to fill up the channels of small streams with sawdust and edgings.

The effect of wind on the levels of water in lakes can best be determined by practical experiment. At the foot of a lake five miles long by one wide (an expansion of Bear Creek, a tributary of the Ottawa River) a dam has been built. It has been observed that when this dam is opened there is a fall in the lake of two inches every twenty-four hours. The effect of a wind coming down the lake is to raise the water at the dam six inches higher than when flowing through in calm weather.

The case of the Muskrat River, county of Renfrew, is a strange one. It takes its source at the Muskrat Lake, which is about eight



miles long and one mile wide. Then for about two miles the river has a width of two hundred feet, and widening out into a lake two miles long by half a mile wide. From this lake to its mouth, a distance of seven miles, it has a width of about one hundred feet. For seventeen miles it resembles a slough in the North-West Territories, has very little current, and filled with a mass of weeds so dense that in many places the channel is narrowed to fifteen or twenty feet. It was claimed that a dam on the river below flooded lands for twenty miles back during and for some time after the spring freshets. The difference between the level of the water at the top of the dam and the water in Muskrat Lake was found to be about a foot. This small difference at a distance of twenty miles, with a nearly stagnant stream between them filled with weeds and rubbish, made it apparent that the dam must have a bad effect during the spring freshet, yet was the cause of only part of the trouble, the weeds and rubbish having a great deal to do with the holding back of the water, which had to percolate through instead of having a clear flow. All the formula which could be deduced from Rankine on the flow of water could not satisfy a case of this kind. We are now on the threshold of an era of disputes concerning water privileges in Eastern Canada, and with this in view more attention should be given to levelling and that part of Hydraulics which goes hand in hand with it, so that committees of inquiry and our courts may have less trouble in securing reliable evidence.

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## THE GRAPHICAL METHOD OF CALCULATING STRAINS.

BY G. B. ABREY, P.L.S., A.M. CAN. SOC. C.E.

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IN announcing this paper in the programme I had not thoroughly appreciated the manner in which it would develop. There is unavoidably a very large amount of drawing required to explain the matter. This drawing cannot be reduced to an amount that would permit its reproduction in our annual report. I will therefore be obliged to modify the title of the heading, and perhaps the best to call it is "A Lecture on the Graphical Method of representing Strains in Structures."

Some years ago (1876), when this method was comparatively new, I took a considerable interest in it. Sheets 1 to 10 and H were prepared at that time, simply for my own instruction, and to save labour I now make use of them. Some others are added that I think necessary to complete the illustrations required.

I am not sure but that a paper of this kind is out of place to read before an association composed as this is, of one's compeers, some members of which, I know, could so much better tell what I have assumed to do. Also, probably nothing new may be found to have been brought out, and perhaps it may show to a great extent merely a compilation from books that many are familiar with.

My excuse is that the subject is so generally useful and interesting, few succeed in originating much that is useful, and my hope is that some criticism may be provoked that will bring out features in a new shape.

The graphical method is not confined to any particular figure or procedure, but generally many ways may be had of accomplishing desired results. In difficult cases, such as drawbridges of complex design, continuous girders, cantilevers, etc., I do not think many of us could estimate by any other method.

### PARALLEL CHORD TRUSS.

Sheet 1 shows a ten-panel truss with parallel chords. All the necessary diagrams for the complete calculation of the stresses in this truss are shown on the sheet.

They consist of—

Elevation diagram.

Load and stress diagrams.

Moment curve for bridge, and full moving loads, and

Shear diagram for combined dead and moving loads.

Maximum stresses on any portion of either chord may be taken off the full load moment curve by scale, multiplied by H on the stress diagram, divided by height of truss, or from the shear diagram by adding horizontal components of strains on diagonals.

Maximum stresses for verticals and diagonals may be taken from shear diagram. Diagrams also show what counter bracing is required.

#### PARABOLIC TOP CHORD TRUSS.

Sheet 2 shows an elevation of an eight-panel truss with a parabolic top chord.

Some additional drawings are required to get the stresses, besides those required for trusses with parallel chords.

We will require moment curves for all positions of the moving loads for the purpose of constructing the supplementary shear diagrams. See sheet  $\frac{1,2}{2}$ .

As an example, suppose we take the diagonal in panel 4 sloping upwards towards the centre. The maximum stress will occur when 1, 2, 3 only are loaded. Draw moment curve for this loading. From the curve obtain tension in the bottom chord of panel 4 equal to 29.3 tons, and compression in top chord of same panel equals 32.3 tons. From the shear diagram the shear in same panel is found to be 2.5 tons. Now from these data construct the *a* figure by drawing shear vertical, and chords and diagonals parallel to the same, in the elevation. Then scale off the diagonal for its stress.

To obtain the stress on the vertical 4, draw a line parallel to the next following section of the top chord. With the same shear the vertical drawn from the extremity of the bottom chord equals stress on No. 4 vertical.

All the stresses are fully illustrated and shown on the sheet  $\frac{1,2}{2}$ .

#### BOW STRING.

Recently I have been engaged professionally to make an examination of the highway bridge over the Desjardins Canal at Hamilton, which has plate girder, end spans 31 feet long each, with a parabolic or bowstring span in the centre 115 feet long.

The bowstring is of the Whipple design, so fully described in his treatise on bridge building.

The sections of the arch are of cast iron of cross section shown in the drawings. The lower chords are wrought iron link bars placed around cast iron pins. The verticals and truss diagonals pass through the pins, and are of round iron rods. The verticals are subject under a moving load to both tension and compression stresses. Diagonals are subject to tension only.

The cross beams are flanged plate girders resting on the pins and attached to the verticals by iron loops.

The bridge is divided into an odd number (9) panels, and has a camber in the centre of 1.5 feet. The arch rises at the centre twelve

feet above the centre line of chords, or 13.5 feet above the horizontal line of the centre of the chord connections at the ends.

All rods are weakened by cutting their ends down for screw threads.

The arch is kept upright by spreading its bearings at the ends to three feet wide, and by splitting the central vertical to the same extent. Diagonals and sway braces are connected by bent eyes. Arch section ends abut without fitting each other than as they left the mould.

One end of the bridge is placed on small rollers made of rod iron. These have long ago ceased to act as intended. The whole rests on piers of framed iron standing twenty-eight feet high above stone abutments.

The bridge has been up and in use for a considerable number of years, and is apparently as good as ever. Engineer inspectors have recently condemned the whole structure, and it is shortly to be replaced by another. I have calculated the strains very fully, as shown, for a moving load of eighty pounds per square foot of platform area, and for wind at forty pounds per square foot of side area. And it will be seen that some of the parts are dangerously weak.

This bridge is not selected as an example to be imitated in any way, nor as a type of a desirable design. I chose it partly for convenience, on account of having it fresh, and partly as one presenting some difficulties in calculation by the usual analytic methods. It also brings out most of the devices of the graphical method for single spans.

Most of the parts of the bridge are calculated by several methods, and it is seen that the graphical method is fully competent for every part. For some portions the method seems laborious, and I do not think I would adopt it everywhere. For the sake of completeness in the illustrations, I have shown the method even for the most simple calculations, and where reciprocal diagrams are used the drawings (sheets 12 and 13) show much more work than is required. The portions drawn in heavy lines are all that are necessary to obtain the stresses. I would call attention to the reciprocal diagrams for maximum strains under bridge loads and full moving loads. These drawings are of easy construction, leave no ambiguity, and fully exhibit every portion. Supposing the arch to be parabolic, these diagrams reveal some unexpected results in the stresses in the diagonals that would probably not have been discovered by other methods. I think no other method so good for this girder under symmetrical equal loading as the reciprocal figures. The sheets also show by the same method the maximum stresses in the diagonals and verticals for all positions of the moving load. Except that some other graphical process is shorter than by reciprocal figures, for moving loads none are so satisfactory when completed. See another method on sheet 14.

See also another method on sheet  $\frac{1,2}{2}$ . See also on sheet 17 a graphical method adopted by Whipple for calculation.

For the cross beams (built girders) there is shown on sheet 16 the bending moment diagrams for both concentrated and distributed loads.

For concentrated loads the graphical method is admirably adapted, or, as in this case, the combined concentrated moving loads, with the distributed bridge load. Also the strength, or moment of resistance of the beam to bending, is very effectively shown by the resistance figure. The usual analytical rule is not accurate, as the moment of the flanges is assumed, and not calculated. This same remark applies to the girders of the end spans.

#### METHOD OF MOMENTS.

Sheet 21 shows the drawings and calculations in detail for the stress of every member of the girder of the same bridge by the method of moments, or better known as Ritter's method, recommended by Dubois as the best method of checking the graphical method.

In the drawing the lever arms are obtained graphically, though they might all be found by calculation. The draft was made in a hurry, though you will see the results check well enough to show that no material error has been committed anywhere by any of the methods.

In this girder, as before remarked, it is not apparent by simple inspection from which direction of the moving load the maximum stress on the verticals would be produced; the drawings show calculations for load both ways.

(Explained on the drawings.)

In the central bay the chords become parallel, and their intersection at an infinite distance. By forming the equation in the usual manner, it is found that each term of the equation has a factor of infinity. So that it is only necessary to divide it out to get a simple resulting equation similar to those for the other members of the truss. This Ritter's method is very simple in its theory and practice, and seems capable of solving all stresses in bridge and roof trusses, as well as in other pieces of mechanism, and deserves more than a passing notice by the engineer.

#### CONTINUOUS GIRDER.

Sheet 9 shows and explains all the diagrams necessary for the calculation of all the stresses in a continuous girder of two spans of unequal lengths, with parallel chords. The design is for one span 80 feet and the other of 100 feet. The bridge weight is supposed to be uniform, as well as the live, full load.

Clapeyrons, or the three-moment method of computation of stresses, has been employed on the sheet. This method, when applicable as it is here, is rather shorter than what we might term the graphical method.

The design on this sheet is in general a copy of one in "Green's Bridge Trusses," shown on a larger scale and in more detail on the sheet. I will therefore direct attention to that treatise for full explanation and proof of the method.

I would remark that if the loading be not uniform on a girder, as also uniform on the other, though not necessarily the same on both, that

the clapeyron method will not apply, nor if it is desirable or necessary to draw curves for partial loads. Then the points,  $B'''$ ,  $B''$ ,  $B'$ , must be obtained by another process, say the following :

*Graphical Method.*—Join AM, CM, calculate areas between the curves and the lines now drawn, multiply the areas found by the distances of the centres of gravity from the outer ends respectively. Call these moment areas, the one on the left  $Aa$ , and on the right  $Cc$ , also let the length of the span on the left be  $a'$ , and on the right  $c'$ .

$$\text{Then } M.B' = \frac{3Aa a' + Cc c'}{a' c' (a' + c')} = \frac{3}{a' + c'} \left( \frac{Aa}{a'} + \frac{Cc}{c'} \right)$$

$$\text{If } a' = c' = l, \text{ then } MB' = \frac{3}{2l^2} (Aa + Cc)$$

Join  $A'M$  and  $C'M$ , calculate the curve areas now enclosed as before, and obtain the moment areas. These will be  $A'a$  and  $C'c$ . Then—

$$MB'' = \frac{3}{a' + c'} \left( \frac{A'a}{a'} + \frac{C'c}{c'} \right)$$

$$MB''' = \frac{3}{a' + c'} \left( \frac{A'a}{a'} + \frac{C'c}{c'} \right)$$

$$MB'''' = \frac{3}{a' + c'} \left( \frac{A'a}{a'} + \frac{C'c}{c'} \right)$$

Sheet 10 shows a four-span continuous girder. Spans of 125, 75, 50 and 50 feet, with parallel chords and triangular bracing, Clapeyrons rule is sufficient for all the strains in this, as in the last, to get chord and shear maximum strain diagrams, it is only required to know the bending moments for full and empty loads and their various combinations. All maximum strains are represented on this sheet.

See Green's treatise for an example of a four-span truss somewhat different to this one, and of spans differently arranged and calculated by the graphical method.

I would call attention to the moment at the central pier, when the first and third spans are alone loaded. The point  $C'$  on the centre vertical being raised completely off, or requiring very strong holding down bolts to keep the truss on its bearing.

#### DRAWBRIDGE.

Sheets Nos. 3, 4, 5, 6, 7, 18, fully illustrate and explain this girder under all positions, but as these drawings cannot be issued with the published report, I will try and explain as well as may be in this written description.

First, draw the load line and stress diagram for each system of the truss, light and loaded (truss is cancellated, that is, the diagonals cross an upright in passing from one chord to the other, and each system of the truss has to be calculated separately). Next, draw the

funicular curves of each system separately for these stress diagrams. For the curves unloaded the funicular polygons may be at once completed by drawing the closing lines to meet the centre vertical. To get the closing line for and curve loading of the truss that causes it to bear on the abutment requires some calculation. Say for full loads, connect both ends of the funicular curve by a straight line, calculate the area enclosed, and multiply it by the distance of its centre of gravity from its outer end. This may be called its moment area. Also calculate the area enclosed in the complete funicular polygon of the truss with loading, and multiply this area by its distance of centre of gravity from the outer end of the span, as before. This product will be its moment area. Add these two moment areas, and divide their sum by one-third the square of the length of the truss span. The quotient gives a point on the centre vertical. Then connect this point by a straight line with the outer end of the full load curve, and it is the closing line completing the funicular polygon for full loads on both spans.

Next, it is necessary to complete the polygons for the bridge, one span loaded and the other span unloaded. Connect the ends of the curve for no load by a straight line, calculate its moment area the same as was done for the full load curve, add together the moment areas for full load, no load, and twice that of the completed polygon for no load, divide the sum by two-thirds of the square of the length of span, and the quotient gives a third point on the centre vertical. Connect this point by straight lines drawn to the outer ends of both curves, and complete polygons are obtained for the truss with one span loaded and the other unloaded.

From these three polygons the maximum bending moments may be scaled for the truss, with both spans loaded, both unloaded, one span loaded with the other unloaded, and the span unloaded and the other loaded. The closing lines drawn crossing the full load curve indicate the points of contra flexure of the truss.

Next, draw in the stress diagram lines parallel to the closing lines of the various polygons. The points, when these intersect the centre vertical, give the supporting forces for the different loadings. We may now proceed to the construction of the shear diagrams.

First, lay off a horizontal line the same length as the truss; lay off on the centre vertical a line equal to the load line for the unloaded truss, connect this point with the outer end, and the figure gives the shear for the bridge, or dead load.

Next, lay off at the outer end, the vertical upwards, equal the supporting force for full loads on both spans, and on the centre vertical lay off the difference between the full load and the supporting force. Join these points; then the figure enclosed gives the shear for full loading.

Next, lay off on the end, vertical downwards, below the horizontal line, the pull on the locking bolts, and draw a line to the centre vertical parallel to the sloping line of the shear diagram for dead load, and the figure enclosed between this and the horizontal gives the shear for the unloaded span when the other span is loaded.

Next, lay off on the end, vertical upwards, the supporting force for the loaded span when the other is unloaded, and draw a line to meet the centre vertical parallel to the sloping line in the shear figure for full loading. The figure enclosed by these and the horizontal gives the shear for the loaded span when the other is unloaded.

Again, lay off parabolic curves tangent to the two lowest lines at the centres of the extreme panels, and we have the maximum shear line for moving load when the other span is loaded.

Lastly, draw a parabolic curve tangent to the two upper sloping lines at the centre of the two extreme panels, and we have maximum shear lines for moving load when the other span is unloaded.

Sheet 18 shows moment and shear diagrams for the drawbridge of the International Bridge near Buffalo, more fully described, so far as the bridge is concerned, in Gzowski's published report.

