AFFILIATED WITH THE ASSOCIATION OF PROVINCIAL LAND SURVEYORS FOR ONTARIO.

REPORT OF PROCEEDINGS

OF THE

ASSOCIATION OF DOMINION LAND SURVEYORS

AT ITS

EIGHTH ANNUAL MEETING

HELD AT

OTTAWA, FEBRUARY 17 AND 18, 1891.

PRICE FIFTY CENTS.

Ottawa:
PRINTED FOR THE ASSOCIATION BY A. S. WOODBURN.
1891.

To Dominion Land Surveyors.

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

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

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

"The Welfare of the Profession."

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

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

Index.

List of Advertisements.

ASSOCIATION OF DOMINION LAND SURVEYORS

Organized April 24th, 1882.

OFFICERS FOR 1891.

HONORARY PRESIDENT.

THE SURVEYOR GENERAL ....OTTAWA, ONT.

PRESIDENT.

J. S. DENNIS, D.T.S.......................................OTTAWA, ONT.

VICE-PRESIDENT.

J. McLATCHIE, D.L.S.......................................OTTAWA, ONT.

SECRETARY-TREASURER.

J. I. DUFRESNE, D.T.S.......................................OTTAWA, ONT.

EXECUTIVE COMMITTEE.

W. OGILVIE, D.L.S.......................................OTTAWA, ONT.

OTTO J. KLOTZ, D.T.S.......................................PRESTON, ONT.

W. S. DREWERY, D.L.S.......................................OTTAWA, ONT.

AUDITORS.

J. J. McARTHUR, D.L.S.......................................OTTAWA, ONT.

J. A. BELLEAU, D.L.S.......................................OTTAWA, ONT.

The Ninth Annual Meeting will be held at Ottawa, the Third Tuesday in February, 1892.

STANDING COMMITTEES

FOR 1891.

GEODETIC AND TOPOGRAPHICAL SURVEYING.

W. S. DREWERY *(Chairman)*, A. O. WHEELER, J. I. DUFRESNE.

LAND SURVEYING.

JOHN McLATCHIE *(Chairman)*, D. C. MORENCY, J. A. KIRK.

PERMANENT MARKING OF SURVEYS.

H. IRWIN *(Chairman)*, H. G. DIXON, J. A. U. BAUDRY.

NATURAL HISTORY.

PROF. JOHN MACOUN *(Chairman)*, W. OGILVIE, THOS. FAWCETT.

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

CONSTITUTION AND BY-LAWS.

Constitution.

ARTICLE I.

Name of the Association.

"The Association of Dominion Land Surveyors."

ARTICLE II.

Objects of the Association.

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

2. "The Association may at any time become affiliated with any other Association of Land Surveyors in Canada, provided that the scheme or arrangement under which such affiliation is to be effected is first submitted at an Annual Meeting of the Association and adopted by a majority of the members then present; and provided further, that such affiliation shall not interfere with the autonomy of the Association except in regard to the substitution, during certain years, of a joint meeting of the affiliated Associations for the Annual Meeting for that year."

ARTICLE III.

Members.

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

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

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

4. Honorary Members must be nominated by two Active Members, and the nomination approved of by a unanimous vote of the Executive Committee. The nomination with approval must be in the hands of the Secretary-Treasurer at least one month before the Annual Meeting. Persons nominated for Honorary Membership shall submit a paper to be read at the Annual Meeting. They shall be elected by ballot in the manner hereinafter provided for the election of officers of the Association. The number of Honorary Members shall not at any time exceed twenty, and they shall be exempt from payment of dues.

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

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

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

6. Associate Members shall not vote.

ARTICLE IV.

Officers.

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

2. The Officers of the Association shall consist of an Honorary President, a President, Vice-President, Secretary-Treasurer, and an Ex-

ecutive Committee, all of whom, except the Honorary President, shall be declared elected at the Annual General Meeting by letter ballot.

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

4. Nominations for Officers of the Association shall be made to the Secretary-Treasurer in writing by two Active Members, at least two months before the Annual General Meeting. The Secretary-Treasurer shall prepare and forward ballot papers to the members of the Association, who shall return them marked in sealed envelopes to the Secretary-Treasurer before the date of the Annual General Meeting.

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

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

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

ARTICLE V.

Meetings.

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

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

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

4. If the Association becomes affiliated with any other Association of Land Surveyors, the joint meeting of such affiliated Associations, held at such time and place as may be agreed upon under the scheme of affiliation, shall take the place of the Annual Meeting of the Association for the year in which such joint meeting is held, and the business of the Association proper to be done at the Annual Meeting for that year, shall be done during such joint meeting, at such time, and in such manner, as may be arranged by the Executive Committee."

ARTICLE VI.

Amendments.

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

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

ARTICLE VII.

Executive Committee.

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

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

3. Whenever the Executive Committee receive information that any Dominion Land Surveyor has signed and certified plans and field-notes of any survey which has not been performed by him in his own

proper person or under his direct supervision and instructions, or has been guilty of any other corrupt practice, they shall forthwith lay the necessary complaint before the Board of Examiners for Dominion Land Surveyors, so that such surveyor may be summoned to appear before the Board to show cause why he should not be suspended or dismissed from the practise of his profession for corrupt practises, in the manner provided by Clause 120 of the Dominion Lands Act.

ARTICLE VIII.

Auditors.

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

ARTICLE IX.

Subscriptions.

1. On and after the 1st of January, 1892, the fees for Active Membership shall be Three Dollars yearly, payable in advance, and there shall be no additional entrance fee for membership.

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

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

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

By-Laws.

ORDER OF BUSINESS.

1.

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

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

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

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

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

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

7. Every member while speaking shall address the Chair.

DUTIES OF OFFICERS.

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

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

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

Programme.

TUESDAY, FEB. 17th, 9.30 A.M.

Meeting of Executive, Standing and Entertainment Committees

Reading of Minutes of Previous Meeting.

Reading of Correspondence.

Report of Secretary-Treasurer.

Report of Auditors.

Appointment of Scrutineers of Ballots.

TUESDAY, 2 P.M.

Reports of Standing Committees on "Geodetic and Topographical Surveying" and "Land Surveying."

Matters submitted to the Association.

PAPER—"The Marking of Surveys in Cities and Towns.

H. G. DICKSON, D.L.S., Brandon, Man.

PAPER—"The Noble Red Man."

T. W. CHALMERS, D.L.S., Adolphustown, Ont.

PAPER—"The Contractor."

JOHN MCAREE, D.T.S., Toronto, Ont.

PAPER—"Survey of Railway Lines."

SAMUEL BRAY, D.L.S., Ottawa, Ont.

LECTURE—"Short Series on Survey Instruments by Members of the Association."

TUESDAY, 7.30 P.M.

President's Address.

LECTURE—"Some remarks regarding the future for Dominion Land Surveyors.

J. S. DENNIS, D.T.S., Ottawa, Ont.

PAPER—"The Gnomonic Projection."

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

PAPER—"Prime Vertical Observations for Latitude."

OTTO J. KLOTZ, D T.S., Preston, Ont.

REMARKS—"The Relation of Mountain Forms to Geological Structure."

GEO. M. DAWSON, F.G.S., F.R.S.C.,
Asst. Director Geological and Natural
History Survey of Canada.

PAPER—"Field Observations for Azimuth."

W. F. KING, D.T.S.,
Astronomer Dept. Interior, Ottawa.

REMARKS—"The system adopted by the Canadian Pacific Railway in the classification of North-West Lands."

L. A. HAMILTON, D.L.S.,
Land Comm'r, C.P.R.

PAPER—"The Solar Attachment to the Transit."

J. I. DUFRESNE, D.T.S., Ottawa, Ont.

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

Reports of Standing Committees on "Permanent Marking of Surveys" and "Natural History."

Unfinished Business.

Report of Scrutineers of Ballots.

New Business.

PAPER—"Notes on Mining Concentration and Reduction of Low Grade Ores and the advantages of Water Power and Electric Transmission in connection with the same."

JAMES BRADY, D.L.S., M.E.,
Victoria, B.C.

PAPER—"The Mining Prospects and Industries of West Algoma."
H. De Q. SEWELL, D.L.S., Port Arthur, Ont.

WEDNESDAY, 1.30 P.M.

Meeting of Standing Committee for 1891.

PAPER—"Tides, Waves, Surfs, Currents and Winds in connection with Works at Sea."
J. E. SIROIS, P.L.S.,
Ste. Anne de la Pocatiere, Que.

PAPER—"Subdivision Work."
JOHN VICARS, D.L.S.,
Cannington, Ont.

PAPER—"Right of Way Surveys for Railways."
HENRY IRWIN, D.L.S.,
Montreal, Que.

PAPER—"Photography in Colours, a problem not yet solved."
H. N. TOPLEY,
Photographer, Dept. Int.

LECTURES—Short Series on Survey Instruments by Members of the Association.

ADJOURNMENT.

Full Discussion after each paper open to all.

Exhibit of Survey Instruments.

WEDNESDAY EVENING—Annual Dinner and Smoking Concert.

Minutes.

TUESDAY, February 17th, 1891.

Morning Session.

The Annual General Meeting was held in Committee Room No. 16, House of Commons.

The President, WM. OGILVIE, took the Chair at 10 a.m. and declared the meeting open.

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

The President resumed the Chair at 11 a.m., and the minutes of the last Annual Meeting were read and, on motion, adopted.

The Secretary-Treasurer then read the following correspondence :—

Announcement of the awarding by the University of Pennsylvania of the prizes for the best paper on "Road Making and Maintenance," from which it was learned that the first prize of $400.00 had been awarded to Henry Irwin, B.S., C.E., Assistant Engineer Canadian Pacific Railway, Montreal, a member of this Association.

The Secretary-Treasurer stated that at a meeting of the Executive Committee of the Association held on the 24th of November last, the following resolution had been passed :

"Resolved, That the Executive Committee having received notice of the award "of prizes offered by the University of Pennsylvania for the best paper on road "making and maintenance, are very pleased to note that the first prize of $400.00 "has been gained by Mr. Henry Irwin, D.L.S., C.E., Asst. Engineer Canadian "Pacific Railway, Montreal, one of the members of our Association; and when it "is remembered that the contest was open to Engineers and Surveyors all over the "United States and Canada, Mr. Irwin is entitled to the sincere congratulations of "all our members, and this Committee desire to extend their sincere congratulations "upon his success. It is also resolved that a copy of this resolution be sent by the "Secretary-Treasurer to Mr. Irwin, and be published in the Annual Report for "1891."

Letter from the Rev. A. Antoine, O.M.I., D.D. of the Ottawa University, acknowledging receipt of the Annual Report of the Association and stating that a two-years course, similar to that which in other Universities in the Dominion leads to the degree of C.E., had been established in the University, and that the suggestions of practical Engineers and Surveyors would be valuable in the realization of such an object.

Reply of the Secretary-Treasurer that the Executive Committee were preparing a few notes, embracing their views as to the form such a course should take, and would submit the same if the University considered them of sufficient worth.