The bridge, when unloaded, is supposed to rest entirely on the central pier, and when closed the ends to just rest on the abutments. Then, in order to prevent the unloaded end from rising when a load comes onto the other span, cams are used to raise the ends sufficiently. In the drawings I have supposed locking bolts to be used. The diagrams on this sheet show all the maximum strains for chords, locking bolts, reactions at abutments, and shear for each panel of the bridge. From the diagram of the elevation it is seen that the truss is cancellated, making it necessary to make the two complete drawings shown. Each system of the truss is calculated separately, and the results added.

Observe how elegantly the strains on the locking bolts are shown. Also, the reactions or supporting forces caused by loading; also the points of contra flexure. These points vary from the outer ends, with no load, to the seventh panel from the outer end, when the span is loaded and the other light. So that the first seven panels from each end must be provided for plus and minus strains.

If, instead of locking bolts, the lifting cams had been supposed used, and of just sufficient power to raise the ends when closed, so that a load on one span would not lift the other when unloaded, the same drawings given here will, with slight modifications and without the necessity of entire new drawings, give all the strains.

Next, if the cams are strong enough to raise, so that three-eighths of the dead load of each span is borne by each abutment, it is then when closed to be calculated as a continuous girder of two equal spans, and when open a special moment and shear diagram would be required to obtain the strains in that position.

In order to obtain the stress on the diagonals and uprights of this bridge, in consequence of the upper chord being inclined, moment curves for all positions of rolling load will have to be drawn, and supplementary shear diagrams constructed, as shown on sheets 4, 6, 7.

From Gzowski's published report I was unable to get all the data necessary for the actual bridge, so that in the diagrams some of the data were assumed. This does not interfere with the example for purposes of illustration, but might be unreliable if applied to the actual bridge.



## MOMENT OF INERTIA.

Sheet 19 shows a moment of inertia diagram for an irregular figure (the section of an American steel rail). The diagram, drawn accurately to scale full size, shows the section, next the resistance figure, and lastly the moment of inertia figure, all the construction lines for each of the figures show in red, and full explanations are written on the sheet. The whole is very simple, both in drawing and principle, and perhaps the section is as difficult as occurs ordinarily in practice. I would say that the graphical method furnishes other methods both approximate and exact, to accomplish same result.

The above is theoretically exact.

## RESISTANCE DIAGRAMS.

Some of these are shown on sheets 16 and 19, to illustrate the subjects there. There are a lot of sketches of various figures here also. There is nothing difficult about them, neither are they tedious in construction.

## TO FIND THE RESISTANCE AREA OF A SECTION OF A BEAM.

Find the centre of gravity of the section  $G$ , draw a horizontal line through  $G$ . Then, if the  $G$  is in the centre between the upper and lower surfaces of the beam, draw horizontal ordinates through the section, and the same through the resistance area section. Lay off the breadths of the ordinates on the beam section, on the upper and lower surfaces of the resistance area sections, and from these points draw lines to  $g$ , and at the intersections with the ordinates draw a curve. The area enclosed is the resistance area.

Lines that are horizontal in the section of beam are horizontal in the resistance section.

Lines that are vertical in the beam section are straight and inclined in the resistance section.

Lines that are inclined in the beam section are parabolic curves in the resistance section.

Lines that are curved in the beam section are curves in the resistance section.

If the centre of gravity of the beam section does not pass at the same distances from the upper and lower surfaces of the beam section, draw the resistance area for that portion of the beam that has its extreme surface nearer to its centre of  $G$ , same as instructed above, and for the portion that has its extreme surface farther from the  $G$  line, draw through the section a line ( $xx$ ) parallel to the  $G$  line and at a distance from it equal to the extreme surface of the other portion; then on this line,  $xx$ , lay off the breadths of the ordinates of the beam section, same as before, and from the points found draw lines to  $g$  and produced backwards and through the intersections of the ordinates, as before, draw the curve for the resistance area.

In all cases the areas on each side of the  $G$  line are equal.

See sheet 20 for the following :

Let it be required to design a beam such that it is equally strong to resist failure by tension or pressure. Suppose a cast iron beam is wanted—

$$\frac{\text{Tension strength of cast iron}}{\text{Compress strength cast iron}} = \frac{3.6}{10}$$

Let the depth of the beam be 13.6 inches, let the breadth of the bottom flange be 16".0, and let the thickness of the flanges be 1" throughout.

Now from the above data draw a section of the bottom flange and web. Draw the axis  $xx$  parallel to the bottom line of the beam through its neutral axis (the neutral axis will be at the distance of 3".6 from the bottom, and 10" from the top). Draw  $xx$  parallel to  $XX$ , cutting the web at 3".6 therefrom.

Next construct the resistance area in the usual way, of the lower flange and web of the beam. Calculate its tension area, also its pressure area. Subtract one from the other. If the pressure area is the greater, the required upper flange will be a minus quantity. However, in the present instance the tension area exceeds the other, and its excess must be added to the pressure flange. In the diagram it is found to be  $\frac{81''}{100}$ , and is laid off as shown on the resistance diagram

marked  $ef$ . Join  $eo$ , cutting off  $jk$  from  $xx' = 0.3''$  equals the breadth required of the top flange to be added, half on each side, to the web.

The beam is now constructed such that the stress on the pressure flange is to that on the tension flange as  $\frac{10}{3.6}$ , having its centre of gravity on the axis  $XX$ .

Compare the above with the usual way of determining the same (see Cotterell's "Applied Mechanics," page 319), which generally includes an error of supposing the maximum stresses of the flanges as being in the line of their centres of gravity.

I had intended, in order to complete this description, to show drawings for centre of gravity of figures and moment of inertia other than those on the sheets explained, and central ellipse of section diagrams. I would refer to Clark's treatise on The Graphical Method for full instructions on that subject.

I have to regret, also, that I had not time at my command to show the application of the method to actual examples of the braced and stone arches, two difficult structures to calculate by the ordinary methods. This method is sufficient for them. See Dubois' "Graphical Statics."

As before remarked, it is quite impossible to publish the large amount of drawing shown here, but to all members that are convenient the writer would now or at any time be pleased to exhibit the drawings to be examined at leisure.

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

## A FEW THOUGHTS ON DRAUGHTSMANSHIP.

By F. L. FOSTER, P.L.S.

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AMONG the many useful topics written on and discussed at our yearly meetings, the subject of Plans and Plan-Making has, I believe, been conspicuous by its absence; and it has occurred to me that a word or two on the practical part of it may be acceptable to the members of our Association.

In consequence of the rapidity expected of draughtsmen in our modern day of hurry and excitement, and the somewhat unreasonable demands made upon surveyors, we are, I think, too apt to look at the merely utilitarian aspect of the art, and lose sight of those qualities attained by many of our predecessors who lived in a less progressive age, namely, artistic finish.

That the merely useful has, to a great extent, supplanted the ornamental, and that young draughtsmen of the present day are, from the cause just mentioned, apt to ignore it altogether, is a conclusion easily arrived at by those giving the subject careful consideration.

It is on this account that I have felt tempted to write a few words on the subject, and to urge upon our members the desirability of assisting their pupils in attaining a carefully finished style of draughting.

One of the first requisites of the art is *utility*, under which head may be placed permanency and accuracy, clearness of detail and absence of all ambiguity. Secondly, artistic design and finish; and I propose—presuming on your patience and good-will—to say a few words in reference to each, adding one or two more on materials and methods of embellishment.

As to the utility of our plans of record, it will be apparent to those who have occasion to examine the contents of our registry offices and Departmental plans that, notwithstanding the high finish attained by some of the draughtsmen of old, much is lacking in this respect. Leaving out of consideration the ambiguity displayed in the lack of bearings and distances, it is to be noticed that the want of permanency is to be added to the faults of the old system. It seems to have been considered a desideratum of good draughtsmanship with many of our predecessors to carry out practically the mathematical definition of a line “length without breadth,” and to demonstrate their ability to write the ten commandments on a six-penny piece, and in consequence of this attenuation of lines and minuteness of lettering, the most powerful reading-glass fails to bring their good intentions

within the scope of ordinary vision. This, coupled with the poor quality of paper and the pale ink used, is a constant source of annoyance to those having occasion to make use of them.

The remedy for this evil is, of course, apparent to us all: which is good, solid lining and lettering, with the best inks, upon well mounted drawing paper or tracing linen.

To think, however, as some appear to do, that firm, strong black lines and fair-sized letters and figures denote a coarse method, is a mistake which perhaps arises from the disagreeable effect caused by the unevenness and lack of uniformity sometimes displayed in lining and lettering. If the draughtsman takes a standard suitable to each plan for his thin lines, and another for his heavy ones, and adheres to them throughout his work, it cannot look coarse if otherwise fairly done.

The exception to this rule may consist in the pen and ink work on the topographical features of maps drawn to a small scale where a high finish is required; but even this finer lining is not always desirable or necessary to good effect.

If this simple rule is carried out (as I see it is being done by some of our modern draughtsmen), and the best materials used, we need no longer fear for the present or future illegibility of our plans of record.

As to artistic design and finish, it will be observed that the chief characteristics of the ornamental parts of maps and plans are somewhat analogous to those of any pictorial design, namely, *form, light and shade, balance and colour.*

That of form applies to the exterior shapes of titles, scales, meridian points, notes, certificates, etc. Light and shade relates to the lightness or depth of tone as separate bodies in relation to the whole space within the border; balance, to the positions they should occupy, and colouring, to the juxtaposition of tints having such relations of harmonious contrast with each other as to be agreeable to the eye while filling their intended office.

From the irregular shape of plans it is often impossible to apply all the rules based upon the above requisites; but, when practicable, it will be found that if the spaces occupied by the different parts of a plan—title, notes, etc.—be placed so as to leave proportionate, or nearly equal areas of the ground or paper between each, the proper effect of balance will be attained.

Upon the proper shaping of the letters and their true balance in relation to each other will principally depend the good effect derived in this respect. The spacing of the letters should be so done as to leave the areas between them as nearly equal as possible, and those between words about twice as large. The same rule of equal areas should be observed in reference to spaces between lines of letters, and no lettering or figuring should touch any other figure or line. As the forms and proportions of letters have been exhaustively treated in works upon the subject of draughtsmanship, it would be beyond the scope of this paper to say more than a word or two in reference to it. Type founders' pamphlets for advertising purposes contain a great variety of letters, and can be studied with profit; but the inventive

powers of the student should be freely exercised in this direction. For ordinary plans, however, the plainest and simplest lettering is the best.

Titles have a pleasing appearance when their general shapes assume those of some regular mathematical figure, such as the ellipse, oblong, triangle, etc.—the first named being generally recognized as the most agreeable; complying, as it does, with one of the requirements of a well-considered design, “the just relation of the straight line with the curve.”

When colours are used on plans, their harmonious contrast with each other can be secured by observing a simple rule based upon the Newtonian theory of the three-fold nature of light, followed by the most successful colourists of all times.

Light, by this theory, is divided into three primaries, three secondaries, and three tertiaries. A good practical way of remembering and applying this theory is to draw an equilateral triangle, and at the three angles place a primary—red, yellow, and blue. On the opposite sides place the secondaries, resulting from the admixture of the two primaries at the adjacent angles. It will thus be found that the secondary opposite the primary red will be green, which is the resultant of the admixture of yellow and blue, and that it will form a harmonious contrast; causing each colour, red and green, to be greatly enriched by being placed in juxtaposition.

For the same reason the primary yellow forms a pleasing contrast with purple, the secondary formed by mixing the primaries blue and red. The primary blue forms a similar contrast with orange, the secondary formed by the mixture of the primaries red and yellow; it will thus be seen that harmony is produced by the presence of the three primaries, or their equivalent of mixed colour. Of the tertiaries, brown, broken green, and gray, it is not necessary to more than make mention in this connection, as they are not applicable to general plan embellishment, though very important in pictures and designs where much variety of light and shade is represented; as in natural scenery, figures, subjects, etc. Darker shades, however, of any primary or secondary colour, when judiciously placed upon a similar colour lighter than itself, will enrich the appearance of both by contrast of tone.

Flat washes of colour of any considerable extent are most successfully and evenly laid in the following manner:—

The material to be coloured should be pinned as tightly upon the drawing board as possible; the farthest side of the board should then be raised to an angle of about 25 degrees with a horizontal line, and, after the full amount of colour to be used is mixed in a suitable receptacle, it is to be applied to the plan with a brush as large as can be safely used, and beginning at the upper edge of the part to be covered and working with horizontal sweeps from right to left and *vice versa* alternately, keeping the brush full so that the lower edge of the extending colour may be very wet till the surface is nearly covered; the remainder can then be worked over with the brush in a drier state, and any pools of colour at the finishing edge, however small, carefully

absorbed before the drying begins. The lack of these simple precautions often causes plans, otherwise well executed, to have an unpleasant appearance in consequence of the unequal drying of the colour. Flat camel-hair brushes of different sizes are the best instruments to use for this work.

The most useful colours for the draughtsman are Crimson Lake, Madder Lake, Carmine, Yellow Ochre, Light Cadmium Yellow, Prussian Blue, Cobalt, Hooker's Green (No. 2), Burnt Sienna and Sepia. All the colours required for the purpose are contained in these or their mixtures. Madder Lake is the most permanent of the three reds mentioned, the other two being liable to fade. The rest are generally considered permanent.

A word or two about materials, in conclusion: Among the various papers used for making plans that are intended for frequent reference and much wear and tear, there are none more serviceable than Whatman's; which, when well mounted on strong cotton, are as nearly imperishable as any drawing paper can well be. Some of the American made "endless" papers are good, and others worthless as regards wearing qualities; being brittle, hard-surfaced and liable to crack and break where folded. As a rule, a paper that has these faults—that will not admit of erasure, that will not take a smooth and even wash of water colour over an erased surface—should not be used by a draughtsman.

The use of tracing linen for plans of record, so prevalent now and for some years past in many of our registry offices, is not, I think, a useless innovation on our old methods. This material, when mounted on stiff pasteboard, is not liable to wear out readily, will preserve the details on the plans satisfactorily, and forms a convenient mode of reference. Any colour applied to the back of a mounted tracing will be practically permanent.

Some of the best inks now used are in a liquid form, and can be recommended for convenience and permanency. After several years' trial of a number, I find that Higgins' waterproof India ink is excellent for general purposes, and possesses the quality so rarely found of allowing a wash of water colour over it without disturbance to any appreciable extent.

Coloured inks should, I think, be used with caution where permanency is required, as some are disturbed by the slightest moisture and become blurred and indistinct from this cause. We often see small letters and figures rendered illegible when proper precaution is not taken in this respect. I have no reason to doubt, however, that the coloured inks advertised by Keuffel & Esser, of New York, and others, are what they are said to be, indellible and proof against disturbance by moisture.

As a concluding remark, permit me to say that when examining and criticizing the draughtsmanship of our professional brethren of old, we are reminded of the fact that we are daily handing down to posterity records of our skill or want of it, and upon the training of ourselves and pupils depends the question whether the verdict will be favourable or otherwise.

## DISCUSSION.

Prof. Galbraith—I think draughting is a thing, in the present utilitarian age, too much neglected. One of the worst things that ever happened to surveyors was the invention of these stencil letters. I think that has done more to spoil good draughting than perhaps any other thing—at least in the way of inventions. I believe in the old-fashioned hand practice in lettering, and do not think that one can be made a draughtsman unless he makes his letters by hand, and is thoroughly practiced in the work. It is a slow and difficult process with the average man. It is just as difficult to learn to make good letters as it is to learn copper-plate. The importance of lettering on a plan cannot be over-rated. It is the one thing that the public can appreciate better than anything else, and it has more influence in commending an engineer to his employers than any other one thing.

I have found it a most useful exercise for a student to have him attempt to cover as large an area as possible with as small a brush as possible. When he is able to do that he can then very easily use larger brushes and get an even tint on a comparatively large surface; and for anyone trying to learn to use his colours properly, I think it is a most useful exercise. However, in doing work I would not do it that way; I should follow Mr. Foster's plan. But I mean when a draughtsman is trying to instruct himself, I think he will succeed better in laying on colours by making that attempt.

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## WATER-WORKS FOR TOWNS AND VILLAGES.

BY HERBERT J. BOWMAN.

*Supt. Water-works, Berlin.*

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Now that our country is rapidly progressing, its hamlets developing into villages soon to seek incorporation as towns and eventually to become chartered cities, the question of water supply for many places is demanding attention. This being the case, many of the members of this Association who have not as yet paid particular attention to this subject, will sooner or later require to look into it, either professionally or from the standpoint of a private citizen. For the benefit of such members, the writer will endeavour to point out the principal features of an efficient water-works system, and will look to those members of the Association who are familiar with this branch of engineering for assistance in discussion of the same.

The necessity of a system of water-works for a town or village is, as a rule, first recognized after some disastrous fire, either in the place itself or in some neighbouring community, and then the municipal council applies itself to the subject, concerning the details of which its members are usually densely ignorant. A committee is appointed to visit towns already supplied with water-works, and after a sum, often more than would be required to employ a competent engineer, has been spent in travelling expenses, etc., some cheap scheme is submitted to the people, who show their want of confidence by voting it down. Thus the agitation for water-works is thrown aside, perhaps for years, unless private capital comes to the rescue, and often the best solution of the difficulty is to contract with some reliable company to put in a complete system on the franchise plan, the town paying an annual rental for its fire protection, water for street sprinkling and public buildings. Under our Ontario Statutes the town may assume control of the works at the end of ten years upon paying their actual value, as fixed by arbitration, or at any time at an advance of ten per cent.

In either case, whether the works are built by the municipality or by a private company, a competent engineer should be employed by the council to prepare plans and estimates for a comprehensive system capable of extension, and all bids, either for construction or maintenance, should be based thereon. This will save time and money, both for the municipality and for the contractors, and will result in the construction of a much more carefully designed system than if left to chance.



The first question to be considered by the engineer is that of the source of supply, and this differs in nearly every case. Occasionally a town is so situated that an available supply of good water may be conveyed to it through pipes by gravity from some natural or artificial reservoir at an elevation sufficient to furnish the pressure required for domestic and fire purposes. This pressure, for the residence portion of a town, should not be less than 40 pounds at the hydrants, which should not be more than 500 feet apart. With 40 pounds pressure at the hydrant and using 100 feet of two and one-half inch rubber hose and one inch ring nozzle, the water will be thrown 70 feet in the air. Even should the fire break out midway between two hydrants, and 300 feet of hose be required, the vertical distance reached by the jet of water would be nearly 60 feet, as may be seen by reference to an excellent little work, Ellis' "Fire Streams," and this should be sufficient for any suburban district.

In the business portion of a town a system of water-works to furnish fire protection without the addition of steam fire engines, should carry a pressure of at least 60 pounds at the hydrants, which should not be more than 300 feet apart. This pressure, with 100 feet of two and one-half inch rubber hose and one inch ring nozzle, would throw a stream 95 feet in the air, or midway between the hydrants; that is with, say 200 feet of hose, the vertical distance reached by the jet would be 90 feet.

Some of our Ontario towns and villages are thus favourably situated that they have or can have a gravity water supply system, but in the majority of cases water must be pumped either by water power or steam.

Where pumping is necessary, and some high elevation is situated close to the town, the best system will be obtained by constructing an earthen reservoir in connection therewith—provided the elevation be sufficient to give at least the fire pressure spoken of before for a gravity supply. If this cannot be obtained a storage stand-pipe may be erected on the high ground, and of sufficient height to give the necessary pressure, or probably ten pounds more, as the stand-pipe will not be filled to the top at all times. However, there are cases where neither of the above systems are used, and "direct pressure" is applied to the mains by continuous action of the pumps alone. This is sometimes called the Holly System, and while it saves the first cost of a reservoir, or water tower, as the case may be, still for towns and villages it is not economic, as it will require a night engineer, and besides the sudden variations in pressure that will result from the opening and shutting of hydrants or railroad water-cranes is very hard upon the pipe system and house plumbing, and will interfere with the satisfactory operation of water motors and hydraulic elevators, etc. Where the consumption is small the duty of steam pumps will not be as great with the continuous and variable action required by a direct pressure system as it will be with a reservoir or stand-pipe in connection, as then the pumping will be done in a couple of hours running at the most economic speed, the fires being banked the remainder of the time. However, the arrangement of valves or gates should be

such that should extremely heavy pressure be required in case of a large fire, the reservoir or stand-pipe may be disconnected, and the system will then possess all the advantages of a direct pressure system for fire service. When the fire is over the gate is opened, the pumps stopped if necessary, and the stored water will maintain the pressure for domestic supply.

When pumping is necessary, the possession of a good water power to drive the pumps is a great advantage to a town, as the yearly cost of pumping will be small and besides the pumps can, at a moment's notice, furnish their maximum supply, which as a rule is not the case with steam. The pumps of several of the earliest water-works systems of this Continent were driven by overshot or breast water-wheels, and turbines are now in general use, connected with the pumping machinery by suitable gearing.

Where the water from the pump is first delivered into the reservoir or stand-pipe and fed from thence through a separate main to the distribution system of the town, the pump may be a single cylinder one, as in this case the fluctuation or pulsation in the water pressure due to each reversal of the stroke will cause no inconvenience. However, usually no separate main is used, and the distribution system is in direct connection with the pumps, so to overcome as much as possible the fluctuations in pressure before spoken of, a duplex or double cylinder pump is used. Comparatively few towns, however, have water power to drive their pumping machinery, and in the majority of cases steam must be used.

For small towns a duplex high-pressure engine is often used, having two steam cylinders side by side and opposite the two water cylinders, which are similar to the duplex power pump. In this form of steam pumping engine the piston of one cylinder works the valve of the other cylinder, and *vice versa*, and neither half can work alone. However, where economy in fuel is an object, the steam cylinders are "compounded," and we have the compound duplex pumping engine with its four steam cylinders working in pairs. The steam exerts its force through one stroke upon the smaller steam piston and expands upon the larger during the return stroke and operates to drive the piston in the other direction, being in effect the same thing as a cut-off on a crank engine.

Every pump-house should contain a duplicate set of pumping engines, as the best of machinery requires to be stopped for the re-packing of steam cylinders, and other like repairs. The capacity of these pumps should not only be sufficient for present requirements, but ample to permit of future extension of the works, and in a small town where the domestic supply will be comparatively light, the capacity is fixed by the number of fire streams that will be required. This will probably not exceed four hose streams, and would be kept up by a pumping engine of one million U.S. gallons capacity per diem. Should the town increase rapidly in population and more water be required for domestic supply, and at the same time at a large fire probably six fire streams be used, the reserve pumping engine will be required to be running simultaneously.

The next question that will present itself is that of the size of the principal supply pipe, and in answering this reference may be made to the following table of

FRICITION OF WATER IN PIPES.

Friction-loss in pounds pressure per square inch for each 100 feet length in different sizes of clean iron pipes, discharging given quantities of water per minute:—

| GALLONS<br>DISCHARGED<br>PER<br>MINUTE. | SIZE OF PIPES—INSIDE DIAMETER. |       |       |        |        |        |        |
|-----------------------------------------|--------------------------------|-------|-------|--------|--------|--------|--------|
|                                         | 4 in.                          | 6 in. | 8 in. | 10 in. | 12 in. | 14 in. | 16 in. |
| 100                                     | 0.33                           | 0.05  | ....  | ....   | ....   | ....   | ....   |
| 150                                     | 0.69                           | 0.10  | ....  | ....   | ....   | ....   | ....   |
| 200                                     | 1.22                           | 0.17  | ....  | ....   | ....   | ....   | ....   |
| 300                                     | 2.66                           | 0.37  | 0.09  | 0.04   | ....   | ....   | ....   |
| 400                                     | 4.73                           | 0.65  | 0.16  | 0.06   | ....   | ....   | ....   |
| 500                                     | 7.43                           | 0.96  | 0.25  | 0.09   | 0.04   | 0.017  | 0.009  |
| 750                                     | ....                           | 2.21  | 0.53  | 0.18   | 0.08   | ....   | ....   |
| 1000                                    | ...                            | 3.88  | 0.94  | 0.32   | 0.13   | 0.062  | 0.036  |
| 1250                                    | ....                           | ....  | 1.46  | 0.49   | 0.20   | ....   | ....   |
| 1500                                    | ....                           | ....  | 2.09  | 0.70   | 0.29   | 0.135  | 0.071  |

Suppose that a town has a gravity supply from an empounding reservoir a mile away and 200 feet above it, what ought the size of the supply main to be to maintain six fire streams and the domestic supply? When there is no water being drawn, the pressure at the hydrants expressed in pounds per square inch would be 200 divided by 2.31, or about 86 pounds. Now, referring to the table for a discharge of 1,250 gallons per minute, which should be ample to maintain the fire streams and domestic supply, it will be found that a ten-inch pipe to supply this amount would have a friction loss of nearly half a pound for each 100 feet of its length, or a total loss of 26 pounds per mile. Deducting this from the pressure with no discharge there is just 60 pounds left, which as before shown would be a fair fire pressure under these circumstances even for a large town.

If in this case, however, the water had to be pumped, it would be better to lay a twelve-inch main, as this would furnish the same fire pressure while discharging the 1,250 gallons per minute, and the reservoir would only require to be located at an elevation of 160 feet above the town instead of 200 feet with a ten-inch pipe. This reduction in the head to be pumped against will result in a great saving in the work to be done by the pumps.

At the present time cast iron pipes protected by coal tar varnish are in general use for water-works mains. They are cast vertically in lengths of twelve feet, and should be tested at the foundry to a pressure of 300 pounds per square inch. The following table will show the weights commonly used for

## CAST IRON WATER PIPE.

| SIZE.                           | 4 in. | 5 in. | 6 in. | 8 in. | 10 in. | 12 in. | 14 in. | 16 in. |
|---------------------------------|-------|-------|-------|-------|--------|--------|--------|--------|
| Weight in lbs.<br>per foot..... | 20    | 25    | 30    | 45    | 60     | 80     | 105    | 135    |

The same foundry that furnishes the pipe will usually make all the special castings, such as tees, crosses, sleeves, bends and reducers required to connect the different branches of the pipe system.

Before beginning pipe-laying all the necessary materials should be on hand, so that the job may be pushed to completion, and no time lost in waiting for pipe, specials, hydrants, gates, or lead and yarn for the joints.

In the climate of Ontario the axis of the pipe should be at least five feet below the surface of the ground to ensure proper protection from frost for the hydrant branches, and particularly for the small service pipes leading to private houses. The ditch will require a width on the bottom of from eighteen inches upward, according to the size of pipe, and the top width will vary according to the nature of the ground, being not much wider than the bottom in clay and often three or four feet wide in loose sand. Four-inch and six-inch pipe may be rolled into the ditch, being only held back by a man with a rope around the spigot end, while eight-inch pipe will require a man at each end with a rope, and the larger sizes of pipe require to be lowered into the ditch with a derrick, some form of differential pulley being used.

A water-tight joint capable of standing great pressure has next to be made between the pipes, and this is secured by using a soft, compressible substance in combination with molten lead. A tarred gasket of jute or hemp is the best, and the office of the "yarn," as it is usually called, is to prevent the molten lead from running into the pipe. The yarn is usually slipped into the joint when the spigot end of the last pipe lowered is being entered into the bell of the pipe already in position, and the pipe being pushed "home," the yarn is packed in the joint with a long yarning-iron and a hammer. To guide the molten lead into the joint a "roll" made of ground clay, such as may be obtained at any pottery, is often used, and the lead should be poured in hot enough to run freely. The roll being removed, the caulker follows, and begins by driving his chisel lightly between the lead and the surface of the pipe all around. Having thus lifted the lead away from the pipe he begins with the smallest caulking tool and drives back the lead a little at a time all around, and following with the larger tools, sets the metal in firmly with strong, even blows.

Those wishing to pursue the practical part of this subject will do well to obtain a copy of Billings' "Details of Water-works Construction," and if the good advice therein given is followed, water mains may be laid to withstand from 100 to 150 pounds pressure with very little risk of failure.

## DISCUSSION.

Prof. Galbraith—We all owe a great deal to Mr. Bowman for his very clear paper on Water-works Construction. It is not often that we have opportunities for hearing how works, in ordinary towns of a few thousand inhabitants, are conducted. The principal information that we have, I suppose, is of the water-works in very large cities, and engineers in Canada find details given there which are practically of very little use to them. I think papers such as the one that Mr. Bowman has read will prove of a great deal of interest. I only hope that every engineer in charge of works of the same kind will make up his mind to give a description of how the work is actually done. In connection with fire streams there is a series of papers now being printed in the *Sanitary Engineer* giving the results of very careful experiments on different qualities of hose, and I think they are all the same size, nominally  $2\frac{1}{2}$  in. hose, and on the effect of different nozzles. I am awaiting with a great deal of interest the next paper on this subject. So far only a general description of results has been given, but it is such to make the paper of a great deal of interest to water-works engineers. I may, perhaps, describe the experiments. They are performed by the engineer, Mr. Neeman; I forget the place. The experiments were made with nozzles ranging from 1 in. to  $1\frac{3}{4}$  ins., both smooth and ring, with different brands of  $2\frac{1}{2}$ -in. hose. When he came to caliper the hose, with the fire stream running, he found that they varied a good deal in cross section, that some hose were practically  $2\frac{3}{4}$  ins. and others less than  $2\frac{1}{2}$  ins, which made a great deal of difference in the discharge. He also found that there was as much as 40 per cent. difference in the discharge, depending on the inside nature of the hose, the sizes being the same. Smooth, solid rubber hose gave a discharge practically of about 40 per cent. greater than the opposite extreme, cotton hose with slight rubber lining. The difference caused by these seemed something remarkable. On the other hand the difference due to nozzles was extremely small. His conclusion was, if you had taken the ordinary lengths and sizes, provided the inside was a fair working, smooth finish without any extreme care being spent upon it, that the discharge of the different nozzles with the same bore was practically very much the same. The way that was settled was this: it was important to separate the influence of the nozzle from the influence of the nozzle, and for that purpose a coupling was arranged by which a pressure gauge could be attached immediately at the base of the nozzle, so that when a certain pressure was shown by that pressure gauge, one nozzle could be said to be under the same conditions as the other, and simply the amount of water that passed per minute had to be measured. Arrangements were made to measure this water exactly, and the discharge of the different nozzles, under the same pressure, was found simply to depend on their diameter in the bore at the end. The discharge from ring is slightly less than from smooth nozzles.

He also said he was inclined to think that the Ellis tables—which, I think, are the only tables we have—were too small by a certain per-

centage; that really the amount of water used was somewhat greater than shown by the table engineers have used, and if that is true, I think, of course, these experiments will be of great interest to water-works engineers. He proposes to use the nozzle itself as a water meter. He found the results so constant for the purpose of measuring the discharge of steam pumps, that he considered a nozzle sufficient, and the method that he proposes being applied is this: near the engineer's room there was to be a reservoir connected by pipes with the force pipe of the pump, and on one face of the reservoir there were two couplings arranged for the direct attachment of these nozzles without any hose at all, and pressure gauges were to be attached to this reservoir, and when the pump was discharged the pressure gauges could be read, and the pump made to increase its discharge or vary the discharge, until the pressures shown on the reservoir were nearly those for which the discharge of the nozzle had been determined; and simply the calibre of the nozzle should be noted, the time of the discharge and the pressure. From this data, he considered, that a more accurate measurement of the water discharged by the pumps could be made than by almost any other way. Now, we take the nominal discharge of a pump calculated from the bore of the cylinder and the stroke of the piston and consider that, with some arbitrary, allowance as the discharge of the pump. Now, if this thing can be actually carried out, one can see that it would settle this uncertain quantity called the "slip." In some water-works there is a chance to measure the slip. For instance, in the Toronto Water-works there is almost no possibility of measuring it, and an arrangement of that kind, I think, would be most useful.