Reply by the Rev. A. Antoine that he would be very glad to receive these suggestions, and that as they came from the best practical authority they would receive their most serious consideration.

Letter from Dr. A. R. C. Selwyn, C.M.G., Director of the Geological Survey, enclosing a copy of an Order-in-Council authorizing the issue each year to the Association of the thirty copies of the Annual Report of the Geological Survey.

The President referred to the courtesy with which Dr. Selwyn had received the deputation who waited upon him in this matter, and his desire to oblige them; the above mentioned Order-in-Council being the result.

It was moved by W. S. DREWRY, seconded by J. J. MCARTHUR, and *Resolved* :—

"That a cordial vote of thanks be tendered Dr. Selwyn for the prompt and cordial manner in which he has met the views of this Association in regard to the yearly issue of the Geological and Natural History Reports, and that a copy of this resolution be sent to Dr. Selwyn."

Letter from J. A. Kirk, D.L.S., of New Westminster, B.C., drawing attention to the fact that it was generally understood in British Columbia that the Department allowed the use of the magnetic needle in making timber limit surveys, although the Manual of Surveys required all surveys to be astronomical. He thought that either the Manual should be amended so as to make compass surveys legal, or that an astronomical survey should be insisted upon.

Letter from the Executive Committee to the Surveyor-General asking that the instructions now issued for timber limit surveys be so amended as to preclude the use of the magnetic needle, and that the instructions be made to accord with the general instructions for the survey of Dominion Lands as set forth in the Manual of Surveys, also that the form of affidavit to be attached to the field notes of timber limit surveys be defined.

Letter from R. J. Jephson, D.L.S., of Calgary, drawing the attention of the Association to the fact that surveys were being performed in that town by the Town Engineer, who is not a Dominion Land Surveyor, and asking that the Association take action to prevent the carrying on of survey work by unqualified persons.

Mr. W. S. DREWRY thought that any person could lay out lots, and that the Association could not prevent them. The Registration Act was full protection.

The Secretary-Treasurer read his report.

Moved by W. S. DREWRY, seconded by THOS. FAWCETT and *Resolved:—*

That the Secretary-Treasurer's report be received and, subject to the Auditor's report, be adopted.

The Auditors presented their report.

Moved by THOS. FAWCETT, seconded by F. X. T. BERLINQUET, and *Resolved:—*

That the report of the Auditors be received and adopted.

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

That L. A. Dufresne, F. X. T. Berlinquet and T. D. Green, be appointed scrutineers of ballots for the election of officers for 1891, and that the ballots be not handed over to the scrutineers until the morning of Wednesday, the 18th inst., at 9.30 a.m., so that members coming until that time may have a chance to vote.

Afternoon Session.

The meeting opened at 2.30 p.m., the President in the Chair.

The report of the Committee on Geodetic and Topographical Surveying was, in the absence of its chairman, read by Mr. W. S. Drewry.

Moved by W. S. DREWRY, seconded by THOS. FAWCETT, and *Resolved:—*

That the report be received and adopted.

The Secretary-Treasurer brought up the question of the sub-Executive Committees, and stated that the following gentlemen had been appointed to act on these Committees during the past year and had accepted their appointments :—

For Manitoba—

J. W. HARRIS and WM. OGILVIE.

For the North-West Territories—

R. C. LAURIE and R. J. JEPHSON.

For British Columbia—

T. S. GORE and A. O. WHEELER.

The Secretary-Treasurer asked the Association to instruct the incoming Executive Committee to confirm these appointments for the present year.

Moved by J. S. DENNIS, seconded by THOS. FAWCETT, and *Resolved :—*

That the Association endorse the action of the Executive Committee in appointing sub-committees in Manitoba, the North-West Territories and British Columbia, and the incoming Executive Committee are hereby instructed to continue these committees, and to ask the gentlemen who have acted during the past year to continue to act for another year.

A PAPER, "The Marking of Surveys in Cities and Towns," by H. G. Dickson, D.L.S., was read by J. S. Dennis.

Moved by F. X. T. BERLINQUET, seconded by J. S. DENNIS, and *Resolved :—*

That Mr. Dickson's paper on "The Marking of Surveys in Cities and Towns" be referred to the Committee on Permanent Marking of Surveys for report.

Several anecdotes relating to the North-West Indians, contributed by Inspector Chalmers, N. W. M. Police, D. L. S., were read by the Secretary-Treasurer.

A PAPER, "The Contractor," by Jno. McAree, D.T.S., was, in his absence, read by the Secretary-Treasurer.

A PAPER, "Survey of Railway Lines," was read by S. Bray, D.L.S.

A short lecture was given by J. S. Dennis, D.L.S., on the Theodolite, Alt-Azimuth and measuring chains, and was illustrated by reference to these different instruments.

A short lecture was given by Wm. Ogilvie, D.L.S., on the Prismatic Transit, Distance Measuring Micrometers, and Chronometers. The lecture was illustrated by these instruments and by diagrams on the blackboard.

The afternoon session was concluded by a short lecture by W. S. Drewry, D.L.S., on the "Triangulation Transit," a new instrument in the annals of Canadian Surveys, and now being used on the Triangulation survey of the Rocky Mountains. The instrument was exhibited and attracted considerable attention.

Evening Session.

The meeting opened at 7.45 p.m., the President in the Chair.

The PRESIDENT read his Annual Address.

PRESIDENT'S ADDRESS.

TO THE MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

It is gratifying to me to welcome you to the Eighth Annual Meeting of our Association.

As you will no doubt have noticed our programme is a very lengthy one, and cannot fail from the nature of the subjects treated to be of great interest, professionally and otherwise.

One cause for regret is the absence of some of the writers from the meeting. No matter how explicit and detailed a paper may be, there is always some idea upon which some member would like more information; or it may be see farther (so to speak) than the writer did at the time of writing, and with his aid make the paper much more comprehensive and valuable.

Before beginning a review of the proceedings of the Executive Committee, since our last meeting, I will briefly refer to the proposed amendments to the Constitution, as set forth in the circular issued in compliance with Article VI. of the Constitution, of which you all have no doubt received a copy.

I. The proposed amendments by Mr. J. S. Dennis to Article II., sub-clause 2, and Article V. sub-clause 4, to enable our Association to become affiliated with any other Association of Land Surveyors.

I think this scheme if carried out will add greatly to our influence as a body by widening the sphere of our communication with our professional brethren in the Provinces. At present we are only warranted in assuming that the scheme will be carried out with Ontario; Quebec and Manitoba (for the present at least) do not see their way to the accomplishment of the scheme, but if successfully carried out and harmoniously and beneficially worked with Ontario, we will be in better condition to again negotiate with the other Provinces. In my opinion one of the ultimate advantages to be derived from the scheme is the consolidation of all the Provincial Surveyors into a grand whole, so that the term "Land Surveyor" will be valid from the Atlantic to the Pacific.

This, I think, is a very desirable end to aim at, and certainly a harmonious scheme of affiliation will materially aid in its consummation.

Mr. Dennis has worked up the details of the proposed affiliation with the Province of Ontario with much care, and the Executive Committee have thoroughly considered them, and submit them with its unanimous endorsation for your consideration. A delegation has been appointed to attend the Annual Meeting of the Ontario Association to be held soon after the Federal Elections, and discuss and arrange with that association the conditions of the proposed affiliation, offering as the basis of arrangement the rules and regulations as drawn up by Mr. Dennis, provided always that those articles are approved by you.

The names of the delegates so appointed, and the conditions under which they undertake the task will, I think, meet with your approval.

II. I regret exceedingly that the conduct of any member of the profession should justify any one in seeking to have Article VII. of the Constitution extended by the proposed Sub-clause 3.

It appears strange that after all the trouble and expense we have to go to fit ourselves for the exercise of our professional duties in a proper manner, and the bonds and penalties we are under for the violation thereof, that any one should so far forget himself as to certify to work done by parties who have no legal right to practise. Such conduct degrades the protession in the eyes of the public, lowers the value and importance of its services, and deprives some professional brother of his just dues, for a paltry fee, of may be a tithe of the value of the work professionally. It appears to me that such conduct could be proceeded against as a fraud, for such it practically is, as it purports to legalise what is not legal, and stamps as correct and accurate work that may be far from being so. It would not exculpate the surveyor or the profession generally, were a survey so performed and certified to, found to be wrong, to state that it was not a surveyor who performed the field work, in fact it would aggravate the offence, as a fraud is not excusable while a mistake may be.

To protect the profession generally against this and other corrupt practices, you are asked to consider and adopt this amendment, and show thereby our loyalty to the object of our Association—"The promotion of the general interests and elevation of the standard of the profession."

III. The proposed amendment of Article IX. of the Constitution increasing the annual fee of membership from two to three dollars, is unavoidable. Our Annual Report is now so extensive, and such a large number of copies have to be struck off to meet the demand of our exchanges, that our expenses from being a merely nominal sum, as in the first few years of our existence, have grown to be quite large.

MEETINGS.

Since our last Annual Meeting nine meetings of the Executive Committee have been held.

STANDARD MEASURES.

The Association and profession generally will be pleased to learn, that a standard measure testing apparatus has been set up in the city, specially for the purpose of testing our standard sixty-six feet tapes.

So far no complete tests have been made, but it is understood operations will be resumed at an early date, and a complete and final test made of a large number of tapes. It is a source of regret to the profession generally, that the control of this test is outside of the survey service. It appears rather circumlocutory, when we want a standard tape tested and stamped, to have to notify the Department of Inland Revenue to that effect, and they in turn notify some one to make the test for them.

With all due deference to the Department of Inland Revenue, I maintain that this could be just as well done by men in our own profession attached to the public service, who are more practically conversant with the needs of such tests, than any other man who has not that practical knowledge ; even admitting (which we do not) that their theoretical knowledge is greater.

I think this Association should strengthen the hands of its Executive Committee by urging upon the Government the necessity of having the control of those tests placed under the direction of the Surveyor-General.

GEOGRAPHICAL NOMENCLATURE.

This question has finally been disposed of by the appointment of an officer, whose duty is to compile a Geographical Dictionary. Let us hope that when hi labors are completed, he will have deepened all the Shoal Lakes but one, deodorized Stinking Lake, cleaned out Cow Dung Lake, located the Beaver Hills, and ejected all the uncanonized Saints.

RAILWAY RIGHT OF WAY SURVEYS.

The President, in his address last Annual Meeting, briefly referred to this question, but unfortunately had to tell you that we had been unable to obtain our legal rights. Since then such representations have been made in the proper quarters, as have caused the issue of a circular from the Department of the Interior, setting forth the fact that the Department will accept no plan or notes of survey unless certified by a duly authorized surveyor, which practically gives us what we have claimed.

TRIGONOMETRICAL SURVEY OF THE DOMINION.

There is nothing further to say on the question than was said last meeting.

GEOLOGICAL AND NATURAL HISTORY REPORTS.

The Committee communicated with Dr. Selwyn, Director of the Geological and Natural History Survey, with a view to getting a copy of the reports of that service for each of our members. That gentleman expressed his willingness to do all in his power to meet our views, but was not in a position to promise us a copy each, as their issue would hardly permit that; but he undertook subject to the approval of the Hon. the Minister of the Interior, to furnish us with thirty copies of each issue, including copies of the Botanical Catalogues and Natural History Reports. The Committee beg to express their thanks to Dr. Selwyn for his agreeable promptness in meeting their views.

Since writing the above, a letter has been received from Dr. Selwyn, informing the Committee that his efforts on our behalf have been successful, and that the Hon. the Minister of the Interior had procured the passage of an Order-in-Council appropriating for the Association thirty copies of the Geological Reports, as well as the Natural History and Botanical Reports, beginning with the issue of the past season, and continuing as they are from time to time issued. A copy of the Order-in-Council accompanied the doctor's letter.

SUB-EXECUTIVE COMMITTEES.

A new feature was introduced into our organization by the Executive Committee since our last Annual Meeting, in the appointment of Sub-Executive Committees in the North-West Territories, and Provinces of Manitoba and British Columbia. The duty of those Sub-Committees is to guard the interests of the profession, by reporting to the Executive any infringement of our professional rights by outsiders, or any breach of the law by members of the profession. Let us hope their labors will be light.

TIMBER BERTH SURVEYS.

It having come to the knowledge of your Committee, that some surveyors in the Province of British Columbia interpreted the instructions for such surveys rather loosely, and thought they were justified in using the magnetic needle in the production of the boundaries of such timber berths; to the injury of those surveyors who are more conscientious, and the discredit of the profession generally; they have with a view to the prevention of such work in the future, sent a letter to the Surveyor-General, calling his attention to the fact, and respectfully submitting such amendments to the instructions to surveyors of timber berths, as will in future, if adopted, prevent the further use of the magnetic needle in any essential part of such surveys.

You all, no doubt, recollect the offer made last year in a circular from a committee of the University of Philadelphia of three prizes of $400, $200 and $100 for three papers on "Road Making and Maintenance," and inviting the members of the Association to compete. One of our members, Mr. Irwin, entered the lists, and carried off the first prize. The Executive Committee have sent Mr. Irwin a congratulatory letter on his success, and I am sure their action will be heartily approved by you.

The Association has just cause to be proud of having upon its roll of membership a gentleman who carried away this prize in the face of all America, and I am sure we all individually, as well as collectively, extend our hearty congratulations to Mr. Irwin.

It is desirable to remind the members of the importance of striving individually all they reasonably can, to increase our membership, and add to our importance and influence as a body. I am sure the market value of our Annual Report and our exchange reports is quite equal to the annual fee, even increased as it is proposed to be; not to mention the good the Association has already accomplished by advocating and guarding our rights.

If each member would undertake to canvass only one Dominion Land Surveyor outside our Association every year, by showing to him the value of our services to the profession, and allowing him the perusal of annual reports and exchanges, I think the result would be a material yearly increase of our membership.

One matter the Committee regrets exceedingly to allude to, is the prospective loss of our Secretary-Treasurer. Mr. Wheeler feels that his worldly interests can be better advanced in another part of our country, and contemplates leaving the service of the Department of the Interior. Owing to the contemplated change his name has not been submitted on the ballot paper for re-election.

The members of the Committee feel, and I am sure the members of the Association are in accord with them, that they are losing a first-class officer, whose zeal and painstaking are equal to his ability, which leaves nothing to be desired.

I feel we will all heartily join in wishing him every success, and himself and Mrs. Wheeler every happiness in his new sphere.

As it is absolutely necessary that the Secretary-Treasurer should be permanently located at Ottawa, the choice of candidates for the office is necessarily limited, but I think we have found in Mr. J. I. Dufresne a gentleman who will discharge the duties of the office with credit to himself and the Association.

PROVINCIAL LAND SURVEYORS ASSOCIATION.

Another Association of Surveyors has come into existence since our last meeting. The surveyors of British Colnmbia have realized that "Unity is Strength," and have formed themselves into an association. Bravo say we, and may they never have cause to regret the step.

The Annual Dinner of the Association last meeting proved so successful, that to forego it this year would be almost a crime. Your Committee have therefore gone to considerable trouble to insure at least as much success as last year; we hope you will manifest your appreciation of our efforts by attending the dinner, and enjoying yourself to the utmost of your power, which we know you will if you will only attend.

Thanking you, gentlemen, for the honor conferred on me by electing me your President, and the attention you have given the perusal of this address, I respectfully submit it for your approval.

WILLIAM OGILVIE.

On the conclusion of the address, J. S. DENNIS brought forward the matter of affiliation referred to therein, and spoke of the proposed amendment to the constitution in order to supply the necessary authority to effect the desired affiliation with the Provincial Land Surveyors' Association of Ontario. He read the proposed set of "Rules and Regulations" to govern the affiliated Associations, which had been approved by the Executive Committe and a copy of which had been sent to the Ontario Association.

Moved by J. S. DENNIS, seconded by THOS. FAWCETT, and *Resolved* :—

That the rules and regulations submitteed by Mr. Dennis as a basis for affiliation with the Association of Provincial Land Surveyors of Ontario, and which have been recommended by the Executive Committee, be adopted.

Moved by O. J. KLOTZ, seconded by A. O. WHEELER, and *Resolved* :

That the Presidents Address be received and adopted.

Moved by J. I. DUFRESNE, seconded by F. X. T. BERLINQUET, and *Resolved* :—

That a copy of the "Rules and Regulations" adopted as a basis for affiliation, be transmitted to the President of the Association of Provincial Land Surveyors for Quebec.

Moved by J. S. DENNIS, seconded by A. O. WHEELER, and *Resolved* :—

That the delegates appointed by the Executive Committee, to represent this Association in the consideration of the question of affiliation at the meeting of the Association of Provincial Land Surveyors at Toronto, are approved by this meeting.

Moved A. O. WHEELER, seconded by J. S. DENNIS, and *Resolved* :—

That artile IX. of the constitution be amended by expunging sub-clause I. and substituting the following therefor:

1. "On and after the 1st of January 1892 the fee for Active Membership shall be three dollars yearly, payable in advance, and there shall be no additional fee for membership."

Moved by J. S. DENNIS, seconded by A. O. WHEELER, and *Resolved* :—

That articles II., V. and VII. of the constitution be amended by adding the following sub-clauses :

"The Association may at any time become affiliated with any other Association of Land Surveyors in Canada, provided that the scheme or arrangement under which such affiliation is to be effected is first submitted at an Annual Meeting of Association and adopted by a majority of the members then present; and provided further, that such affiliation shall not interfere with the autonomy of the Association except in regard to the substitution, during certain years, of a joint meeting of the affiliated associations for the Annual Meeting for that year.

Article V, sub-clause 4,

If the Association becomes affiliated with any other Association of Land Surveyors, the joint meeting of such affiliated Associations, held at such time and place as may be agreed upon under the scheme of affiliation, shall take the place of the Annual Meeting of the Association for the year in which such joint meeting is held, and the business of the Association proper to be done at the Annual Meeting for that year, shall be done during such joint meeting, at such time, and in such manner, as may be arranged by the Executive Committee.

Article VII., sub-clause 3,

Whenever the Executive Committee receive information that any Dominion Land Surveyor has signed and certified plans and field notes of any survey which has not been performed by him in his own proper person or under his direct supervision and instructions, or has been guilty of any other corrupt practice, they shall forthwith lay the necessary complaint before the Board of Examiners for Dominion Land Surveyors, so that such Surveyor may be summoned to appear before the Board to show cause why he should not be suspended or dismissed from the practice of his profession for corrupt practices, in the manner provided by clause 120 of the Dominion Lands Act.

A LECTURE, "Some remarks regarding the future for Dominion Land Surveyors" was delivered by J. S. Dennis, D.T.S.

A PAPER, "The Gnomonic Projection" was read by Staff Commander J. G. Boulton, R. N., and was illustrated by diagrams specially prepared by the Commander.

Moved by S. BRAY, seconded by F. X. T. BERLINQUET, and *Resolved*:—

That the thanks of the Association be tendered Staff Commander Boulton, R.N., for his able and practical paper on the Gnomonic Projection and that the paper be received.

A PAPER, "Prime Vertical Observations for Latitude" was read by O. J. Klotz, D.T.S., and illustrated by diagrams on the black-board.

A PAPER, "Field Observations for Azimuth," was read by W. F. King, Chief Astronomer, and fully illustrated by figures on the blackboard.

Moved S. BRAY, seconded by L. A. DUFRESNE, and *Resolved*:—

That Mr. King's valuable paper on "Field Observations for Azimuth", be received, and that the thanks of the Association be tendered him for the same.

A PAPER, "The system adopted by the Canadian Pacific Railway in the classification of North-West Lands," was read by L. A. Hamilton, D.L.S., Land Commissioner, Canadian Pacific Railway.

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

That Mr. L. A. Hamilton, be tendered a cordial vote of thanks for his very interesting remarks on the "System adopted by the Canadian Pacific Railway in the classification of North West Lands".

A PAPER, "A New Signal to be used in Mountainous Countries," was read by L. A. Dufresne, D.L.S.

WEDNESDAY, February 18th.

Morning Session.

The meeting opened at 10.15 a.m., the President in the Chair.

The Report of the Committee on "Permanent Marking of Surveys," was read by its Chairman, J. S. DENNIS.

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

That the report of the Committee on Permanent Marking of Surveys be adopted.

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

That this Association tenders a cordial vote of thanks to Dr. Bourinot, Clerk of the House of Commons, for his kindness in allowing us to use one of the Committee Rooms in the House of Commons for our Annual Meeting, and that a copy of this resolution be sent to Dr. Bourinot.

Moved by A. O. WHEELER, seconded by J. S. DENNIS, and *Resolved* :—

That it was with feelings of deep regret that the members of this Association received the news of the very painful accident met with by the Surveyor General, and that this Association now begs to tender Capt. Deville their warmest sympathy in the trying circumstances in which he is placed, and at the same time to express their sincere congratulations upon the bright prospects for his early recovery.

Moved by J. I. DUFRESNE, seconded by T. D. GREEN, and *Resolved* :—

That this meeting thoroughly appreciates the enterprise of Messrs. James Hope & Co. in making an exhibit of surveyors and engineers' instruments and draughtsmen's supplies, and recommend the members of the Association to extend to Messrs. Hope & Co. their patronage in every way possible.

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

That Mr. Jephson's letter relating to the Town Engineers of Calgary, be referred to the incoming Executive Committee.

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

That the incoming Executive Committee do strike the Standing Committees for the year.

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

That the incoming Executive Committee do deal with the matter of exchanges for the current year and that the meeting recommends that the number of exchanges be reduced.

The Scrutineers of Ballots submitted their report.