Mr. Bowman—One part of that paper might be criticized, in view of what has happened in the last few weeks, and that is advocating for the residence portion of a town a pressure not greater than 40 lbs. I saw by the papers that during the late destructive fire in our Provincial University, that the pressure in that neighbourhood was supposed to be about 45 lbs. That is more than I judge necessary for a town, although we see the failure of the water-works to cope with that fire. It was not due so much to the low pressure as the distance which the hydrants were placed from the building. On the way to the meeting I called at one of the fire stations here, and found that during that fire hydrants instead of having one length of hose attached to them were forced to carry three, and the length of the hose required was very great—400 and 500, and, I suppose, 600 feet. The nozzles they have here are adjustable, from  $1\frac{1}{2}$  in. to 1 in., and the firemen required to adjust their nozzles down as small as they could to get any height of stream. With 45 lbs. pressure and 100 feet of hose we get a stream 75 feet in the air. With 200 feet of hose it would only throw it 66 feet in the air. With 300 feet of hose it only threw it 58 feet in the air, and with 400 feet of hose about 50 feet in the air. It goes down very rapidly. Also, 1,000 feet of hose, with an inch nozzle, would throw only 30 feet in the air. So that the trouble was not so much the pressure as the long distance the hose lines had to be carried. If there had been hydrants enough so that only 300 feet of

hose were required, they would get streams from 50 feet to 60 feet in the air, which, if they got into the building with them, would be ample. For a building like the University it is not sufficient to have hydrants placed around to protect from fire. One of the best methods of fire protection in connection with a system of water-works is to have the place protected by automatic sprinklers throughout the building. They are used particularly in cotton mills and woollen factories, and so on. They have a system of piping throughout the factory, and every eight feet there is one automatic sprinkler which is capable of discharging 20 gallons or upward per minute. They will begin to discharge if a fire occurs underneath them by the melting of a very sensitive alloy. This alloy can be set to go off at a temperature of 150 degrees Fahrenheit, and either puts the fire out or holds it in check until larger streams can be brought to bear on it. In case of a large library, the building being fireproof would not prevent the library burning, unless some such means as this were used.

Mr. Stewart—Are these automatic sprinklers used in the city and tested here?

Mr. Bowman—I think the Massey Works and the *Mail* Building are protected by them.

Mr. Stewart—I saw them in Rat Portage, and I believe they work satisfactorily there.

Mr. Dickson—They have them in Rathbun's mill at Deseronto, and in the dry lumber rooms they found a fire had been started and was put out by these sprinklers.

Mr. Stewart—Do you consider one engine sufficient, or whether it would not be likely to get out of order and require two engines?

Mr. Bowman—Yes; two would be preferred. No machinery is such but it will get out of order for a couple of days. One boiler would be sufficient for one pump. There is not so much danger of that getting out of order.

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

## EXTRA STRESSES IN STRUCTURES.

BY G. B. ABREY, P.L.S., A.M. CAN. SOC., C.E.

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IN choosing the subject under the above title, I would say that my little experience and study have led me to believe that too many of the loads and stresses that all structures actually have to sustain, are ignored or thought to be covered by the convenient terms, "factor of safety," "good and bad practice," etc. It is perfectly certain that all structures subject to variable loading and conditions have to sustain stresses not estimated for in the original design. Some of these unprovided for stresses depending upon many circumstances may appear in unlooked for and aggravated quantity. Except under one or two headings which are treated here more fully, I will only call attention to some others of the more prominent, and not attempt to follow them to details.

*Impact.*—If a weight or load be applied suddenly or fall from a height, it will move with a velocity in coming in contact with a body and produce the effects of impact on that body. When a body in motion strikes another body a mutual action takes place, consisting of a pair of equal and opposite forces, and acting on the striking body, the other, on the body struck. Changes of figure and dimensions, or strains, are produced in both bodies because of the stress applied to them. The simplest case, and the only one here considered, is when the impact is direct—take for example a pile being driven by the action of a falling weight.

If  $R$  be the resistance which the pile offers to being driven or is the load which would, resting on the pile, just cause it to commence to sink, and if  $W$  be the falling weight from a height  $h$  and  $x$  the space through which the pile sinks in consequence of the blow, then the mutual action between the pile and the weight consists of a pair of equal and opposite forces,  $R$ .

The whole height through which the weight falls is  $h + x$ , and the space through which the resistance is overcome is  $x$ ; therefore, by equating energy exerted and work done, we have  $W(h + x) = r x$ . This question shows that the force of the blow measured by the space the pile is driven is proportional to its energy.

We have assumed that the whole energy of the blow is consumed in driving the pile; though always there will be some used in causing vibrations and damage to the head of the pile.

As the pile is driven deeper, its resistance increases and ultimately becomes equal to the crushing stress of the material; then it will not



sink further and the whole energy of the blow is wasted in crushing. If the striking body is of such material that it may also be damaged or crushed, the energy of the blow would be expended in damaging both bodies, so that we may write down as general question of impact :

Energy of blow = work done in overcoming resistance to movement of body struck, + work done in internal changes of striking body, + work done in internal changes in body struck ; and of these three terms the most important will depend on the relative magnitude of the resistance to movement and the crushing stress of the materials of the two bodies, so that as the body struck offers great resistance to motion, the damage to the one or both of the bodies becomes correspondingly great.

Let us apply the equation to the case of impact on perfectly elastic materials. Suppose a structure or piece of material of any kind resting on fixed supports and struck by a body harder than itself, so that we may neglect all changes in the striking body, we will also neglect all vibrations of the nature of sound produced in both bodies which would consume some energy, so that the whole energy of the blow is considered expended in straining the piece of material or structure struck.

Now, the effect of impact is to produce a mutual action  $S$ , representing a force applied to the structure at some definite point, and the structure suffers deformation, and the point of application moves through a space  $x$ . The resistance to deformation is proportional to  $x$ , because the limit of elasticity is not reached ; it therefore commences by being zero, and increases gradually till the velocity of the striking body is wholly destroyed,

The mean value of  $R$  is half its maximum value. During the first part of the period of impact, the mutual action  $S$  is greater than the resistance, and during the second part less ; but when the maximum strain has been produced the mean value during the whole time must be exactly equal to the main resistance ; the weight and the structure being momentarily at rest. The strained structure will immediately, in virtue of its elasticity, commence to return to its original form, but for the moment a strain was produced, which is a measure of the effect of the blow and which must not exceed the power of endurance of the material.

Let, now,  $R$  = the maximum resistance and let the blow consist in the falling of a weight  $W$  through a height  $h$ , above its first contact with the structure, then  $h + x$  is the whole height fallen through, and it follows that  $W(h + x) = \frac{1}{2} R x$ , and  $x = \frac{Wh}{\frac{1}{2}R - W}$ .

The resistance  $R$  may also be described as the "equivalent steady load," being the load which, if gradually applied at the point of impact, would produce the same stress and strain which the structure actually experiences.

We most conveniently compare it with  $W$  by supposing that we know the deflection  $\delta$ , which the structure would experience if the

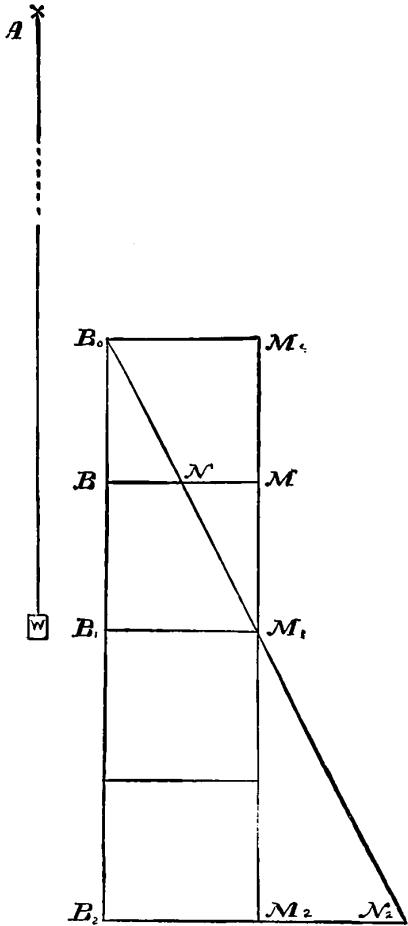
striking weight  $W$  were applied as a steady load at the point of impact. We then have  $\frac{x}{\delta} = \frac{R}{W}$ ; substituting the value of  $x$  we get

$$\frac{R^2}{W^2} = \frac{2R}{W} + \frac{2h}{\delta}.$$

Let the height  $h$  be  $n$  times the deflection  $\delta$ , then solving the quadratic, the positive root of which is  $R = W (1 + \sqrt{2n + 1})$ , thus showing how the effect of a load is multiplied by impact.

A particular case of the foregoing is when  $h = 0$  then  $R = 2W$ , so that if a load  $W$  is suddenly applied to a perfectly elastic body from rest (not as a blow) it will produce a pressure just twice the weight. This is a very important case.

If a long elastic string be fastened at  $A$ , say, and if a gradually increasing weight be applied, the string will stretch and the weight descend; now let the weight required to produce any given extension be represented by the ordinate of the sloping line,  $B_0NN_2$ . (See figure).



Next, instead of applying the load gradually let  $W$ , represented by  $B_0M_0$  be applied suddenly, the string will of course stretch and the weight descend; when it has reached  $B$  the tension of the string pulling upwards, represented by  $BN$ , will be less than  $W$  acting downwards; also in the descent  $B_0B_1$  an amount of energy has been exerted by  $W$ , represented by the area or the rectangle  $B_0M_0MB$ . At the same time the work done in stretching the string is represented by the area of the triangle  $B_0NB$ , and the excess of energy exerted over work done, has given velocity to the descending weight and is stored as kinetic energy in  $W$ . On reaching  $B_1$  the tension of the string is just equal

to the weight, but the stretching goes on; the weight has its greatest velocity, which corresponds to kinetic energy shown by triangle  $B_0M_0M_1$ . Now any further extension causes the upward pull of the string to be greater than  $W$ , yet  $W$  goes on descending until the energy it has exerted is balanced by the work done in stretching the string; then its kinetic energy will be exhausted and  $W$  will be brought to rest. This will occur when the area of triangle  $B_0N_2B =$  that of rectangle  $B_0M_0M_2B_2$ , that is when  $B_2N_2 = 2 B_2M_2$  or  $B_0B_2 = 2 B_0B_1$ . So that the tension of the string, caused by the sudden application of the load, is twice that due to the

same load steadily applied. The string will not remain extended so much as  $B_0B_2$ , for now the upward pull of the string exceeds  $W$  and will cause it to rise again; on reaching  $B_1$  it will have the same velocity upwards that it had downwards on first reaching  $B_1$ . This will carry it up to  $B_0$ , when it will again fall, and so on. Practically the internal friction, due to imperfect elasticity and air resistance, will soon absorb the energy and bring  $W$  to rest at  $B_1$ . For the purposes of this paper it is not necessary to consider the case of impact from high velocities. In such cases the inertia of the structure becomes a factor, and the energy of  $W$  is largely expended in damaging the part struck and not the whole expended in straining the structure. In the case of vibrating loads, synchronism comes into action. From the illustration of the elastic string and figure above, suppose in the first instance  $W$  at rest, then the corresponding extension ( $\delta$ ) is  $B_0B_1$  and  $W$  is at  $B_1$ . Next imagine  $W$  suddenly and vertically raised, it will oscillate about  $B_1$ , as a mean position. In any position  $B$ , the tension, is represented by  $BN$  and  $W$  by  $BM$ , so that  $NM$  is the unbalanced force which draws  $W$  downwards when it is above  $B$ , and upwards when below. Now  $NM$  is proportional to  $BB_1$  and  $W$  therefore moves under a force always proportional to its distance from  $B_1$ . This is a simple harmonic motion. Now the time

of a double vibration of the weight is given by equation  $t = 2\pi \sqrt{\frac{\delta}{g}}$

being the same as that of the small oscillations of a pendulum of length  $B_0B_1$ . It is dependent only on the elasticity of the string and the magnitude of  $W$  and not on the extent of the vibration. The vibrations of any structure may be distinguished into general and local, or into those of the whole and those of its parts. Next, suppose  $W$  oscillating about  $B_1$  and let  $B$  be its extreme upward position. At the instant when  $W$  is at  $B$ ; imagine a small downward force,  $P$  applied, the effect will be that  $W$  descends to a position  $B_2$  before coming to rest. Such that  $B_1B_2$  will be greater than  $BB_1$ , instead of being equal as would otherwise be the case. Then suppose  $P$  removed,  $W$  will rise to a point as much above  $B$  as  $B_1B_2$  is greater than  $BB_1$ . Again, suppose  $P$  applied, then  $W$  will descend below  $B_2$  and this process may be continued indefinitely. So it would appear that a load  $P$ , however small, applied and removed at intervals corresponding to the natural period of vibration of the weight, will produce a vibration of continually increasing extent, and indefinitely augmenting the tension of the string until it breaks. If  $P$  be applied as before at  $B$ , but removed and replaced at a different interval, the vibration will still augment at first but will be limited and will be followed by a diminution, etc., indefinitely. In actual structures the circumstances are much more complex and calculations difficult, but the principles are right. Whenever a load on a structure fluctuates the stress caused is greater than that calculated for its maximum and the stress is greater the more nearly the period of fluctuation approaches the period of vibration of the structure or the part of it affected. For the portion on impact, I would refer to "Cotterell's Applied Mechanics." Much

of what is here written is compiled and extracted from that excellent treatise on the subjects it treats of.

*Initial Tension.*—Most of the smaller members of a truss requires to be screwed up to an extent regulated by theory. This stress is called initial tension. In small rods and braces, this stress is a large factor or proportion and should never be neglected. I would refer to Waddell's valuable treatise on bridges for information and tables relating to these strains.

*Reversion of Stresses.*—Girders of the triangular or Warren type, the web members of which are subject to change of stress from tension to pressure, or *vice versa* from moving load. These changes may be more or less sudden, and approximate to nearly twice that estimated for the movable portion of the load.

*Inertia.*—The slowness of a structure or its parts to come into action always adds to the stress in practice. I mean that a part of a member may have to sustain a sudden application of a load, while the drag or inertia of the whole takes time to adjust itself into action. This is, perhaps, a special case of impact from imperfect elasticity. (See Impact in another place.)

*Stress from Traction.*—An engine in starting a train often exerts its full power, as will be observed, by the slipping of the drivers on the rails. The weight of the engine on its drivers may be, say 40 tons, so that if the coefficient of friction be 1.5 of  $w$  the traction of a locomotive would be eight tons. This force would be exerted horizontally on the rail or support of the drivers. Suppose any bridge (sheet 2 $\frac{1}{2}$ ): Let the engine stand at  $l$  with a train attached to the right, off the bridge, in starting forward a pull of eight tons would be exerted on the chords,  $l$  to  $A$ , either causing motion to the whole structure, or resisted by the friction or fastenings at the support  $A$ . If the engine were to back up, the stress would be at  $m$  to  $B$ . In the case of light bridges, motion should be provided for, and in all cases the extra stress should not be neglected. In a design like the one here, no portion would be affected except the lower chord and its fastenings. In the reciprocal diagram for full load and maximum stresses, the portion  $x$  shows the extra stress and amounts to from 37% to 14% additional in the panels on the lower chord. In small bridges the extra stresses from this source became a large factor.