Moved by L. A. DUFRESNE, seconded by F. X. T. BERLINQUET, and *Resolved* :—

That the report of the Scutineers of Ballots be received and adopted.

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

President	J. S. DENNIS,
Vice-President	JOHN MCLATCHIE,
Secretary-Treasurer	J. I. DUFRESNE,
Executive Committee	WM. OGILVIE, O. J. KLOTZ, W. S. DREWRY,
Auditors	J. J. MCARTHUR, J. A. BELLEAU,

The Balloting for Auditors showed an even number of votes for J. A. Belleau and F. Driscoll. The President gave his casting vote in favor of J. A. Belleau.

A PAPER, "The Mining Prospects and Industies of West Algoma," by H. De L. Sewell, D.L.S., was read by the Secretary-Treasurer. The paper was illustrated by photograghs and proved of great interest.

Moved by THOS. FAWCETT, seconded by L. A. DUFRESNE, and *Resolved* :—

That the Executive Committee be authorized to confer with the Dominion Government with a view to having the testing of subsidiary standards of measure for the use of Dominion Lond Surveyors, transferred from the Department of Inland Revenue to the Topographical Branch of the Department of the Interior, as this Association believes, with all due deference to the Department of Inland Revenue, that these standards could be more correctly and expeditiously tested by the Topographical Survey Branch, and with more satisfaction to the members of the profession.

Afternoon Session.

A Paper, "The relation of Mountain Forms to Geological Structure" was read by Dr. G. M. Dawson, Asst. Director Geological Survey.

Moved by J. I. Dufresne, seconded by Thos. Fawcett, and *Resolved* :—

That a cordial vote of thanks be tendered Dr. Dawson for his highly interesting paper on "The relations of Mountain Forms to Geological Structure".

A Paper, "The Solar Attachment to the Transit" was read by J. I. Dufresne, D.T.S., and illustrated by diagrams on the black-board.

A Paper, "Tides, Waves, Surfs, Currents and Winds, in connection with works at Sea," by J. E. Sirois, D.L.S., was read in French by J. I. Dufresne. At the close of the paper, Mr. Dufresne read some notes which he had prepared in order to convey to the English-speaking members present the subject matter of Mr. Sirois' paper.

A Paper, "Right-of-Way Surveys for Railways" was read by Henry Irwin, D.L.S.

Mr. Irwin then brought forward a problem relating to the correction of the bearings in a traverse started on an erroneous bearing, and illustrated the problem by diagrams on the black-board, and by blue-print drawings specially prepared.

A Paper, "Sub-division Work" by Jno. Vicars, D.L.S., was read.

A Paper, "Photography in colors, a problem not yet solved," by H. N. Topley, Photographer to the Department of Interior, was read.

A Lecture on the "Dip Circle," used in the field determination of Declination, Inclination, and Intensity, was delivered by W. F. King, Chief Astronomer, and proved very interesting and instructive.

This concluded the business of the meeting, and it was

Moved by O. J. Klotz, and seconded by Thos. Fawcett, and *Resolved* :—

That this meeting do now adjourn until the third Tuesday in February, 1892.

MEMBERS PRESENT AT THE MEETING.

Honorary Members:

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

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

Dawson, George Mercer, D. Sc. Assoc. R.S.M., F.G.S., F.R.S.C., Asst. Director Geological Survey Department of Canada.

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

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

Active Members:

Bigger, C. A.
Berlinquet, F. X. T.
Bray, Samuel.
Dennis, J. S.
Drewry, W. S.
Dufresne, J. I.
Dufresne, L. A.
Dumais, P. T. C.
Fawcett, Thos.
Gibbons, Jas.
Green, T.
Irwin, Henry.
Klotz, Otto J.
Lewis, J. B.
Mountain, Geo. A.
Morency, D. C.
McArthur, J. J.
Nelson, J. C.
Ogilvie, Wm.
Rauscher, R.
Wheeler, Arthur O.

Associate Members:

Dowling, D. B.
Smith, Jacob.
Symes, P. B.
Topley, H. N.

Visitors:

Rev. A. Antoine, O.M.I., D.D., Ph.D., Prof. of Mechanics.............................Ottawa University.
Rev. W. Murphy, O.M.I., D.D., B.A., Prof. Civil Engineering.............................. " "
John R. Hall, Secretary..........................Dept. of Interior.

L. A. Hamilton, Land Commissioner............Can. Pacific Ry.
G. U. Ryley, Timber and Mines...............Dept. of Interior.
Dr. Wicksteed.
Wm. McL. Maingy.
J. Macara.
J. Stewart.
Theo. A. Burrows.
H. G. Wheeler.

G. Louryan,	Student	Ottawa	University
A. Robert,	"	"	"
A. Morel,	"	"	"
J. J. Gillespie,	"	"	"
F. X. Genest,	"	"	"
H. Cameron,	"	"	"
A. Plunkett,	"	"	"
W. Davis,	"	"	"
E. Govern,	"	"	"
E. McElhinney,	"	"	"
A. Silvain,	"	"	"
H. Lapierre,	"	"	"

NEW MEMBERS 1890-91.

Burk, W. R	Ingersoll, Ont.
Berlinquet, F. T	Three Rivers, Que.
Beaudry, J. A. W	Montreal, Que.
Gibbons, Jas	Topographical Survey, Ottawa.
Gosselin, Louis	Quebec, P.Q.
Gosselin, Pierre	Quebec, P.Q.
Lewis, J. B.	Ottawa, Ont.
MacMillan, Jas. A.	Calgary, Alberta.
Miles, Chas. F	Walkerton, Ont.
Ritchie, J. F	Lethbridge, Alberta.
Sullivan, H.	Lorette, Que.
Sullivan, J	Valleyfield, Que.
Wilkins, W. F.	Norwood, Ont.
Whitcher, A. H	Ottawa, Ont.
Van Nostrand, A. J.	Room "J", Yonge St. Arcade, Toronto.

Reports.

REPORT OF SECRETARY-TREASURER.

OTTAWA, February 16th, 1891.

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

GENTLEMEN,—

I now lay before you my report for the Association Year, extending from February the 18th, 1890, to February the 16th, 1891, inclusive.

Our exchanges were the same as the preceding year, viz. :—With the Societies of Michigan, Ohio, Illinois, Indiana, Arkansas, Connecticut and Iowa. The Indiana Reports, which had failed to materialize at the time of my last report, have since come to hand in fine shape, the proceedings of the two last meetings of that society being found together in one volume. Copies of the foregoing exchanges have been distributed to every member of the Association.

Nine hundred copies of the Seventh Annual Report were printed and distributed to our members, exchanges and to the public generally in a manner thought to be most advantageous to the Association. Some few copies have been sold and about twenty remain on hand.

Our Active Membership list has been largely augmented during the year, the names of eleven new members having been added to the Roll. They are as follows:

W. R. Burk, Ingersoll, Ont.; J. A. U. Beaudry, Montreal, Que.; F. X. T. Berlinquet, of Three Rivers, Que.; Jas. Gibbons, of the Topographical Survey, Ottawa. Ont.; Louis Gosselin, Quebec; Pierre Gosselin, Quebec; Jas. A. MacMillan, Calgary, Alberta; J. F. Ritchie, Lethbridge, Alberta; F. W. Wilkins, Norwood, Ont.; A. H. Whitcher, of the Department of the Interior, Ottawa, Ont., and A. J. Van Nostrand, Toronto, Ont. One member only has withdrawn his name, Mr. Henry W. Selby, who has now made his home under the Stars and Stripes and has retired from the profession.

Our Membership Roll stands as follows: Honorary Members, eleven; Active Members, eighty-three; Associate Members, twelve; total membership, one hundred and six.

During the year 270 letters have been received and 385 letters have been written, a decrease of 186 as compared with the preceding year, showing clearly that the profession is now taking a much larger interest in the Association, in that much better results have been attained with far less correspondence.

Five printed circulars have been issued and distributed among the members during the year. The first: A synopsis of the proceedings at the Seventh Annual Meeting, and published in advance of the Annual Report, chiefly for the benefit of those members who were not present at the Annual Meeting. The second: To obtain the information contained in "The Members Record," as published in the last Annual Report. It is now for you, gentlemen, to say if this feature of the Report has proved a success and is worth while following up and expanding. The third: Was a circular letter requesting members who had the opportunity, to send Botanical and Natural History specimens to Prof. Macoun of the Geological and Natural History Museum. I am not aware if any were sent. The fourth called on our members to furnish papers and other contributions to the programme for the 8th Annual Meeting. This has been well responded to, as a glance at our programme will show. The last was in connection with Corrupt Practices, and this is a matter that has been dealt with by the President in his address.

I have much pleasure in stating that the Deputy Minister of the Interior, Mr. A. M. Burgess, has kindly given instructions that all members of the Association be furnished yearly with copies of the Annual Departmental Report, and has had the names placed upon the Distributing List for the said Report.

I submit a statement of Receipts and Expenditures for the past Association year. You will notice by comparison with the preceding statement that great economy has been observed and that all unnecessary, and in some cases necessary, expenses have been avoided with this object in view.

I regret to say, however, that it will be necessary to still further reduce the expenses of the Association, for at least a year, and I would respectfully suggest that the number of the societies with which we exchange be reduced from seven to four, and that the issue of the Annual Report be reduced from nine hundred copies to five hundred copies.

I do not consider that it will be necessary to curtail our publication and distribution for longer than one year, the more especially if the amendment relating to fees, which I have proposed, be endorsed by the meeting.

I would further suggest that strict economy be observed in the matter of lithographic maps for the coming Annual Report, as this is a very expensive item. I may, however, be a little premature in offering this suggestion.

On glancing through the advertisement pages of the Seventh Annual Report, you will notice the increased number of cards inserted by our own members. This, I think, speaks well for the Association, and every member who has a practice should take advantage of the opportunity offered of making known his whereabouts and the nature of the practice in which he is engaged. The nominal charge of $1.00 per card is not to be considered in connection with the benefits derived. All go-a-head men should appear in our pages.

In conclusion, gentlemen, I have a duty to perform, to me a very sad one: that of wishing you good-bye.

In presenting this, my last report, I feel as though I were parting from an old and dear friend. I have found it necessary to resume the active practice of my profession and am compelled to relinquish that which has been, at all times, a very great pleasure to me.

I have found the work of the Association by no means a light one but always a work of love, and as each new member came in or some little triumph was scored by the Association, it seemed as though I was personally the gainer.

I may, however, assure you that though long distance may separate me from the headquarters of the Association, I shall always have a very warm place for it in my heart, and am prepared at all times to further its best interests to the utmost of my power and ability.

The Association, gentlemen, is a success. In good hands it will be a still greater success. Already much has been done to elevate the standard of the Profession through its agency, and to have the same properly recognized throughout the Dominion, and more will yet be done, always provided our members bear in mind that "In unity is strength," and are ready and willing to lend a hand for the welfare of our Profession. With every wish for its best success,

Allow me, gentlemen, to remain,

Your faithful servant,

ARTHUR O. WHEELER.

STATEMENT OF RECEIPTS AND EXPENDITURES

FOR THE YEAR EXTENDING FROM FEBRUARY 18TH, 1890 TO FEBRUARY 16TH, 1891 (INCL.).

Statement No.			
	RECEIPTS.		
	By Balance on hand at 7th Annual Meeting	$ 25 35	
" 1.	" Sale of 7th Annual Reports	4 49	
" 2.	" Advts, in 6th Annual Report	1 00	
" 3.	" " 7th " "	75 00	
" 4.	" Stamps for return postage on electros	09	
" 5.	" Dues for year 1888	3 00	
" 6.	" " " 1889	4 00	
" 7.	" " " 1890	75 00	
" 8.	" " " 1891	116 00	
			$303 93
	EXPENDITURES.		
" 9.	To Cab-hire and Cartage	50	
" 10.	" Expressage and Freight	16 44	
" 11.	" Duty paid	20	
" 12.	" Lithographing and Engraving	16 50	
" 13.	" Miscellaneous	76	
" 13.	" R. Dunlop, for services	1 00	
" 13.	" Rent of St. Andrews Hall	5 00	
" 14.	" Printing and Publishing (on acct.)	210 00	
" 15.	" Postage	33 10	
			$283 50
	Balance in hand		$ 20 43

REPORT OF AUDITORS.

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

Gentlemen,—

We, the undersigned auditors, appointed by the Executive Committee of your Association, beg to report that we have examined the accounts of the Treasurer and find them to be correct, and well and clearly kept.

J. J. McArthur, W. S. Drewry, } *Auditors.*

Ottawa, Feb. 17th, 1891.

REPORT OF COMMITTEE ON GEODETIC AND TOPOGRAPHICAL SURVEYING.

The Committee on Geodetic and Topographical Surveying beg to report that no field work, save that in the Rocky Mountains, has been done during the year ; and that matters are in a quiescent state.

However, the dawn of a bright future has appeared from the fact that the Technical Branch of the Department of the Interior has now blossomed into the Topographical Survey of Canada, which augurs well for the long looked for initial step being taken in that great work.

OTTO J. KLOTZ,
Chairman.

REPORT OF COMMITTEE ON PERMANENT MARKING OF SURVEYS.

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

Gentlemen,—

Your Committee on the Permanent Marking of Surveys beg to submit the following report :

The subject of the marking of our surveys in a permanent and lasting manner is well worthy of careful investigation and should receive due consideration at the hands of all the Associations of Land Surveyors, and also by the different Governments carrying on land surveys.

There is no part of the operations connected with the survey of tracts of land into farms, or village or town lots, of so great importance to the general public as that of having the corners established by such surveys marked in a permanent and lasting manner. It is quite unnecessary to offer any argument in support of this assertion, when addressing those who have all to a greater or less extent been engaged in re-locating and establishing "lost corners", and who have seen the ruinous litigation which has followed the effort to re-establish surveys which were poorly marked, and the marks having disappeared, disputes regarding corners or bounding lines dependent thereon have naturally followed. In this connection it may be safely said, that if all the money which has been spent in the litigation which has arisen owing to faulty marking of surveys, had been spent in marking them in a permanent manner in the first instance, the boundary corners of farms and lots throughout the whole country would have been so marked that disputes regarding their position would be impossible.

This, however, is not the side of the question which the Committee desire to discuss, but rather to submit a few remarks regarding the manner in which the land surveys of the different Provinces of the Dominion have been and are being marked, with suggestions regarding changes necessary to arrive at the desired end of permanence.

In all the older Provinces of the Dominion the wooden post and bearing tree have been almost entirely used in marking the original surveys; and while it is intended to try and show that wooden posts are poor marks for surveys, at the same time we must admit that under certain favorable circumstances wooden posts remain in place for a long time, and further that in the early days of surveying in the older Provinces it was manifestly impossible to mark the surveys in a very permanent manner.

At the present time the regulations in force regarding the marking of surveys in the different Provinces are as follows:—

Beginning with Quebec we find that the wooden post is still the recognised monument for corners in original surveys. The law provides that in certain cases, when requested by the interested parties for whom he is working, the surveyor may plant stone or iron posts, but as this is only done at the request and expense of private individuals, it cannot be expected that very much in the direction of permanent marking will be accomplished.

In Ontario the present conditions are very similar to those in Quebec. The wooden post is the stand-by in marking original surveys, and while the conditions under which re-established surveys are marked in a permanent manner with stone or iron monuments are somewhat more liberal than in Quebec, the difficulty still exists that this work is only done at the expense of private individuals or municipalities.

In Manitoba and the North-West Territories the original surveys are now marked in a very thorough and permanent manner. During the first few years of the surveys in that part of the Dominion wooden posts were used to mark section and ¼ section corners. These posts, however, in prairie districts, were protected by a mound of earth thrown up around them, and they were therefore very much more permanent marks than the simple wooden post. In the wooded parts of the country the use of wooden posts and bearing trees was allowed, and as a consequence in many cases the marks of the surveys have been totally obliterated by fires, and many miles of line have had to be re-established, the marks of which had been destroyed in this way.

About a year ago the regulations regarding the marking of surveys in Manitoba and the North-West Territories were amended so as to provide that all township and section corners must be marked with iron posts, and in wooded country additional provision against obliteration of the marks is made by providing for the erection of mounds so that no amount of forest fires will affect the marks. The surveys marked under these new regulations are probably the most permanently marked original surveys which have been performed in the world. They are of course not so permanently established as some of the topographical surveys which have been made in certain countries, and which are referred to permanent buildings and natural features, but there is no other country in which the original surveys of the country into farm holdings are so permanently marked as the Dominion Lands Surveys in Manitoba and the North-West Territories.

In British Columbia, both the Provincial Surveys and those performed under the Dominion Lands System in the Railway Belt, are marked with wooden posts only, and when we consider the frequency with which the greater part of the country is swept by forest fires it is easy to foresee that a very few years will remove the entire marks of the surveys in districts of considerable extent.

In a report of this kind it is not only necessary to give the facts, but also to suggest a remedy which would correct the weak points in the systems under discussion. Assuming, therefore, that the desirability of permanentiy marking our land surveys is admitted, we will proceed to recommend some changes in the systems of marking corners of original surveys now in force in several of the Provinces so as to accomplish the desired end of permanence.

As a first requisite, we are of opinion that in all original surveys performed under instructions from the different Governments, the corners of intersecting Township boundaries and, in Provinces where concessions are laid out, the intersection of concession lines with Township boundaries, should be marked with an iron or stone post, and mound and pits. This would of course add something to the first cost of the surveys, but the future saving, by rendering litigation as to the position of these points unnecessary, would repay ten times the additional cost in the first instance. To make the original marking still more complete and permanent, it would be well that iron or stone posts with mounds and pits should be placed at every mile on concession or primary lines.

In the report of this Committee submitted last year, the chairman called attention to a method by which the surveys made for extensive publlc works throughout the country might be made to assist in perpetuating the marks of original land surveys. The system proposed was that when surveys were being made for railway lines, canals, or other permanent works, the co-ordinates of any corner or line of original surveys as referred to the lines laid down for these permanent works should be noted, and the results of these notes put in the form of a table of co-ordinates which in a small space would afford a great deal information.

This suggestion is a good one; everything which is likely to furnish information regarding original corners, so as to make their positions more lasting and permanent or more readily re-established if lost, is for the public good. The adoption of any scheme of this kind would only be possible after legislation to enable the results of these surveys being made use ot in re-establishing original land surveys. However the scheme is well worthy of consideration by the different Governments interested.

Several methods might be suggested for more permanently marking our land surveys, but they cannot be discussed in a report of this nature. The first thing to be done is to try and draw the attention of the authorities interested to this important subject, and then by united action to accomplish the required changes in the laws relating thereto. It is suggested that a special committee be appointed to prepare a short pamphlet on this subject containing facts as to present systems of marking and details of the changes necessary to make the marking more permanent and easily established when lost. This pamphlet ought to be sent to the different Governments and also to the other Associations, who should be invited to co-operate in having the necessary changes adopted and legalized by amendments to the several Acts bearing on land surveys.

This question is deserving of every consideration at the hands of the different Associations of Land Surveyors, and the Committee trust that this Association will do all in its power to further needed improvements in existing systems of marking original surveys.

Respectfully submitted,

J. S. DENNIS,

Chairman.

REPORT OF SCRUTINEERS OF BALLOTS.

FEB. 18th, 1891.

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

GENTLEMEN,—

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

For PRESIDENT	J. S. Dennis.
" VICE-PRESIDENT	John McLatchie.
" SECRETARY-TREASURER	J. I. Dufresne.
" EXECUTIVE COMMITTEE	Wm. Ogilvie. O. J. Klotz. W. S. Drewry.
" AUDITORS	J. J. McArthur. J. A. Belleau.

T. D. GREEN.
L. ACHILLE DUFRESNE.
F. X. THOS. BERLINQUET.

Notices.

NINTH ANNUAL MEETING, AND AFFILIATION.

The Executive Committee have much pleasure in announcing that arrangements have finally been completed for the affiliation of the Association with the Association of Provincial Land Surveyors for Ontario, the rules and regulations adopted to govern the relations being given hereunder.

The first convention will be held at the next Annual General Meeting of the Association, in Ottawa, on the Third Tuesday in February.

It is earnestly hoped that members will do all in their power to make the Ninth Annual Meeting a success, by attending the meeting and by contributing a paper on some subject of interest to the profession.

Later in the year members will be specially invited to interest themselves in assisting the Executive Committee in providing a good programme for the Ninth Annual Meeting, and a cheerful and general response to the appeal is confidently looked for.

ANNUAL DINNER.

The Annual Dinner of the Association was held at the Raquet Court, and proved a great success. About fifty members and guests attended the dinner, among whom were many of our honorary members. The dinner was followed by a smoking concert, at which the music contributed by members and a good orchestra afforded much pleasure.

This social gathering has now become an established feature of the Annual Meeting, and not only adds much to the interest taken in the meeting but makes our members better acquainted with each other, and serves to more firmly cement the Association and to advance our objects by establishing unity and good feeling.

Questions Submitted.

Correction of a Traverse run from an Erroneous Assumed Variation of the Needle; Either Without or With an Incorrect Chain.

The attention of the writer was called to this problem by an advertisement in *Engineering News* about the end of last summer.

The question was stated in the advertisement as follows, viz :—

"The field notes of a line of highway read as follows:—Commencing "at Meander Post No. 5 and running thence North 62° East, 14·00 "chs. ; 2nd, North 43½° East 8·00 chs. ; 3rd, North 5° West 12·00 "chs. ; 4th, North 72½° East 10·25 chs. ; 5th, South 12° West 6·43 "chs., to a stone set for Meander Post No. 3. I commence at Meander "Post No. 5, and, with Variation 2° 17′ East, run a random line accord- "ing to the field notes, setting temporary stakes at each angle in the "line, and come out 62 links East of Meander corner stone No. 3. "1°—What is the correction for the variation of the needle? 2°—What "is the correction for the stake at each angle, and how shall I find it?"