(Drawings referred not published.)

*Temperature.*—In calling attention to extra strains from temperature, I would again refer to the bow string, described in my other paper, as a particular example. One end of this bridge is secured by bolts to its support. The other end rests on round iron rods on top of the bed plate. These rods were, no doubt, originally intended to ease the friction caused by expansion from change of temperature. At the time I examined the bridge, none of these rollers were in a position to do service. They lay diagonally at all angles to the line of bridge and were embedded in sand, etc., accumulated on the bed plate. The

bridge has, therefore, either to slide on the iron support or sway the pier backwards and forwards. If the latter, then the shorter end span would have to slide. Suppose the pier to be immovable and the bridge to slide, suppose it expands equally and symmetrically and does not suffer deformation, therefore the extra horizontal component of pressure on top chord from rise of temperature is :

$$\frac{\text{dead load}}{\text{coef. } F \times 2} = \frac{24.82}{6 \times 2} = 2.07 \text{ tons,}$$

and the extra tension stress on bottom chord, from fall of temperature is the same, or in this case they amount to 2.6% on the chords. (See sheet 11—not published in proceedings.) All examples may not be as bad as this one selected, but it instructs caution in design and the extra is seldom a cipher in amount.

*Compound Stresses.*—Some members of a structure, such as cross beams in the floor system, which are designed chiefly to resist bending action, are usually subjected to other stresses as pressure members to the floor truss carrying the vibrations and wind loads to the abutments. The extra stresses in these in some parts of a structure may be great and must be estimated for.

*Workmanship and Details.*—Workmanship is never theoretically perfect, and when it is bad, we cannot estimate for the defects. The workmanship and details are perhaps the most important factor in the structure. The calculation of stresses and resistances of details and connections are tedious and sometimes not practicable; when bad workmanship, etc., enters as a factor, the process is much complicated. I will only suggest a few imperfections :—

A member may be cut too long or too short and forced home.

Threads of screws and nuts not properly cut or fitted.

A weld not perfect or complete.

Abutting joints not planed to fit or at the true angle.

Pins and eyes ill-fitting; eyes not at right angles to stresses, nor in the axes of bars.

Rivet holes not opposite, or bored, or punched true.

Riveted connections of members not true and causing bending action in pressure members where perhaps the intention was to fix the ends.

Want of homogeneity and imperfections in materials.

*Factor of Safety.*—After all stresses are tabulated, some factor of safety is assumed for the material to cover all deficiencies and ignorance. Usually permanent and movable loads are added together and a factor of safety taken for their sum, making no distinction between the two parts of the load. Now evidently this is not good practice; a much larger factor should be taken to cover the movable load than for the steady load, and as these two components enter in all propor-

tions, the factor of safety should be applied separately and before the stresses are added. Of course every foreseen stress should be estimated carefully and allowed for before filling in the sections of the members. The working load proper for the material, if not well understood, should be ascertained by careful experiments. I am aware of the many shortcomings of this essay and that a practical bridge engineer would have handled the subject so much better than you now find it. Some mole hills may have grown to mountains and some mountains may be reduced to mole hills, perhaps, and some large hills may have been passed unseen. Still I hope some hint may have been thrown out or idea suggested that will serve a useful purpose.

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# APPENDIX.

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## BIOGRAPHICAL SKETCH

OF

## THE LATE COLONEL CHEWETT.

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COLONEL CHEWETT, whose portrait we have selected to accompany this year's proceedings of our Society, was one of the Surveyor Generals of Upper Canada. Our engraving was made from a miniature on ivory, by Hoppner Meyer, and appears to be exquisitely painted. We are assured by the family that the likeness is good, and when one considers that the old gentleman was past ninety when he sat for his portrait, we are struck with the remarkable freshness of his complexion and the abundance of his hair, though in this latter the appearance is deceptive, for Mr. Chewett wore his hair in powder on all occasions of state or ceremony, the survival of a fashion prevalent in his early days. Our illustration, therefore, presents Mr. Chewett younger looking than one would expect, yet at ninety years he was really both healthy and active, was always an early riser, and in summer took a "constitutional" on the pathway before his house every day the weather permitted.

We propose in our sketch of Mr. Chewett's life to note only a few prominent events and confine ourselves in the main to extracts from a private journal, for the years 1792-3, in the possession of his family, in which he dwells almost wholly on professional matters, and therefore cannot be otherwise than interesting to the members of our Association.

Mr. Chewett, born in London on the 21st December, 1753, was educated as a hydrographical engineer for the East India Company's service. He received his appointment to an East Indiaman towards the close of 1770, but shortly before sailing he was taken with small-pox, and his place supplied by another. On his recovery, rather than wait for another ship, which in those days were few and *very* far between, he embarked on a small vessel bound for Quebec, where he arrived in 1771 and commenced the practice of his profession.

On the 20th May, 1774, a little past the age of twenty, he was taken into the office of the Surveyor General of the Province of

Quebec, and afterwards served in the Quebec militia from the latter end of September, 1775, to the 6th May, 1776, during which time the place was besieged by the rebellious Americans. The siege was put an end to on the latter date by the arrival of His Majesty's ship of war, *Isis*, and the *Surprise*, frigate, under the command of Sir Charles Douglass, having on board the flank companies of the 29th Regiment, commanded by Lord Petersham. During the siege Mr. Chewett was employed, by order of His Excellency, Captain-General Carleton, Governor of Quebec \* (there being no Engineer in the Province, and the Surveyor-General, Major Holland, being with the army at New York), under the direction of the Deputy Surveyor-General, the Hon. John Collins, in surveying the fortifications surrounding the city, and in determining the distance of the rebel batteries, whenever and wherever erected. After the defeat of the Americans, Mr. Chewett was appointed acting Paymaster of Works for the posts of St. John, Isle aux Noix, and their dependencies on Lake Champlain; to the Engineers, Quarter Master General and Naval Departments, and remained in these appointments until 1783, when he was recalled by Lieutenant-Governor Hamilton to Quebec and again placed in the Surveyor-General's Department.

In 1786, Mr. Chewett was sent by the Surveyor-General, Major Holland, to take charge of the district of Lunenburg, formerly the eastern Townships of Upper Canada, and now comprising the easternmost counties of Ontario. Here he was employed for several years surveying and laying out lands for the disbanded troops and loyalists.

Mr. Chewett married in 1791, but before doing so he wrote the following letter to his friend, the Hon. John Collins, to procure him a marriage license, and which the writer discovered some years ago in the office of the Crown Lands Department in Toronto, where, no doubt, it still remains. It is a curiosity, and will bear analyzing; there is a bashfulness about it that seeks to conceal *love* by representing *expediency*, and a *timidity* lest his superior should think that at his age (37) he might be guilty of a folly. One can hardly help thinking that were he not obliged to send so far (Quebec) for the license, and to a

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\* General Carleton arrived at Quebec in November, 1775, from Montreal, by the assistance of Mr. Bouchette, the master of a small vessel, who was afterwards made a Provincial Navy Captain for this service. General Carleton, at Quebec, issued a proclamation that all who were desirous of leaving the country from national feeling were at liberty to do so. Very few availed themselves of the permission, the French-Canadians preferring to remain in the city, and those occupying St. Rocque and St. John's suburbs said if arms were given them they would come in and defend the city. The Americans attacked on the 31st December, and these Canadians fled, leaving their arms in the hands of the Americans. The suburbs were then burned, by order of General Carleton. In May, 1776, volunteers were required to act against Montreal, then in the hands of the Americans—only *one* volunteered from Quebec. A Canadian, however, named Baygeau, of St. Thomas, redeemed his countrymen's want of pluck by bringing forward over two hundred from his place of residence. He afterwards became a priest, and died a bishop.



friend, who happened to be the Chief of his Department, he would have been less embarrassed. However, here is the letter :—

“ CORNWALL, 22nd April, 1791.

“ DEAR SIR,—Having found out a girl whom I mean to make a partner for life, and without which it is impossible to exist in this settlement, having no settled place to retire to after the fatigues of a survey, or take care of the little property I have (this, I hope you will not think unreasonable at the time of life I am come to, as it does not proceed from motives of folly, but of a mature and deliberate consideration), I therefore must pray you as my friend, to obtain a license for me and Isabella McDonell (she is of the family of Major Archibald McDonell, of the Long Sault), to be sent by the first opportunity; and in doing so you will oblige an old servant who is, with the greatest respect,

Dear Sir,

Your most obedient, humble servant,

“ W. CHEWETT.

“ The Honourable JOHN COLLINS, Esq.”

We have no means of fixing the date of his marriage, but his first son was born on the 20th May, 1792.

In the autumn of 1791, Lieutenant-Governor Simcoe, the first Governor of the new Province of Upper Canada, arrived at Quebec, when Mr. Chewett was recommended to him to take charge of the Surveys Department of the upper country. Governor Simcoe accepting the recommendation, Mr. Chewett was ordered to report at Quebec, and we will now confine ourselves chiefly to extracts from his journal, which is the one he carried in his pocket, and consists of rough notes made, for the most part, daily, often in pencil, and from which he must have made up his regular journals, some of which are to be found in the Crown Lands Department. It commences on 23rd December, 1791. From that date until the 25th January, 1792, he was engaged in making plans of the District of Lunenburg for the Surveyor-General's office, and on the 26th he notes: “ Employed making into letters the certificates for the family and bounty land for the Township Osnabruck, sent up in the summer, 1790, as the people did not attend to receive them agreeable to the advertisement of the 3rd February, 1701,” and afterwards engaged on plans for Williamsburg, Charlottenburg, and “ of the present situation of Cornwall for the Board.”

“ 5th February, 1792.—Writing to the Deputy Surveyor-General and making up my account current, as there is a mistake in the one sent to Mr. Frobisher, and packing up a plan of Cornwall of the original proprietors.

“ 6th.—Making a plan of Cornwall,” this work and “strengthening the lines on the several plans of the Grand River in order to reduce to the standard scale of the district,” occupied his time till the 27th.

“ 27th.—Set out from the Grand Remous and arrived at Charlottenburg (probably Glengary House, or the mouth of the Riviere aux Raisins).

“ 28th.—Set out from Charlottenburg and arrived at the Cedars.

“ 29th.—Set out from the Cedars and arrived at Lachine.

“ 30th.—Set out from Lachine and arrived at Montreal.”

We call the reader's attention to the date of his arrival in Montreal, 30th February—1792 being Leap Year, he must have arrived on the 29th. He probably started on the 26th, not the 27th. It would be interesting to see if he has copied this error into his official journal in the Crown Lands Department. He remained in Montreal on the 1st March, and on the

“ 2nd.—Set out from Montreal and arrived at Berthier.

“ 3rd.—Set out from Berthier and arrived at Point du Lac.

“ 4th.—Set out from Point du Lac and arrived at St. Anns.

“ 5th.—Set out from St. Anns and arrived at Point aux Trembles.

“ 6th.—Set out from Point aux Trembles and arrived at Quebec.

Waited on Governor Simcoe—promised employment—presented him my plans—very well received—engaged to dine with him the next day.” He appears to have been in attendance upon Governor Simcoe till the 18th, when he “waited on Governor Clark, when I am informed there is a requisition from Governor Simcoe to the Surveyor-General's office for my departure.

“ 19th March.—The Surveyor-General has sent Governor Simcoe's requisition to Governor Clark to know how he is to act.

“ 20th.—Governor Clark's answer is that since the separation of the Province he does not conceive there can be any outfit from his Government, therefore Mr. Surveyor-General says he can give no orders. But the Surveyor and Deputy Surveyor-General have given me the strongest recommendation as the most proper person to carry the business into execution. So far, so good.

“ 21st.—Waited on Governor Simcoe—delivered him the plans—but upon entering into conversation, he was pleased to say he had dropped the idea of carrying on the survey until he took possession of his Government, when he should have everything at his command. Requested by him to copy all the instructions relative to settling the Upper Country—buy a book for the same and charge to the Surveyor-General.” He was engaged in this work until the end of the month. On the

“ 25.—Waited on Governor Simcoe, and he requested me to lend him a copying glass. He desired me to enquire of Major Holland in what manner and in what quantity the lots of land were given in the Town of New Johnstown, now called Cornwall. Went to the levée of Governor Clark.

“ 26th.—Carried the copying glass to Governor Simcoe. He was not visible.

" 27th.—Applied to Major Holland agreeable to the order of Governor Simcoe to know in what manner the town lots were given away in New Johnstown, now Cornwall, and he says there was no settled mode of locating them, 'twas optional with the Surveyor-General, therefore Major Gray's *ipse dixit* does correspond with Major Holland's.

" 1st April, 1792.—Waited on Mr. Dunn relative to £100 6s 4d currency that Mr. Frobisher refused to pay me. Mr. Dunn said that Mr. Collins ought to pay me for the balance coming, as well as for my drafts (plans?). Attended the leveé. Employed bringing up my journal. Mr. Robert Coffin returned from his survey, having made as far as Cap la Magdelaine, the ice broke up at Three Rivers, consequently impassable. There should have been a provisional order for surveying by land.

" 2nd.—Employed copying instructions to the several surveyors. Dined with His Excellency, Governor Simcoe." From this date until the 15th he was engaged in copying instructions.

" 15th.—Waited on Governor Simcoe. He wishes me to go off as soon as possible, and I am to enter into his pay from the 10th April at the same pay I usually had, with permission, when not employed for Government, to work for the public. He wishes to have the plan of the River Rideau by Mr. French.

" 18th and 19th.—Employed making up my account to the 10th April.

" 20th.—Employed copying Mr. French's sketch of the Rivers Rideau and Petite Nation.

" 21st.—Carried the plans from the Surveyor-General's office to Governor Simcoe, with a receipt for the same. Dined with Governor Simcoe. He wishes to have the plan of Cornwall in its present situation; the plan of Kingston in its present situation; the harbor of Cataraqui and surroundings and Mr. Kotte's survey from the 8th or the Township of Elizabethtown with the Thousand Islands.

" 22.—Breakfasted with Governor Simcoe and received from him Point Henry Frederick in order to have a title put to it. Also the Town of Toronto to know whether it has ever been laid out, and a letter to Major Holland upon business. Went to Major Holland's lodgings, but he is in the country.

" 23rd.—Made a demand for the following plans:—The plan of Cornwall in its present situation. *Answer.*—Not in the office. The plan of Kingston. *Answer.*—Not in the office. The plan of Cataraqui Harbor and its surrounding. *Answer.*—Not in the office. Mr. Kotte's survey of the Mille Isles to be copied. Messrs. De Penneur and Pennoyer's plans on the River Rideau. *Answer.*—Not come to hand.

" 24th.—Reported them to Governor Simcoe.

" 26th.—Waited on Governor Simcoe with Major Holland. Governor Simcoe wishes to have the plans authenticated. Major Holland requests to have the box and plans sent back.

" 27th.—Went to Governor Simcoe and brought back the plans and began their examination." He was employed at this work and in

writing letters until the 10th of May. On the 6th he records as an event:—"This morning left Quebec, the *Recovery*, Capt. Forester, in which went Mr. Toosey and family,"—(for England.)

"10th May.—Governor Simcoe came to the office about 1½ o'clock p.m. and requested to have the plans as he should send off his baggage next morning. At 6 p.m. carried him the plans

"11th.—Employed writing letters and instructions into a book for Governor Simcoe.