As the final point in the trial line was stated to have been simply *East* of, and not *due East* of, the true point; and as no correction was asked for except of the variation of the needle; the writer assumed that the chaining was supposed to be correct, that "*East*" simply meant *Easterly*, and that the whole error was due to assuming an erroneous variation of the needle.

Of course, if the final point of the trial line be given as *due East* of the correct point, an error in chaining would also be implied, for otherwise, from the given bearings of the traverse, the final point of the trial line could not be *due* East of the correct position.

The writer also assumed that the bearings were astronomical.

CASE I.—CORRECT CHAIN.

Let the starting point at Post No. 5 be marked A, the next corner, as located incorrectly by the trial traverse, be called B, and so on ; the last point of the trial traverse being F; and let the true position of the various corners be marked B′, C′, &c., up to F′, the final point at stone No. 3.

Through the point A draw the assumed Astronomical Meridian AY, obtained by taking the variation of the needle to be 2° 17′ East.

The traverse as run on the ground is plotted on Figure 1 from this meridian. Draw also through A the Magnetic Meridian AZ.

Now, since the starting point is fixed, and since the various lines of the traverse are assumed to be mutually correct as regards their bearings and distances, and since the error as above stated is assumed to consist solely in commencing with a wrong variation of the compass, the correction to be made in the field virtually amounts to shifting the whole system of lines, as run on the ground, through the angle BAB′ or FAF′ round A as a centre, the angle BAB′ being equal to the error in the assumed variation of the needle.

This correction is actually what would be done on a Plan supposing the traverse to have been correctly plotted and to end at K instead of K′, through plotting the first bearing from a wrong meridian; the draftsman would trace the Traverse and, fixing it at A with a needle point, would swing the tracing round so as to place F on F′ and then prick in the intermediate points.

The proof of this correction is very simple. Suppose BB′ to be the chord of a circle having A as its centre, the angle ABC being equal to AB′C′, and B′C′ being equal to BC, then the triangle ABC is equal to the triangle AB′C′, and therefore AC is equal to AC′, therefore CC′ is the chord of a circle having A for its centre; also the angle B′AC′ is equal to BAC, therefore, subtracting the common angle B′AC from both, C′AC remains equal to B′AB, similarly AD can be shown to be equal to AD′ and the angle D′AD to be equal to C′AC; and so on for all the points of the traverse.

The first operation is to calculate the Latitude and Departure of each of the lines AB, BC, &c. Then from these find the total Latitude and Departure of each of the points C, D, E and F from A; the above Latitudes and Departures being referred to the assumed Astronomical Meridian AY.

From the Total Latitudes and Departures find the bearings and lengths of the lines AC, AD, AE and AF.

Now since FAF′ is an isosceles triangle, since $\frac{1}{2}$ FAF′ $= \frac{\frac{1}{2}\ FF'}{AF'}$ from this FAF′ is found to be 1° 04′ 44″ which is the amount of the error in the assumed variation of the needle, and the correct variation is (1° 04′ 44″ + 2° 17′ 00″) = 3° 21′ 44″ Easterly, as shown in Figure 1, where the true Astronomical Meridian is marked AX

Therefore instead of laying off an angle of (62° − 2° 17′) = 59° 43′ from the Magnetic Meridian, in order to get the first course AB, the angle to be laid off from said meridian should be (62° − 3° 21′ 44″) = 58° 38′ 16″.

Now since the angles BAB′, CAC′, &c. are each equal to 1° 04′ 44″ and the triangles BAB′, CAC′, &c. are isosceles, the angles ABB′, ACC′ &c. are each equal to $\frac{180° - 1°\ 04'\ 44''}{2} = 89°\ 27'\ 36''$.

From this value of the angles ABB′, ACC′, &c., and having already found the bearings of AC, AD, &c., the bearings of the lines BB′, CC′, &c., as referred to the bearings of the trial traverse can be calculated, and from these last bearings the angles ABB′, BCC′, &c., which must be known in order to get the directions BB′, CC′, &c., can be found; it being assumed that the work is being done with a transit and that the compass is not being used to run the courses; otherwise the bearings of the lines BB′, CC′ would be sufficient.

The lengths EE′, DD′, CC′ and BB′ still have to be calculated.

Now since the triangles FAF′, EAE′, &c., are all similar EE′ = $\frac{FF'}{AF} \times$ AE, DD′ = $\frac{FF'}{AF} \times$ AD, &c., where FF′ is given and AF, AE, &c. have all been found.

The results of the calculations are given in the following table:—

TABLE 1.

TABLE OF CALCULATIONS for Correction of a Traverse, run with a correct Chain, but starting with an erroneous Variation of the Compass.

1	2	3	4	5	6	7	8	9	10	11	12
Stations.	Courses.	Distances.	Latitudes.	Departures.	Total Latitudes.	Total Departures.	Bearings of Lines AB, AC, &c.	Lengths of Lines. AB, AC, &c.	Bearings of Lines BB′, CC′, &c.	Angles ABB′, BCC′, CDD′, &c.	Lengths, BB′, CC′, &c.
		Chains.						Chains.			Chains.
A	N 62° E	14·00	N. 6·573	12·360 E.	N. 6·573	12·360 E.	N. 62° E.	14·000	N. 28° 32′ 24″ W	89° 27′ 36″	0·264
B	N 43½° E	8·00	N. 5·803	5·507 E.	N. 12·376	17·867 E.	N. 55° 17′ 29″ E	21·735	N. 35° 14′ 55″ W	101° 15′ 05″	0·409
C	N 5° W	12·00	N. 11·954	1·046 W.	N. 24·330	16·821 E.	N. 34° 39′ 31″ E	29·580	N. 55° 52′ 53″ W	129° 07′ 07″	0·557
D	N 72¼° E	10·25	N. 3·082	9·775 E.	N. 27·412	26·596 E.	N. 44° 08′ 39″ E	38·190	N. 46° 23′ 45″ W	61° 06′ 15″	0·719
E	S 12° W	6·43	S. 6·289	1·336 W.	N. 21·123	25·260 E.	N. 50° 05′ 46″ E	32·928	N. 40° 26′ 38″ W	52° 26′ 38″	0·620

Sin. $\frac{1}{2}$ FAF′ = $\frac{FF'}{2AF}$ – Angle FAF′ = error in assumed Variation of Needle = 1° 04′ 44″.

NOTE.—All the Bearings in this table have reference to the erroneous Meridian.

CASE II.

Erroneous Assumed Variation of the Compass and Incorrect Chain.

If the bearing FF′, see Fig. 17, be assumed to be *due* West, then there must also have been error in chaining.

If this error be supposed to be due to the length of the chain not being correct, and the error to be distributed evenly over all the lines of the traverse proportionately to their respective lengths, the correction would be different from that for Case I.

The angular displacement of the whole will still be that due to the error in the assumed variation of the needle, but the length of each of the lines AB, AC, &c., which join the starting point A with the various points of the Traverse as run out, will be increased proportionately to the excess in length of AF over AF′.

This is readily proved as follows, viz.:—In the triangles ABC and AB′C′ the angles AB′C′ and ABC are given equal, and AB′:B′C′ :: AB:BC, therefore the triangles are similar, therefore AC:AC′::AB:AB′, therefore the excess in length of AC over AC′ is proportioned to the excess in length of AB over AB. Also the angle BAC = the angle B′AC′ therefore, deducting the common angle B′AC from both, the angle BAB′ remains equal to the angle CAC′. Similarly it can be shewn that AD:AD′::AC:AC′ and that the angle DAD′ = the angle CAC, and so on, till finally $\frac{AF'}{AF}$ is shewn to be equal to $\frac{AB'}{AB}$, and the angle FAF′ to be equal to the angle BAB′.

The Latitudes and Departures of the various courses must be calculated with reference to the true meridian since the length AB, BC, &c., are not known, their values, as well as the total Latitudes and total Departures and the bearings and lengths of the lines AB′, AC′, &c., would be the same as already given in columns 1 to 9 of Table 1, the values in this latter table having reference, however, to the assumed erroneous meridian.

The bearing and length of AF′ and the bearing E′F′ being known, the two latter bearings being referred to their true meridian, the angle AFE′ can be found; but the angle EFF′ is given, since the bearing of FF′, relative to EF is given, and the angle EFA is given equal to the angle E′F′A, therefore the angle AFF′ can be got by subtraction of EFF′ from EFA.

The length FF′ being given the next step is to calculate the length of AF and the angle FAF′.

Having found FF′ the lengths of the remaining correction lines can be found as before, and will be the same as given in column 12 of Table 1 :—for, since the angles FAF′ and EAE′ have been shewn to be equal and since AF:AF′::AE:AE′, the triangles AFF′ and AEE′ are similar, therefore $EE' = FF' \times \frac{AE'}{AF'}$, and the angle AEE′ = the angle AFF′. The lengths DD′, CC′, &c., can be similarly found, and in the same manner it can be proved that the angles ADD′, ACC′, &c., are each equal to AFF′.

Knowing the angles AFF′, AEE′, &c., and also the bearings of the lines AF, AE, &c., with reference to the erroneous meridian, the bearings of the lines EE′, DD′, &c., with reference to the last mentioned meridian, can be calculated.

If the directions of the lines EE′, DD′, &c., are to be laid out with a transit and not with a compass it may be more convenient to calculate the angles ABB′, ACC′, &c., these are given in column 11 of Table 2.

The calculations shew that the error in the assumed variation of the compass is 0°. 41′. 32″, which is the difference between the bearings of AF and AF′ as referred to the true meridian; and the error in chaining is equal to the excess in length of AF over AF′, or 0.473 chains in 32·928 chains, or 1·43 links per chain.

TABLE 2.

TABLE OF CALCULATIONS for Correction of a Traverse, run with an incorrect Chain and starting with an erroneous variation of the Compass.

1	2	3	4	5	6	7	8	9	10	11	12
Stations.	Courses.	Distances	Latitudes.	Departures.	Total Latitudes.	Total Departures.	Bearings of Lines AB′, AC′, &c.	Lengths of Lines AB′, AC′, &c.	Bearings of Lines BB′, CC′, &c. = Column 8 + 39° 54′ 14″.	Angles ABB′, BCC′ CDD′, &c.	Lengths, BB′, CC′ &c.
		Chains.						Chains.			Chains.
A	N. 62° E.	14·00	N. 6·573	12·360 E.	N. 6·573	12·360 E.	N. 62° 00′ E.	14·00	N. 78° 05′ 46″ W	39° 54′ 14″	0·264
B	N. 43½° E.	8·00	N. 5·803	5·507 E.	N. 12·376	17·867 E.	N. 55° 17′ 29″ E	21·735	N. 84° 48′ 17″ W	51° 41′ 43″	0·409
C	N. 5° W.	12·00	N. 11·954	1·046 W.	N. 24·330	16·821 E.	N. 34° 39′ 31″ E	29·580	S. 74° 33′ 45″ W	79° 33′ 45″	0·557
D	N. 72½° E	10·25	N. 3·082	9·775 E.	N. 27·412	26·596 E.	N. 44° 08′ 39″ E	38·190	S. 84° 02′ 53″ W	11° 32′ 53″	0·719
E	S. 12° W.	6·43	S. 6·289	1·336 W.	N. 21·123	25·260 E.	N. 50° 05′ 46″ E	32·928	Due West.	102° 00′ 00″	0·620
							Bearing of AF N. 50° 47′ 18″ E.	Length AF 33·401 chains.			