"12th.—Ordered before a committee of Council with the several surveyors now at Quebec in order to give in an estimate of the number of days it would require to run the out-lines of a Township of ten miles square on a river, and gave the following, viz :

|                                                                           |      |     |
|---------------------------------------------------------------------------|------|-----|
| " Running the front on a river.....                                       | Days | 15  |
| "    one side line.....                                                   | "    | 10  |
| "    one rear line.....                                                   | "    | 10  |
| " Returning to the first station in order to finish the closing line..... | "    | 1   |
| " For the closing line.....                                               | "    | 10  |
| " Allowance for bad weather and other casualties ..                       | "    | 14  |
|                                                                           | —    |     |
| Total days.....                                                           |      | 57  |
| " 1 Surveyor, 10/ per diem.....                                           |      | 10/ |
| " 2 Chain Bearers, 2/ " each.....                                         |      | 4/  |
| " 8 Axe Men, 1s. 6d. each.....                                            |      | 12/ |

" Provisions for the party to be allowed the same as the Deputy Surveyor-General was allowed, 1s. 3d. per day for each man. Implements:—

" 6 New England axes.

" 4 Tommy-hawks.

" 1 Oil cloth.

" 1 Batteau or Canoe, and all the contingencies to be sworn to.

"13th.—Waited on Governor Simcoe; and he desired me to copy Mr. Gale's remarks on the District of Lunenburg, and to obtain from Mr. Collins his treaty with the Mississaga Indians. In consequence of which waited on Mr. Collins and he promised to give it me. Went to the leveé of Governor Clark."

Until the 19th he was employed copying orders, on the

"19th.—Copying a reference to a plan for Governor Simcoe, who came to the office and signified that I must leave Quebec on Monday. Mr. Collins promised to settle with me in the afternoon, but put it off until after leveé on Sunday.

"20th.—Breakfasted with Governor Simcoe and told him Mr. Collins was to settle with me after the leveé. Waited on Mr. Collins, who put it off until 9 o'clock a.m. on Monday, as he must have reference to the council books and to the account current book in the office. Packed up my little baggage ready for departure. Dined

with Governor Simcoe, and after dinner received my instructions and an order on Capt. McGill, Acting Receiver-General, for £30 stg.

" 21st.—Waited on Governor Simcoe and received two letters, one for Sir John Johnson, and another addressed to Capt. Duncan and Capt. Munro. Waited on Mr. Collins to settle my account, which took us from 10 a.m. until 2 p.m. Waited on Governor Simcoe with Dft., but he was not at home. Waited again at 3 p.m. He seemed very much displeased. Went with him to Mr. Secretary Coffin—not to be found. About half-past 1 p.m. a boat upset in the river, in which were fourteen people. The Curé of Quebec, two ladies and all the rest were drowned. Went to the play.

" 22nd.—Waited on Mr. Coffin with Mr. Collins and obtained a letter of credit for my balance. Finished the whole of my business at 1 p.m. Waiting for Mr. Angus McDonell. He came in the evening after the tide had turned and going down, so that it was impossible to go off, and I am therefore forced to delay my departure until the morning. At 9 p.m. went to bed in order to be ready for departure.

" 23rd.—Rose at 4½ a.m. Called up Mr. Angus McDonell. Got our baggage on board. Breakfasted at 6 a.m. Paid my account. Set out at 7½ a.m. and arrived at Sillery at 8½ a.m. It being the turn of the tide the boat got on ground. Took out its load and launched her into the water. Made up a square sail of a cotton main sail. Waiting for the turn of flood. At six p.m., Mr. Angus McDonell having all his chemical apparatus on board, embarked and made Cap Rouge at 8 p.m., the wind being from the S.W. very strong against us.

" 24th.—At 6 a.m. Left Cap Rouge, the wind from the S.W. against us and arrived at 10½ a.m. at Pt. des Ecureuils. Waiting for the turn of the tide. At 7½ p.m. the tide turning. We embarked at Lotbiniere, opposite to Deschambault, at 10½ p.m.

" 25th.—At 7½ a.m. the tide and the wind coming about from the N.E., got under weigh and came opposite Grandines' Church. Very squally with thunder and lightning. When about three miles further Mr. Angus McDonell was very much panic struck, let go the halyard, broached too the boat and frightened the crew, who lay on their oars and all I and Mr. Grant could say—we telling them there was no danger, which in fact there was not—they would not row a stroke and we drifted to Grandines. When about 100 yards from the shore he was in so great a fright that he attempted to get out of the boat, and when I asked him what he was about to do, he said he did not think there was so much water at the place. We arrived at 10½ p.m. and lay up the boat as snug as it was possible.

" 26th.—Went down to the boat and found her full of water, which the people, by their negligence, had left last night, although ordered to bale her. I severely reprimanded them, and one of them took it into his head to desert. Mr. McDonell went after him. At 10 a.m. Mr. McDonell not returned, the tide making very fast and I am afraid if he does not come soon that we shall lose it. At 11 a.m. Mr. McDonell returned with the deserter and sat down to breakfast. The

wind continuing strong, we determined to reach Three Rivers. When we were abreast of Cap la Magdelaine, McDonell, seeing the church and one house, wanted to go in, let go the sail and made the people take to their oars, and as the boat came to the shore made a leap and ran as if the devil was after him, not waiting to secure his own baggage. The boat immediately filled, and Mr. Grant and myself did what we could to those articles that belonged to ourselves. When the business was over we found him (McDonell) sitting by a fire, and said he could not endure the cold.

" 27th.—A vessel from London passed Cap la Magdelaine at 3 p.m. Another ship from London at 6 p.m. We got out our boat, bilged and broken to pieces. We endeavoured to stop the leak, but could not, and forced to send over to Three Rivers for pitch and oakum, and to get a carpenter.

" 28th.—Employed the carpenter examining and repairing her, which detained us until 4 p.m. Embarked and made a little river about half a league beyond Three Rivers at 6½ p.m. The wind being from the S.W. so strong that we could not proceed further.

" 29th.—At 6½ a.m. left the little river, the wind strong from the S.W. Came to Point du Lac, and there came to an anchor in order to see if the wind would change or abate, but it grew more violent and we were obliged to return to the place we set out from. At 6 p.m. Bouillard deserted the second time.

" 30th.—Embarked again at 6 a.m. and made Machiche, the wind being very strong against us from the S.W.; but we could not get into the river, and so we were forced to anchor off the point exposed to the whole of the lake.

" 31st.—At 4 a.m., the weather being calm, got under way and stood through the lake in hopes of the wind freshening. When about three miles above River du Loup the wind came from the S.W. so strong that we were forced to stand in for River du Loup, which we made with much difficulty at 2 p.m. At 6 p.m., the wind coming from north, we made the entrance of Chenal du Nord at 10 p.m.

" 1st June, 1792.—At 6 a.m. embarked. Light wind from the N.E. and S. At 11 a.m. the wind failed. At 8 p.m. made the upper end of the Seigniori of La Valtrie.

" 2nd.—Embarked at 6 a.m., the wind variable from N.E., N. and S. Made Montreal about 4½ p.m.

" 3rd.—Sunday. No business to be done. Waited on Sir John Johnson.

" 4th.—Waited on Sir John Johnson. The letter not ready. Employed packing up my little baggage. Waiting for my provision.

" 5th.—Waiting for Sir John Johnson's letter.

" 6th.—Set off for Lachine and arrived in the evening.

" 7th.—At 1 p.m. left Lachine and arrived at the Cascades at 8 p.m. Very rainy.

" 8th.—At 4½ a.m. left the Cascades and arrived within about one league and a half of Coteau du Lac at 9 p.m.

" 9th.—5½ a.m. departed, and arrived at the mouth of the Riviere aux Raisins at 9½ p.m., the wind being against us all the time.

" 10th.—Sunday. 6 a.m. left the Riviere aux Raisins, and arrived at Cornwall at 9 p.m.; the wind being against us all the fore part of the day.

" 11th.—Set out from Cornwall at 6 a.m., and arrived at the head of the Long Sault at 9 p.m. We found very much difficulty in getting up the Long Sault.

" 12th.—Left the Long Sault, and arrived at Grand Remous at 10 a.m. Breakfasted. Employed unloading the boat and searching for the leak. Found it in her bottom. Exchanged the batteau. Put the provision again on board. Employed packing up my little necessaries for campaign, and settling my little family affairs. At 9 p.m. Mr. McDonell not yet arrived. A report is spread that a Mr. McDonell was drowned this evening. Sent off my servant with a horse to enquire after him.

" 12th.—At 4 p.m. servant not returned. Employed packing up the remaining part of my little necessaries.

" 13th.—At 10 a.m. Mr. McDonell returned. At 3 p.m. part of Governor Simcoe's corps came too and made a halt, commanded by Capt. Shaw. Obligated to wait this afternoon for my servant.

" 14th.—At 1 p.m. set off, and made Capt. Munro's at 9 p.m. Delivered my letters.

" 15th.—At 6 a.m. left Capt. Munro's, and made Campbell's at the Town of Johnstown at 8 p.m.

" 16th.—At 6 a.m. left Campbell's, and made Airs' at 7 p.m.

" 17th.—Left Airs' at 5 a.m., and made the middle of the 11th township at 7 p.m.

" 18th.—Departed at 5 a.m., and made Kingston at 7 p.m.

" 19th.—This day one of my servants refused to go any further, and the commanding officer interfered in his behalf, in consequence of which I was forced to let him remain, although he was £1. 10. cy. in my debt. Waited to get another man in his place, and to lay in a little stock for our voyage.

" 20th.—6 a.m. left Kingston, and arrived at Lieut. Parrott's at 7 p.m.

" 21st.—6 a.m. left Parrott's, and arrived at the Green Point at 7 p.m.

" 22nd.—At 6 a.m. left the Green Point, and arrived at Crisdall's and informed Capt. Meyers—to whom I had a letter from the interpreter at Kingston, in order to find me an Indian (? guide or interpreter). Two miles below building a sawmill.

" 23rd.—At 6 a.m. set off for Capt. Meyers', who informed me the person whom he wished to go with me was at the Appanne Mills (? Napanee), but was hourly expected. Employed getting an Indian who knew the Salt Springs, and a Scotch lad who speaks Indian as an interpreter.

" 24th.—Employed as yesterday. At 12 m. left Capt. Meyers' and arrived at the head of the bay, waiting for the person whom he wishes to go with me. Employed grinding axes.

" 25th.—Employed grinding and making helves for our axes, securing our baggage, laying up our boat, getting a canoe for the ex-

pedition. This evening arrived Capt. Meyers and informed me that Mr. Blacker would arrive in the morning.

“26th.—Mr. Blacker arrived, and after having spoken concerning the springs on the Trent, he informed me that he saw Mr. Jones, surveyor for Niagara, who informed him that he has a salt spring at the head of Lake Ontario which produced a large quantity of salt. A salt spring being a mineral water, consequently, as a mineral, therefore cannot belong to Mr. Jones, and so ought to be inspected. At 1 p.m. set out from the mouth of the River Saggettewedguam, and arrived at 6 p.m. about four miles from its confluence. On the east side the land in general is high—that is to say, from 10 to 20 feet; on the west side low, and on both but indifferent and stony land. Encamped about 7 p.m. Rainy weather all the evening. The water very strong from its mouth, so that the Indians are forced to get out of the canoe and lead it all the way except about a mile from its mouth.

“27th.—Departed from our encampment about 6 a.m., and arrived at the head of the first rapid at 3 p.m. and dined at 3½ p.m. Set out for the head of the second rapid and arrived at 7½ p.m. and encamped. The land on the north side appears tolerably good, except in some few places above the head of the first rapid, and that on the south side for about five or six miles; the rest appears to be low and swampy.

“28th.—At 7 a.m. set out for the spring.

“29th.—Blazed the track all the way from about four miles and a half. The first part, for about a mile, is very swampy. Arrived at the spring about 9 a.m., and upon examination found it to be a pool of about 2½ ft. in diameter, with no run from it, strongly impregnated with sulphur. Smell and taste nearly like to a solution of gunpowder, which induced me to believe it had been some imposition of the Indians, but Mr. McDonell and myself, after having with our kettles taken out all the water and dug down to a clay and gravel bottom, the water rose from about 10 a.m. to 10 a.m. the next morning the same height, very clear, and about the same quality.

“30th.—At 10 a.m. began the operation of examining and weighing the water, after which Mr. McDonell filled two kettles for boiling. Employed the people digging with axes and shovels we had made, and dug down about five feet and about four feet in diameter and the spring made no more water. At 5 p.m. it began to rain, and rained hard all the night.

“1st July, 1792.—At 10 a.m. Mr. McDonell, having finished his operations, we packed our baggage and McDonell went across the “carrying” in order to go down in the canoe, and I remained, waiting for the people to return, to go across the woods to the mouth of the Saggettewedguam, as one canoe could only take three people and the baggage. One was a person who acted as interpreter, a John McIntosh, and the other a son of Capt. Meyers, who knew the greatest part of the country, and who volunteered the journey. At 2 p.m. the people returned and we set off, and made 8 miles and at 7 p.m. encamped.

“2nd.—At 6 a.m. set off, and came to the hills of Lake Ontario at 10 a.m., about five miles west from the head of the Bay of Quinte, in



order, as the Indian said, to avoid the swamps, and at 2 p.m. arrived at the mouth of the Saggettewedguam. Mr. McDonell arrived at noon with canoe. So soon as the people had dined, sent them for the batteau. We are informed by some other Indians there is another spring. Sent for the chief, who says it only runs in the winter, but that he must have a bottle of rum this evening. His whole aim seems to be for the bottle of rum. He has now trumped up another story, that he knows of another which he has seen while hunting; that it is about a yard in diameter, boils up and runs, but that a person may drink the water of it. That salt has never been made of it, and that the spring or mud hole we were at is the only place where salt has been made, consequently, it certainly must be the spot to which we were directed, as it corresponds perfectly in regard to the situation, but not to the quantities of salt that has been made there. As no person in the country ever having seen above a few ounces, and exactly of the same taste with that McDonell made. Another thing that makes it appear to be the place, we found at our encampment the trees blazed all around at the foot of a high hill on the east, and the spatulas with which they had stirred the salt; also a scum they had thrown off, like unto that which McDonell had from clarification with eggs, both in taste and smell.

“3rd.—McDonell employed asking several questions of the chief, but his answers tend to the same purport of last evening—that is to say, the bottle of rum. Returned the interpreter to his master, and made every acknowledgment in our power for his politeness.

“4th.—At 6 a.m. set off from the Saggettewedguam, and made Capt. A. McDonell's on the Presque Isle de Quinte at 11 p.m.

“5th.—At 6 a.m. set out from Capt. A. McDonell's, and arrived at Kingston at 8½ p.m.

“6th.—Ordered by the Major of Brigade to wait on the Governor at 10 a.m. The Governor gone to visit the Mills and did not return until 2 p.m. Waited on him and gave our remarks concerning our journey to the Salt Springs. Mr. McDonell neglected to make out his report. Ordered by the Governor to wait on him at 8 a.m. on the morrow, as also Mr. McDonell.

“7th.—Waited on the Governor at the hour appointed, but Mr. McDonell did not attend. Ordered to call again at 10 a.m., and to bring Mr. Aitkin along with me. Attended. Employed labelling and sorting plans.

“8th.—The Governor was sworn in at 10 a.m. Ordered by him to attend at 7 a.m. on the morrow.

“9th.—Attended at the hour appointed. Employed in labelling plans and answering several questions with regard to the Surveyor-General's Department, in regard to dividing the districts. Ordered to enquire whether the settlement of the District of Nassau was numerous. Ordered to attend early, that is to say, at 7 a.m. on the morrow. Agreeable to the order of enquiry, applied to Mr. Secord, who is a young man of about twenty, and the only person in the place who knows. He says the settlement in general is full of inhabitants from

the Chippeway Creek to the head of Lake Ontario, and in many places from ten to twelve miles in the rear.