NOTE.—The Bearings given in Columns 2 and 8 have reference to the True Meridian, while the Bearings in Column 10 are referred to the Erroneous Meridian. The Angle FAF′ = error in assumed Variation of Compass = 0° 41′ 32″. Error in chaining = 0·473 chs. in 32·928 chs. or 1·43 Links per chain.

CASE III.

ASSUMED VARIATION OF THE COMPASS SUPPOSED TO BE CORRECT, AND THE ANGLES LAID OFF CORRECTLY, BUT CHAIN SUPPOSED TO BE INCORRECT.

The same Traverse is taken for an example as in the cases 1 and 2, but the bearing FF′ is assumed to be the same as that of AF′.

In this case B′B is given as being in the direct prolongation of AB′, and the angles AB′C′ and ABC are given equal; also, by hypothesis, AB′:BC′::AB:BC, therefore the triangles AB′C′ and ABC are similar, and since AB is a straight line, BC is parallel to B′C′; also the angles BCA and B′C′A are equal, therefore AC′C is a straight line, and AB′:AC′::B′B:C′C.

Similarly it can be proved that AD′D, AE′E and AF′F are straight lines and that D′D, E′E and F′F are respectively proportional to AD′, AE′ and AF′, therefore the lengths of the correction lines EE′, DD′, &c., will be the same as given in Column 12 of Tables 1 and 2, and the bearings of these lines will be the same as those of AE′, AD′, &c., in Column 8 of Table 2.

In this case the total Latitudes and Departures of the C′, D′, &c., have to be calculated as in Case 2, and from them the bearings and lengths of the lines AC′, AD′, &c., must be found.

The lengths of the correction lines will then be calculated as in the previous cases, and if thought convenient, the angles E′ED, D′DC can be calculated.

The results of the calculations are given in Table 3.

It will be seen that if, after calculating the length and bearing of AF and AF′, the length AF should prove to be the same as that of AF′, then the chaining must have been correct; and if the bearing AF′ should turn out to be the same as that of FF′, then the assumed variation of the compass must have been correct; but, if neither of the above conditions are fulfilled, then both the chaining and the variation of the compass must have been erroneous; it being assumed in all cases that the various angles of the traverse have been correctly laid out.

The writer would suggest that the methods of correction given above might be applied to the case of a traverse which will not close when plotted; when the error, if any, in the chaining might be supposed to be distributed uniformly over all the lines, and when the plot is laid out from a wrong meridian.

TABLE 3.

TABLE OF CALCULATIONS for Correction of a Traverse run with an incorrect Chain, but with correct Variation of the Compass.

1	2	3	4	5	6	7	8	9	10	11	12
Stations.	Courses.	Distances.	Latitudes.	Departures.	Total Latitudes.	Total Departures.	Bearings of Lines AB′, AC′, &c.	Lengths of Lines AB′, AC′, &c.	Bearings of Lines BB′, CC′, &c.	Angles ABB′, BCC′, CDD′, &c.	Lengths of Lines BB′, CC′, &c.
		Chains						Chains			Chains
A	N. 62° E.	14·00	N 6·573	12·360 E.	N. 6·573	12·360 E.	N. 62° 00′ E.	14·00	N. 62° 00′ E.	0° 00′ 00″	0·264
B	N. 43½° E.	8·00	N. 5·803	5·507 E.	N. 12·376	17·867 E.	N. 55° 17′ 29″ E	21·735	N. 55° 17′ 29″ E	11° 47′ 29″	0·409
C	N. 5° W.	12·00	N. 11·954	1·046 E.	N. 24·330	16·821 E.	N. 34° 39′ 31″ E	26·580	N. 34° 39′ 31″ E	39° 39′ 31″	0·557
D	N. 72¼° E.	10·25	N 3·082	9·775 E.	N. 27·412	26·596 E.	N. 44° 08′ 39″ E	38·190	N. 44° 08′ 39″ E	28° 21′ 21″	0·719
E	S. 12° W.	6·43	S. 6·289	1·336 W.	N. 21·123	25·260 E.	N. 50° 05′ 46″ E	32·928	N. 50° 05′ 46″ E	141° 54′ 14″	0·620

NOTE.—The error in Chaining = 0·620 Chs. in 32·928 Chs. or 1·88 Links per Chain.

Papers.

THE MARKING OF SURVEYS IN CITIES AND TOWNS.

When I had the honor of being asked to write a paper, to be read before the Association at its Eighth Annual Meeting, I hesitated, and it was with extreme reluctance that I consented to do so, knowing that, being one of the youngest members, or rather one of the latest to enter the Association, I could not hope to advance anything which would prove of benefit to the rest, but would be purely and simply looking for information.

With this selfish motive in view, gentlemen, I claim your indulgence, and am satisfied of receiving it, knowing that "the improvement of each other" is one of the highest aims of the fraternity. Having read with interest the paper on the "Permanent Marking of Public Surveys," and the report of the committee on the same, it occurred to the writer that some remarks under the above heading might not be amiss, with the hope that it might lead to a discussion and interchange of opinion, thus giving useful hints to him and others in the profession. While being fully aware that my subject is one which has, no doubt, been thought over by every surveyor who has had to do with private or local practice; I think that, with new members continually coming in among us, it will bear repetition.

The subject of marking of surveys in cities and towns should be the finer part of the acceptance of the term Marking of Surveys, or rather the more mechanical part of that term.

In the original survey of a town—my experience has been altogether in the West, since and including "boom-time"—the lots are marked very much as a more extensive survey, by posts two inches square or larger. These are generally measured in and sighted in line by a transit, after which the sledge or mall is brought into use. Some of the posts go down directly in line, others come into contact with a stone or solid lump of clay and go in on a slant, thus being thrown slightly off, either from the line or from the measurement. Long after the survey is completed, someone, probably the owner of a particular lot, comes along and finds no post in his immediate vicinity but one which is on a slant, and which he at once straightens up and makes secure. This post is at the corner of a block, and he, in future, "swears by it," for, is it not one of the old original survey posts? As time goes on, the services of a surveyor are brought into requisition, occasionally, and, together with the above and other similar cases, for it is next to impossible to get more than one such post out of every three to drive in exact position, he finds he has a kind of a zig-zag street line. Even though he could afford the time, and had the inclination to do so, the surveyor would hardly be justified in making this line straight, and moving or overlooking those posts which he knows to be of the original survey, and which he has no positive reason to believe were tampered with. Of course the discrepancy may not be noticeable to any but a professional man, and may not then be perceptible until actual measurements are made, or instruments used, but the local surveyor always has the uncomfortable knowledge that his lines, though undoubtedly conforming with the marks originally laid down, are not theoretically correct, that his street may be a few inches narrower or wider in certain places than in others, and that in the event of some of his old points being removed or obliterated, his surveys of lots might be questioned. In the event of a strange surveyor coming in, who undertakes to "stake out" a lot, the chances are, that through ignorance of the position, he will select points from which to start other than those which would be taken by the local man, and, as a consequence, they would not agree. By the way, there is a marked similarity in that respect between ours and the medical profession, for it is a well known fact that two of them seldom prescribe the same remedy for any particular ailment, unless as a result of a consultation.

The subject might be enlarged upon almost indefinitely, but I will not now make any further demands upon the time of the meeting, or of the space in the Annual Report. As a remedy for cases like the above, in future surveys would it not be well for the surveyor to insist upon iron bars being furnished him for block corners, to be placed by him accurately and firmly in the ground? The intervening lots could be marked by ordinary posts.

Of course, in case of any question arising, the position of a lot post would be governed by reference to the iron bars at the corners. In cities and towns, the only remedy for cases of this kind, and for discrepancies in the survey of a far more serious nature, is that the matter be taken up by the civic authorities, and the necessary legislation obtained to have a re-survey made. There is one such case in this Province, and I cannot help but think that the lot of the surveyors who practise there, who can always find accurate points at each corner, and who have all the necessary plans and notes to consult when needed, is, professionally, a happy one.

H. G. DICKSON, D.L.S.

Brandon, February 12, 1891.

DISCUSSION.

J. S. Dennis—Thought the marking of surveys in cities and towns a very important matter. Many of the members were aware of the difficulties arising from faulty marking of surveys. The use of wooden posts for marking block corners in cities and towns should be discontinued.

During his service as surveyor for the Hudson's Bay Company he had marked their portion of the city of Winnipeg with iron bars an inch square and five feet long. These were placed at all block corners, five feet from each street line, and driven down to within about two inches of the top. When the sidewalks were built they were built over the bars, which were thus protected, and it was always a simple matter to accurately re-establish the block corners by measurement from these bars.

Wm. Ogilvie—Something of the same kind had been done in marking the survey of the By estate in the City of Ottawa, and had been found to work well.

F. X. T. Berlinquet—Thought the centre of the street might be used and the boundary marks placed at say a depth of two feet.

J. S. Dennis—Did not think the plan proposed by Mr. Berlinquet would work very well. In a crowded city thoroughfare it would be difficult to set up an instrument over a mark in the centre of the street.

On motion, Mr. Dickson's paper was referred to the Committee on Permanent Marking of Surveys for report.

THE CONTRACTOR.

In the system of Dominion land surveys the subdivider or contractor constitutes the rank and file of the profession; his work is laid out for him, so to speak, his sphere is comparatively limited, his operations in any year being confined to a few square miles of country, thus his errors as well as his more worthy achievements are circumscribed. But although he might be said to be in the lower ranks, his work is not by any means unimportant, but on the contrary will always have a strong claim upon those who take an interest in the welfare of our profession; and it is with the desire of saying something that might tend in the direction of securing greater respect for the contractor's office, and sympathy for his difficulties, and of exciting him to improve his status and efficiency, coupled with the desire to contribute something towards the interest of our Annual Meeting, and our Report, that I offer the present paper. The task might better have been executed by one with a larger and a more varied experience than my own, but my attempt may serve as a beginning to be continued by others, for I think we should, at every Annual Meeting, have a paper on this subject.