"10th, 7 a.m.—Repeated the information I had received to the Governor. Employed docketing plans and writing a list of them. Ordered to enquire concerning the strength of the militia in the District of Nassau. Mr. Wm. McKay reports concerning the number of militia in the district of Nassau, and from his having been a military man I should think it the best information we can obtain on this spot, that

|                                                                                        |          |
|----------------------------------------------------------------------------------------|----------|
| The 1st Battalion, from the head of the lake to Niagara, consists of about . . . . .   | 160 men. |
| The 2nd Battalion, from Niagara to the Chippeway Creek, consists of about . . . . .    | 200 "    |
| The 3rd Battalion, from the Chippeway Creek to Long Point, consists of about . . . . . | 200 "    |
| <hr/>                                                                                  |          |
| Total . . . . .                                                                        | 560 men. |

"He says the above-mentioned number is near the amount of the muster of the last year, and that he does not think they have increased to more than six hundred. Mr. Jones arrived this evening.

"11th, 7 a.m.—Attended on the Governor. Employed in docketing and referring plans, and in dividing the District of Lunenburg and Meiklenburg into counties.

"12th.—Employed dividing the District of Nassau and Hesse into counties," and so on at office work until the 24th, when he left Kingston, and arrived at Gananoque at 7 p.m.

"25th.—At 6 a.m., left Gananoque, and arrived at the upper end of the township of Augusta. Made all the interest I could in the behalf of Mr. White, the Attorney-General, with the principal people of Elizabethtown. The gentlemen seem much to favour him.

"26th.—At 6 a.m. left Augusta, and arrived at the Grand Remous at 9 p.m.

"27th.—Employed unloading my batteau and settling with my party. Allowed them five days to carry them home, it being customary." Here, as commanded by Governor Simcoe, he appears to have been busily engaged in making and copying plans, and closing up his work in this part of the country before handing the district over to his successor, Mr. Hugh McDonell. He was then to join the Government at Niagara, and take charge of the surveys of Upper Canada as Surveyor-General. Closing up his affairs occupied a month, for we read that on the 28th August he was "waiting the opportunity of batteau to take him up the river." On the 29th a "brigade of batteaux" passed up, and, taking passage, he was landed in Kingston at midnight of Sunday, 2nd September, 1792.

"3rd.—At 4 p.m. left Kingston, and arrived during the night within about fifty miles of Niagara.

"4th.—Gentle breezes, the weather cold. Came abreast of Niagara about noon, and lay off the whole of the day for want of wind. About 8 p.m. came to an anchor, but the wind changing, immediately

weighed anchor again, and about 11 p.m. came to alongside the wharf off Navy Hall.

"5th.—Waited on Major Littlehales to inform the Governor of our arrival. The Governor too unwell to see anybody.

"6th.—Waited on Major Littlehales to ask for a tent or marquee. Was answered, so soon as the Governor was well he would mention it to him.," Here the Governor was confined to his bed with fever, and supposed to be dangerously ill. The Counsellors and members of the House of Assembly had arrived, but the House, on meeting, was prorogued to Monday, the 17th. In the meantime Mr. Chewett appears to have found lodgings in a tavern at the rate of three shillings per day, and his servant at two shillings.

"17th September, 1792.—At 1 p.m. the Governor came to the House of Peers and made a speech to the members of both Houses. The Commons then were ordered to return to their House, to be sworn in and to choose a Speaker." After this, till the 30th, Mr. Chewett does not seem to have seen anything of the Governor or to have had anything to do except to describe some boundaries of townships at the request of the Chief Justice, in order "to make them into patents."

"30th September, Sunday.—Attended the Governor, who, after speaking on various subjects, concluded with saying he had appointed Mr. David Smith Surveyor-General, and that we must enter into business immediately. After the levée was over, the Surveyor-General was pleased to say the Governor would appoint me Deputy Surveyor-General, and requested that I would attend him at 4 p.m. on Monday to begin business." Mr. Chewett was disappointed. When Governor Simcoe arrived at Quebec in the autumn of 1791, Major Holland, Surveyor-General of the Province of Quebec, proposed to Governor Simcoe his appointment as Surveyor-General of the Upper Province, but on Mr. Chewett's arrival in Quebec, early in 1792, Governor Simcoe candidly told him that he could not make the appointment, as it had been promised to Lt.-Col. Provost, who would not come to the country, but that Mr. Chewett should be the acting Surveyor-General. How Mr. Smith, a captain of the 5th Regiment, in garrison at Fort Niagara, became Surveyor-General in place of Colonel Provost, is not explained; at least there is no record among Mr. Chewett's papers, though until this date official documents were signed by Mr. Chewett as "acting" Surveyor-General.

"1st October, 1792, Monday.—Attended the Surveyor-General at 4 p.m. No business to be done, as he had not received instructions.

"2nd October.—Ordered to the Governor at Navy Hall relative to a tract of land prayed for by a Mr. Easton. Ordered to write a description of the place. Complied with the order." And after this date he appears to have been busily engaged in office work and attending at Navy Hall, etc., until he records that on

"3rd November, 1792.—Received from Mr. Smith fifty H. joes, which Mr. Smith received from the Receiver-General, all of them light, and given as full weight. I expostulated with the Receiver-

General, but he said the merchants would give a draft for them on Montreal.

“4th November.—Dined with the Agricultural Society at the Freemasons’ Hall. Governor Simcoe and his suite were present.

“5th.—Left Niagara about 10 a.m., and

“6th.—Arrived at Kingston at 6 p.m.

“7th.—Remained to settle my accounts with Mr. Forsyth.” This occupied him till the 9th, when he left Kingston at midday, and arrived at midnight at No. 10 in the township of Young.

“10th November.—At 6 a.m. left the place where we slept the last night, and arrived at the place of my residence at 9 p.m.” Here he remained all winter, making plans and schedules of pretty nearly all the townships in the Eastern District. On the 17th April, 1793, he records: “Packing my little necessaries for the voyage to Niagara. On the 18th four batteaux arrived about half-past six in the evening, belonging to Mr. Frobisher, but were too much loaded to take in passengers.” He was told that others were following, and would arrive the next day. It was not till the 20th that two belonging to Mr. Glenny came by, in which were Dr. Burns and Mr. Bowman, passengers. With these gentlemen he proceeded to Kingston, and arrived on the 24th. Here he was detained until the 5th May waiting for a fair wind to enable the *Mississaga* to make a start. On the 5th, the wind being fair for Niagara, he embarked and they weighed anchor. It, however, died away, so he came ashore and returned to Kingston. It was not until the 9th the *Mississaga* got off at 6 in the morning, and they arrived at Niagara the next day at 11 a.m.—not bad sailing. He now records: “The Governor and his suite being gone to Toronto, waited on the Chief Justice.”

“11th May.—Waited on the Receiver-General.

“12th May, Sunday.—Waited on the commanding officer Major Smith.

“13th.—Arrived at half-past two p.m. His Excellency Governor Simcoe from Toronto.

“14th.—This morning arrived the Surveyor-General.

“15th.—Waited on the Surveyor-General, and received a balance of £10 currency, which I paid to Mr. Crooks on account for Mr. Glenny.” From now on he appears to have been hard at work upon plans, etc.

“31st May, Friday.—Both Houses being assembled at one o’clock p.m., and on the appearance of the Governor the garrison of Niagara fired a royal salute, a compliment to him as the representative of the crown. The Governor being seated, an order was sent to the Commons for their attendance. The passage to the bar was so crowded they could hardly come up to it, owing to the serjeant-at-arms being out of the way. Methinks there should be a pale to the bar for the Commons to enter, in order to be separate from the populace. The Governor was then pleased to make a most noble and gracious Speech from the Throne, which made the heart of every true Briton jump for joy.

“4th June, 1793.—Being the anniversary of His Majesty’s birthday, attended the leveé, but being dressed in boots, was told by the

sentries that none but military men were thus admitted. Returned in order to dress myself accordingly, but was too late. In the evening an elegant ball and supper was given for all His Majesty's loyal subjects, and the ladies made a splendid appearance, though not very numerous. After supper a number of loyal toasts went round, suitable to the occasion. The company went to their homes about 2 a.m. in great good humour, and a few of the gentlemen spent the evening all night!

"5th June.—Employed by His Excellency the Governor making a reference to a plan of Toronto by Joseph Bouchette." Shortly after this date, Mr. Chewett set out with a surveying party, going up the Niagara river, transporting his batteau round the falls, and arrived at Fort Erie on the 18th. From this point he proceeded westward, and was engaged in surveying the county, its shores and harbours, the rest of the year.

Mr. Chewett settled in Toronto when the Government was moved from Niagara, and occupied a log house near the north-east corner of York and Wellington Streets, afterwards converted into a root-house when he built a residence for his family on Market Street (now Wellington). This building, a little changed by additions, still (1890) stands, the foundation of which was laid in 1799.

On the 1st January, 1800, Mr. Chewett was appointed Registrar of the Surrogate Court for the Home District, and retained that office upwards of forty years.

In 1802 Mr. Surveyor-General Smith retired and left for England, and, although Mr. Chewett was promised the appointment, it was found that Mr. Smith had disposed of his office, together with his house and land in the town of York (Toronto) to Mr. Charles B. Wyatt. Mr. Wyatt, however, was suspended the same year for having conspired with Mr. Justice Thorpe and others against the Administration of the Hon. Mr. President Grant, and Mr. Chewett was afterwards appointed joint Surveyor-General with Mr. Ridout.

During the American War of 1812-14 Col. Chewett commanded the 3rd Regiment of West York Militia, and upon the reported landing of the Americans near the Humber on the night of 26th April, 1813, Major-General Sheaffe withdrew his troops, believing he could not sustain an attack, and (leaving instructions with Col. Chewett and Major Allen, residents of the town, to treat with the American commander for terms,) retreated for Kingston.

The next day, the 27th, the Americans advanced on the town, and the Canadians, seeing the capture of the place inevitable, blew up the powder magazine to prevent its falling into the hands of the enemy. Unexpectedly, the force of the explosion caused the stones and debris of the building to be discharged directly amongst the American soldiers drawn up in the square of the Fort, killing General Pike and over two hundred American soldiers. The terms of capitulation were signed the same day, by which, among other concessions, two hundred and ninety-three Canadian militia were surrendered prisoners of war.

In 1832 Mr. Chewett was permitted to retire on full pay, after a governmental service of over fifty-eight years. The remaining period of Mr. Chewett's life was passed in a quiet, uneventful manner. An

ardent lover of his country and a true British subject he always kept His or Her Majesty's birthday, and marked the occasion by loyal toasts at his dinner table; and we find recorded in his journal for 1838 (the Rebellion year): "November 19th.—This morning came Messrs. Walton and Capreol, under the resolutions adopted by the Common' Council, to visit all the male inhabitants of the city of Toronto who had not been enrolled for the defence of the city, dated 15th inst., when they were pleased to receive me as a volunteer for the Ward of St. George—my own patron saint!" Mr. Chewett was then within a month of completing his eighty-fifth year. After this there was still before him nearly eleven years—eleven years of healthful, pleasant life. No sickness, pain or trouble that too often renders the closing years of the aged, years of labour and sorrow. To the day of his death he was up and about, making notes of little trifles of interest to himself alone—one of which was winding his watch, which he daily did at noon. On the 24th September, 1849, appears in his own handwriting the last words he ever wrote, "Wound up." Four hours and a half afterwards he laid himself down on his bed, dressed as he was, and quietly fell asleep in death.

# LIST OF MEMBERS.

## ACTIVE MEMBERS.

| NAME.                                                  | OCCUPATION.                                                                                            | ADDRESS.               |
|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------------|
| Abrey, George Brockitt . . . . .                       | 17 Arcade,                                                                                             | Yonge Street, Toronto. |
| Aylsworth, Wm. Robert . . . . .                        | Engineer for Napanee, Tamworth & Quebec Railway, also Township of Tyendinaga.                          | Deseronto.             |
| Aylsworth, Charles Fraser, Jr. . . . .                 | Engineer for Tps. of Sydney, Thurlow, Rawdon, Huntingdon, Hungerford and Madoc, also Village of Madoc. | Madoc.                 |
| Baird, Alexander . . . . .                             | Engineer for Tps. Romney, Tilbury W., Colchester S., and Malden, also Town of Leamington.              | Box 195, Leamington.   |
| *Beatty, David . . . . .                               |                                                                                                        | Parry Sound.           |
| Berryman, Edgar, M. Can. Soc. C.E. . . . .             | Chief Engineer Quebec Central Railway.                                                                 | Sherbrooke, Que.       |
| *Blake, Frank Lever . . . . .                          | Astronomical Assistant at Observatory.                                                                 | Toronto.               |
| *Bolger, Thomas Oliver . . . . .                       | City Engineer.                                                                                         | Kingston.              |
| Bolger, Francis . . . . .                              |                                                                                                        | Penetanguishene.       |
| Bolton, Jesse Nunn . . . . .                           |                                                                                                        | Albion.                |
| *Bolton, Lewis . . . . .                               | Engineer for Townships of Elma, Grey, Morris, Town of Listowel and Village of Drayton.                 | Listowel.              |
| Booth, Charles Edward Stuart, A. M. Can. Soc. C.E.,    | 393 Division Street,                                                                                   | Kingston.              |
| *Bowman, Arthur Meyer, Grad. S.P.C., Toronto . . . . . |                                                                                                        | Berlin.                |
| Bowman, Clemens Dersteine . . . . .                    |                                                                                                        | West Montrose.         |
| *Bowman, Herbert Joseph, Grad. S.P. Sc. (Toronto);     | A.M. Can. Soc. C.E. . . . .                                                                            | Berlin.                |
|                                                        | Superintendent B. W. W.                                                                                |                        |
| *Bowman, Isaac Lucius . . . . .                        |                                                                                                        | Berlin.                |
| *Bray, Edgar . . . . .                                 |                                                                                                        | Oakville.              |
| Browne, Harry John . . . . .                           | 17 Toronto Street,                                                                                     | Toronto.               |

| NAME.                                                | OCCUPATION.                                                                       | ADDRESS.                          |
|------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------|
| Browne, Wm. Albert                                   |                                                                                   | 17 Toronto Street, Toronto.       |
| Burke, Wm. Robert                                    |                                                                                   | Ingersoll.                        |
| *Burt, Frederick Percy                               |                                                                                   | New York City.                    |
|                                                      | Chief Draughtsman "Engineering News."                                             |                                   |
| Campbell, Archibald Wm., A. M. Can. Soc. C.E.        |                                                                                   | St. Thomas.                       |
| Campbell, David Suter                                |                                                                                   | Box 153, Mitchell.                |
|                                                      | Engineer for five Townships.                                                      |                                   |
| Casgrain, Joseph Philip Baby, A. M. Can. Soc. C.E.   |                                                                                   | Morrisburgh.                      |
| Cavana, Allan George, D.L.S.                         |                                                                                   | Orillia.                          |
|                                                      | Engineer for Townships of Rama, Mara, Carden and Dalton; Land, Loan and Ins. Agt. |                                   |
| Cheesman, Thos.                                      |                                                                                   | Mitchell.                         |
| Chipman, Willis, B.A.Sc. (McGill); M. Am. Soc. C.E.; |                                                                                   |                                   |
| M. Can. Soc. C.E.                                    |                                                                                   | Brockville.                       |
|                                                      | Consulting Engineer and Engineer for Town of Brockville.                          |                                   |
| Coad, Richard                                        |                                                                                   | Glencoe.                          |
| Cozens, Joseph                                       |                                                                                   | Sault Ste. Marie.                 |
|                                                      | Mem. Am. Soc. M.E., Pres. Sault Ste. Marie & Hudson Bay Ry.                       |                                   |
| Davidson, Walter Stanley                             |                                                                                   | Petrolea.                         |
| *Davis, John                                         |                                                                                   | Guelph.                           |
|                                                      | Engineer Guelph Junction Railway.                                                 |                                   |
| Deans, William James                                 |                                                                                   | Oshawa.                           |
| De Morest Watson                                     |                                                                                   | 240 Lisgar St., Toronto.          |
| De Gursé, Joseph                                     |                                                                                   | Windsor.                          |
|                                                      | Chief Engineer, Lake Erie, Essex & Detroit River Railway.                         |                                   |
| Dickson, James                                       |                                                                                   | Fenelon Falls.                    |
|                                                      | Engineer for Tp. of Fenelon, Inspector Crown Lands Surveys.                       |                                   |
| Doupe, Joseph, C.E. (McGill)                         |                                                                                   | 7 Princess Street, Winnipeg, Man. |
| Ellis, Henry Disney                                  |                                                                                   | 76 St. Patrick Street, Toronto.   |
|                                                      | Assistant Engineer Ontario & Atlantic Div. C. P. Ry.                              |                                   |
| Esten, Henry Lionel                                  |                                                                                   | 32 Adelaide Street East, Toronto. |
| Evans, John Dunlop M. C. Soc. C.E.                   |                                                                                   | Trenton.                          |
|                                                      | Chief Engineer Central Ontario Railway, Engineer Canadian Copper Company.         |                                   |
| Fawcett, Thomas, D.T.S.                              |                                                                                   | Gravenhurst.                      |
|                                                      | Dominion Government Surveys                                                       |                                   |



| NAME.                                                                                    | OCCUPATION.                                                                                    | ADDRESS.                        |
|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------|
| Fitton, Charles Edward . . . . .                                                         | Engineer Wahnapatæ Mining Company, Land and Insurance Agent.                                   | Drawer 31, Orillia.             |
| Flater, Frederick William . . . . .                                                      |                                                                                                | Chatham.                        |
| Foster, Frederick Lucas . . . . .                                                        |                                                                                                | 176 Argyle Street, Toronto.     |
| Galbraith, John, M.A.; Assoc. M. Inst. C.E., D.T.S. . . . .                              | Professor of Civil Engineering, School of Practical Science.                                   | Toronto.                        |
| Galbraith, William . . . . .                                                             |                                                                                                | Bracebridge.                    |
| Gardiner, Edward . . . . .                                                               | Engineer County of Lincoln.                                                                    | St. Catharines.                 |
| Gaviller, Maurice, C.E. (McGill) . . . . .                                               |                                                                                                | Box. 32, Barrie.                |
| *Gibson, Peter Silas, B.Sc.; C.E.; M.Sc. (Univ. of Mich)..                               |                                                                                                | Willowdale.                     |
| *Hanning, Clement George, C.E. (Trinity College, Dublin, Ireland) . . . . .              |                                                                                                | 135 Bloor Street East, Toronto. |
| Henderson, E. E. . . . .                                                                 |                                                                                                | Henderson P. O., Maine.         |
| Johnston, R. T. . . . .                                                                  |                                                                                                | 131 Wellington St. W., Toronto. |
| Jones, Thomas Harry, B.A.Sc. (McGill) . . . . .                                          | City Engineer.                                                                                 | Brantford.                      |
| Keefer, Thos. Coltrin, C.M.G.; M. Inst. C.E.; Pres. A. Soc. C.E.; Can. Soc. C.E. . . . . |                                                                                                | Ottawa.                         |
| Kirk, Joseph . . . . .                                                                   | Engineer for Townships of Mornington, South Easthope, North Easthope and Village of Melverton. | Box 373, Stratford.             |
| Kirkpatrick, George Brownly . . . . .                                                    | Chief Clerk Survey Branch, Department of Crown Lands.                                          | 8 Coolmine Road, Toronto.       |
| Klotz, Otto Julius, D.T.S.; C.E. (University of Michigan)..                              | Astronomer for Department of Interior.                                                         | Preston.                        |
| Laird, Robert, Grad. S. P. C., Toronto..                                                 |                                                                                                | 771 King St. W., Toronto.       |
| *Lendrum, Robert Watt . . . . .                                                          |                                                                                                | Vankleek Hill.                  |
| Low, Nathaniel E. . . . .                                                                |                                                                                                | Wiarton.                        |
| *Lumsden, Hugh David, M. Inst. C.E.; M. Can. Soc. C.E. . . . .                           | Engineer for Atlantic & North-West and International Railways.                                 | Sherbrooke, Q.                  |
| McAree, John, Grad. S.P.S.; D.T.S. . . . .                                               |                                                                                                | 113 Winchester St., Toronto.    |

| NAME.                                                          | OCCUPATION.                                                                           | ADDRESS.                          |
|----------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------|
| McCulloch, Andrew Lake,                                        | Grad. S. P. Sc.,                                                                      | Toronto . . . . . Galt.           |
|                                                                | Engineer for Town of Galt, Townships of Beverly and North Dumtries.                   |                                   |
| McEvoy, Henry Robinson . . . . .                               |                                                                                       | St. Mary's.                       |
|                                                                | Tourists' Guide, North Bay.                                                           |                                   |
| *McGeorge, Wm. Graham . . . . .                                |                                                                                       | Chatham.                          |
|                                                                | Engineer County of Kent.                                                              |                                   |
| McGrandle, Hugh . . . . .                                      |                                                                                       | Huntsville.                       |
| McKay, Owen . . . . .                                          |                                                                                       | Windsor.                          |
|                                                                | Assistant Engineer L. E. E. & D. R. Ry.                                               |                                   |
| *McKenna, John Joseph . . . . .                                |                                                                                       | Dublin.                           |
| McNabb, John Chisholm . . . . .                                |                                                                                       | Chatham.                          |
|                                                                | Engineer for Erie & Huron Ry. and Town of Chatham.                                    |                                   |
| *McPhillips, George . . . . .                                  |                                                                                       | Windsor.                          |
| *Manigault, Wm. Mazyck . . . . .                               |                                                                                       | Strathroy.                        |
|                                                                | Engineer for Townships of Caradoc, East Williams, Adelaide and Town of Strathroy.     |                                   |
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| Soc. C. E. . . . .                                             |                                                                                       | Pembroke.                         |
|                                                                | Engineer County of Renfrew.                                                           |                                   |
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| Murphy, Chas. Joseph . . . . .                                 |                                                                                       | 32 Adelaide Street East, Toronto. |
| Niven, Alexander . . . . .                                     |                                                                                       | Haliburton.                       |
|                                                                | Outline Surveys, Crown Lands Department.                                              |                                   |
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| Ross, George, B.A. Sc. (McGill) . . . . .              | Engineer for Town of Welland and six Townships.                                   | Welland.                              |
| Russell, Alexander Lord . . . . .                      | Mining Engineer.                                                                  | Box 240, Port Arthur.                 |
| Sankey, Villiers . . . . .                             | City Surveyor.                                                                    | City Hall, Toronto.                   |
| Saunders, Bryce Johnston, B.A.Sc. (McGill) . . . . .   | Engineer for Counties Leeds and Grenville, Townships Augusta and Elizabethtown.   | Box 114, Brockville.                  |
| Sanderson, Daniel Leavens . . . . .                    |                                                                                   | Enniskillen.                          |
| Scane, Thomas. . . . .                                 | Engineer for Townships of Orford and Done, and Town of Ridgetown.                 | Ridgetown.                            |
| *Selby, Henry Walter . . . . .                         | Engineer for Townships of Nottawasaga, Sunnidale and Floss.                       | Stayner.                              |
| *Sewell, Henry DeQuincy, Assoc. M. Inst. C.E. . . . .  |                                                                                   | Port Arthur.                          |
| Sherman, Ruyter . . . . .                              | Assistant City Engineer.                                                          | Brantford.                            |
| Speight, Thomas Bailey . . . . .                       |                                                                                   | Arcade, Yonge Street, Toronto.        |
| Stewart, Elihu . . . . .                               |                                                                                   | Collingwood.                          |
| Stewart, Louis Beaufort . . . . .                      | Lecturer on Surveying.                                                            | School of Practical Science, Toronto. |
| Tiernan, Joseph M. . . . .                             | Engineer for three Townships.                                                     | Tilbury Centre.                       |
| *Traynor, Isaac . . . . .                              | Engineer for Townships of Egremont, Proton, Melancthon and Osprey.                | Dundalk.                              |
| Tyrrell, James Williams, C.E. (Toronto) . . . . .      | Engineer for Townships of Ancaster and Flamboro' West, and Village of Burlington. | 42 James St. N., Hamilton.            |
| Unwin, Charles . . . . .                               |                                                                                   | 17 Toronto Street, Toronto.           |
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| *Vicars, John . . . . .                                | Engineer for Township of Brock and Village of Cannington.                         | Cannington.                           |

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| Warren, James, Mem. Can. Soc. C.E. ....                      |                                                                                        | Kincardine.        |
|                                                              | Engineer for the Townships of Greenock, Ashfield and Culross, and Lucknow Water Works. |                    |
| Weatherald, Thomas .....                                     |                                                                                        | Box 116, Goderich. |
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| Wheelock, Chas. Richard .....                                |                                                                                        | Orangeville.       |
|                                                              | Engineer for Counties of Wellington, Dufferin and Peel.                                |                    |
| Whitson, James Francis .....                                 |                                                                                        | North Bay.         |
|                                                              | Engineer for six Townships.                                                            |                    |
| *Wicksteed, Henry King, B.A.Sc. (McGill), M. C. Soc. C. E. . |                                                                                        | Ottawa.            |
|                                                              | Chief Engineer Brantford, Waterloo & Lake Erie Railway.                                |                    |
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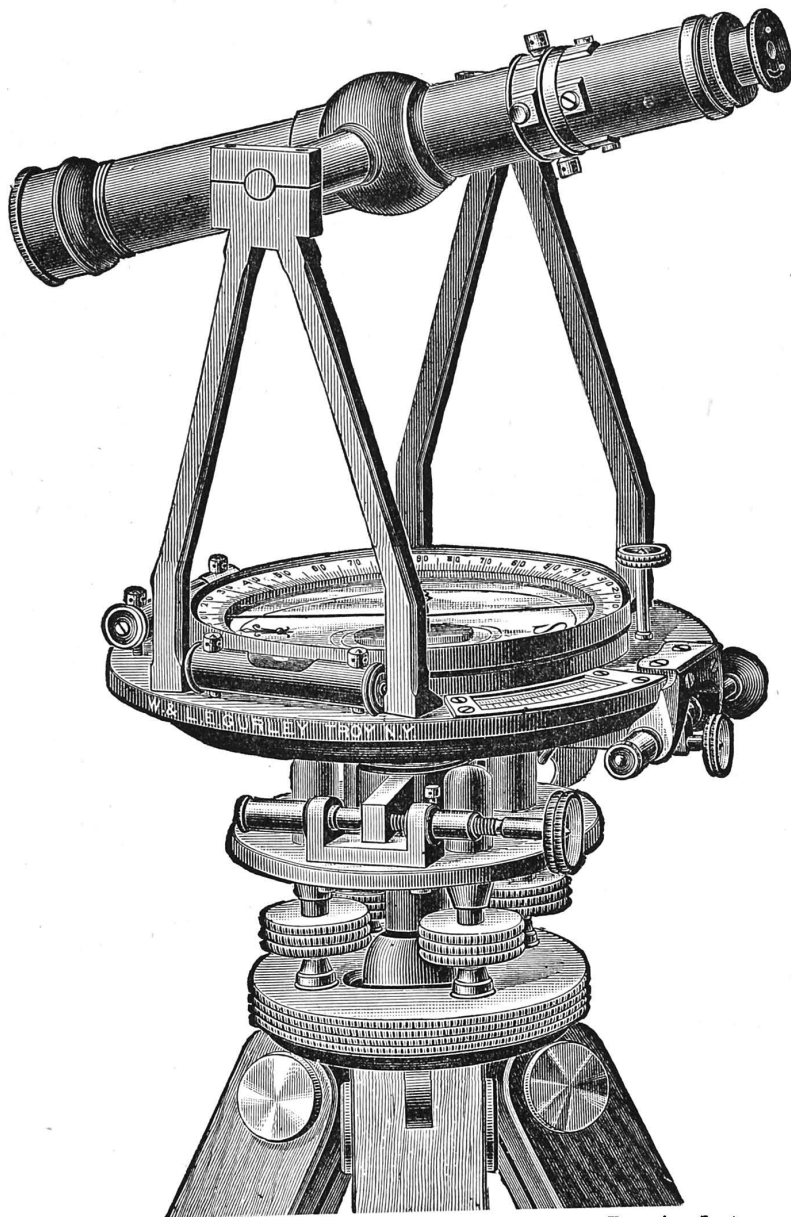
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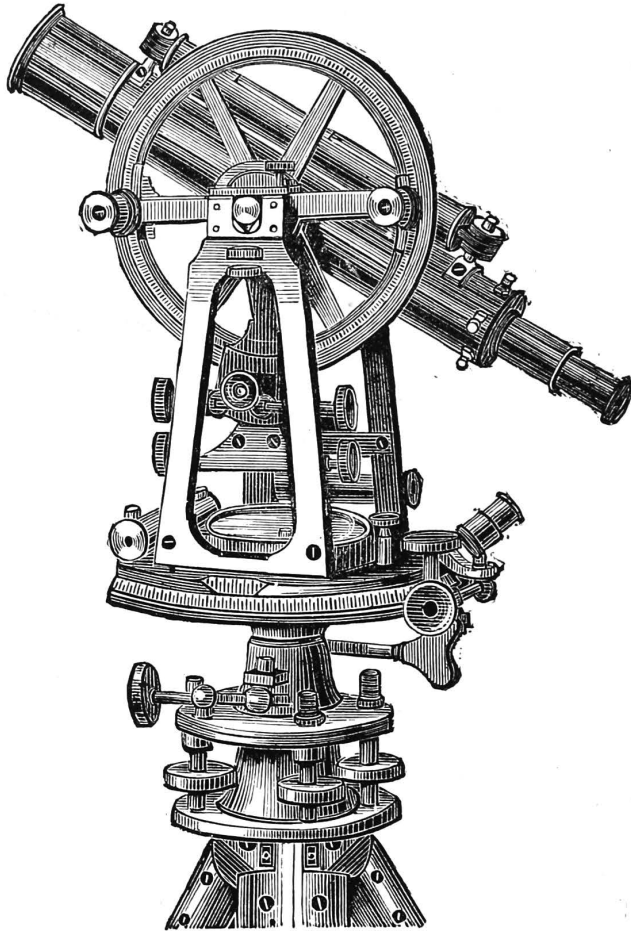
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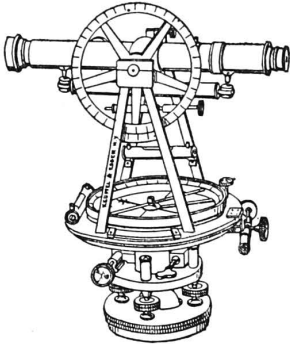
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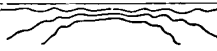
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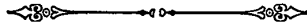
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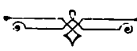
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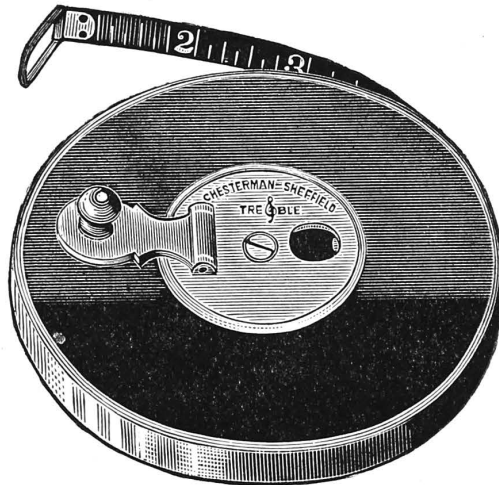
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