As the bulk of our Dominion land surveys is subdivision work, and this is nearly all done by contract, it follows that the contractor is largely responsible for the public reputation which the profession may sustain and the estimation in which they are held as a body of scientific men. That some contractors have not well sustained this reponsibility must be admitted; they have made some scandalously bad surveys, and left work behind them of which their brethren are ashamed, and which none more strongly condemn than the majority of contractors themselves. But I think that those who do not fairly try to do their work well are the exception: the vast majority honestly desire to fulfil the terms of their contracts and are not afraid of having their work visited by the inspector. They feel that they are able to keep within the limits of accuracy prescribed by the Manual, and if sometimes their operations are subject to disapproval it is not through lack of honest purpose on their part, or want of professional ability, but generally through an error in judgment, and in cases where a difference of opinion might fairly exist. Errors and inaccuracies in subdivision work are apt to be ascribed to the cupidity of the contractor, because his work is paid for by the mile, it being forgotten that imperfect work has been done by surveyors whose remuneration did not depend upon the amount of work done, and who were therefore under a minimum of temptation to slur it over. When we consider the disadvantages under which the surveyor has to do his work,—the fatigue and general discomfort, the lack of skilled or of sympathetic assistants, the scant recognition of his talents, and his too small pecuniary reward—the generally good quality of the work in our North-West surveys is creditable alike to the honesty, the fortitude, and the ability, of the men who did it.

Surveyors are not perfect any more than other men, but they do not make greater or more numerous mistakes than are made by other professional men; they are as capable and as conscientious as any others.

But while we must always be ready to repel unjust criticism, we must not be satisfied with a low standard of excellence in regard to our work: we must cultivate greater respect for it, and strive to realize fully its importance. Contractors must faithfully adhere to the terms of their contract, and show that they are worthy of the confidence of the department that employs them, and they should unitedly strive in every legitimate way for every reform that may be necessary to enable them to do justice to themselves as a body, and also to the public. Some of the points which, in my opinion, need attention, I intend now to touch upon.

One thing that might be complained of is the smallness of the amount of the contract, compared with the proportion that is consumed in the expenses of getting out to the field and returning. The unsurveyed territory is getting farther and farther away, so that a large part of the outlay on any survey is what might be called unproductive. But since in any year there is only a certain sum to be expended on surveys, if the contracts were made larger they would be fewer in number. Again, as many contractors are not sure of work from year to year, they are obliged to follow a kind of hand-to-mouth system in the business parts of their work. They are at a disadvantage in the disposal of their "plant" at the end of the season: the contractor may "sell it for a song," or store it somewhere where it may be eaten up with rust or mildew, or stolen before it is needed again.

Another drawback is the fact of the contractors being under the necessity of taking an entirely new party every year, and thus of never having a perfect set of assistants, because in a party picked up thus at haphazard there will generally be at least one man who does not amount to much. The survey is so small that by the time he has his men broken in and instructed in their work, the work itself is at an end, and it is so many months until he will need them again that he cannot make any arrangements for their rejoining him next year, even if the men thought it worth while to entertain the idea of a re-engagement so distant and for so short a period. Again, as the contractor is generally going into a new section of country, which is to him a *terra incognita* except in its general features, he is liable to waste valuable time through the absence of information in regard to the best route to his work, in regard to the existence and position of trails and streams within the limits of his survey; it takes time to find out the best camping places and the best means of reaching them. It would often be a great advantage, too, to know what settlers, if any, were near the work, whether men could be engaged or supplies stored, and to know about the mails. How few returning from the completion of a contract cannot see where they could have saved money if before starting they could only have had some of the information which they afterwards had to acquire by actual experience?

The last grievance of the contractor which I shall mention at this time arises out of the existence of errors in the outlines of the townships which he has to subdivide. Before beginning his subdivision he should, I think, be compelled to re-chain all his outlines already run, doing whatever work of opening out the old line might be necessary to admit of accurate chaining being done. For this preliminary work of revision he should receive enough to cover the expense—say one dollar a mile in prairie, and two dollars a mile in bush. If, after going over two or three miles, no error was discovered, then he should desist, and go on with his subdivision, receiving no compensation for this small amount of re-chaining. Of course, absolute agreement between the new chaining and the old is not to be expected, but on level ground with a line well opened out, a surveyor ought to be sure of his own chaining to a link, or, at most, two links in the half mile. It is too much to expect the contractor to make a complete re-survey of his boundaries without reimbursement, and yet in some cases it may happen that anything short of this complete re-survey would be unsatisfactory. When the contractor receives his contract he is given certain lines and monuments to start from, and to which his instructions oblige him to adhere, and it is manifestly unjust that he should incur pecuniary loss through any errors or inaccuracies in the data supplied. If there are errors in the outlines the subdivider will find them out after his work has begun if he does not take the precaution to look for them beforehand; the latter is the wiser course for him to follow. In Mr. McLatchie's paper of last year the errors found in surveys were dwelt upon in detail and very clearly and forcibly pointed out; and his remarks received a good illustration only the past season when a contractor had to entirely re-survey and post one of his boundaries, besides finding grave errors in others. It might not be a bad thing for contractors in future to be instructed to re-trace the old boundaries and put down iron posts, and in the bush, mounds. It is to be hoped that in future all outlines will be so carefully run, chained, posted and mounded, that the subdivider can confidently begin work without previously overhauling the work upon which his own is to be based.

Of the disadvantages and grievances herein spoken of, some are susceptible of remedy and some not. The amount of the contract and the rates paid for the work are fixed for us, and must be simply accepted or refused; we cannot alter them directly; we may, however, be allowed respectfully to protest that both the amount of contract and the rates need to be augmented. But both the surveyor making the block survey and he that makes the outline survey, might, with no extra labor, furnish some information that might often be of service to the subdivider. They might accompany the returns of their surveys with a short report for the benefit of the subdivider, giving him points about the best means of getting to the work, about the trails and streams, etc.; a copy of this report could be included in the subdivider's instructions. Especially should all surveyors be ready to help each other with such information and advice as is in their power to give.

Upon receipt of his contract the contractor should make careful and deliberate preparations for executing the work. Unless he is already familiar with the locality of his survey, and the best means of reaching it, he must take steps for gaining all the information possible, by communicating with the Department of the Interior if necessary, with all the surveyors who have preceded him in that particular part of the country, or by writing to settlers. He must study out his campaign from beginning to end—where he is going to get supplies, how they are to be transported, where he is to get his party, how many men he is going to have, how long he will need them, whether he is likely to be overtaken by winter, how he is to bring his party back, and the arrangements about funds to pay them so soon as the time comes when they may be discharged. It is most desirable that everything should be foreseen, and every contingency provided for. Doing this, or leaving it undone, will make a great difference on the profits of the job, and not on the profits only but in the actual quality of the work done; for the more money the surveyor is going to make out of his survey the less temptation he has to slight his work, so that on moral grounds, as well as on economical, it is important that he do not go to work in a haphazard way, but follow a carefully considered plan.

I was much interested in Mr. McLatchie's description of his method of producing lines under exceptional circumstances, and the putting sods on the back pickets. During last autumn, in Manitoba, I used pieces of thin translucent paper on my back pickets, and found that they made capital signals, especially when looking back towards the sun. Frequently I have been able to sight on this small bit of paper, rendered visible by the light which it *transmitted* when nothing else of the picket could be made out, and the whole field was an indistinguishable maze. I used the paper from the leaves of an ordinary school scribbling book. The paper must not be opaque. In running lines through poplar woods it is necessary to have the means of securing the identification of the back picket when sighting to it, for on long sights in an unfavorable light a small tree standing close to the line might be mistaken for the picket, unless the latter is by some means rendered conspicuous. I believe that errors in the production of lines have sometimes originated in this way.

Henceforth, in Manitoba and the North-West, the surveys will be largely in timbered country where the use of carts will be impracticable, and other means of transport must be employed. In Ontario and Quebec the canoe and the pack-strap are the surveyor's simple and effective transport outfit, and among the Indians, half-breeds, trappers and explorers, it was always comparatively easy to make up a party of men who were suitable for the work; it is not so easy to get them now as formerly, however. But in the North-West it is different; there the usual way of carrying freight has been by carts in the open country, and by dog-trains through the woods in winter: there has been very little packing done there on men's backs. This question of transport will, in the very near future, require a solution from surveyors, and contractors especially are very much interested in it. The natural man does not take kindly to a pack-strap, and among the men one meets out West very few would cheerfully attempt to make themselves efficient in the use of that instrument. On the few occasions in which my baggage, etc., had to be transported through the woods, I found that I was about the only one of the party who knew anything about making up or carrying a pack. It has occurred to me that it might be possible to use pack-horses on a survey in the woods, except in swampy country. A little extra work on an ordinary line would make it passable for a horse with his pack load in the poplar woods of Manitoba and the North-West, where also is found grass for the animal's subsistence. If any of our members have had experience in this line, and would prepare a paper on the subject for our next meeting, I submit that they would be doing a real service to the profession; perhaps some one who has worked in the Rockies or in British Columbia will take the matter up.

Owing to the succession of dry seasons in the North-West, it has of late years often been impossible to find water at points where, for the economical carrying out of a survey, it was most desirable that camps should be located. As a consequence, a great deal of extra fatigue and loss of time has been incurred in making long marches to work and back again, morning and night. In many cases where even a flying camp would have been a great economy, the absence of water precluded the bivouac of a night or two. Information, then, in regard to a suitable vessel to carry water on a pack-horse, or on a pack-strap, would be valuable. I have heard of a pair of kegs being used, slung across a horse's back: possibly vessels of gutta percha might be used. In some cases it might pay to dig a well in order to have a camp at a desired place. I did this on one occasion in 1889, in the bush country south of Portage La Prairie, but there is a tract there underlaid by a bed of quicksand, and water can be reached almost anywhere within five or six feet of the surface.

It cannot be expected that the cheap rate at which the land in the North-West has been surveyed hitherto is to continue indefinitely: the work is becoming of a more difficult character, is getting to be farther and farther away from the settlements, and it will be increasingly difficult to obtain the right class of men as assistants. In view of this the prices paid for the work will have to be advanced if the contract system is to be continued. Even now the rates are too low: they are much lower than are paid by the Ontario Crown Land Department. Let contractors, therefore, stand shoulder to shoulder and help each other in every possible way. Let them strive to raise the standard of their work, faithfully adhering to the terms of their contracts, and in every way showing themselves worthy of public confidence and respect, and from this moral vantage ground energetically and persistently work for a just recognition of their rights until these are obtained.

JOHN McAREE.

TORONTO, February 13th, 1891.

SURVEY OF RAILWAY LINES.

Mr. President and Gentlemen,—

The survey of railway lines is familiar to some of our members, but a number have not yet been called upon to perform such work; to these the few remarks I am about to make on the usual field practice in the survey and location of railways will, I hope, be of some interest; but I especially wish to draw the attention of all the members of this Association to the fact that the survey of railway lines is a very important branch of the profession of a surveyor, yet it is practised by many who do not necessarily pass any examination or undergo any course of training to qualify them for such work.

To be a Civil Engineer it is absolutely necessary to be first a good surveyor, yet by legal enactment no one may perform the ordinary duties of a Land Surveyor without having first passed a preliminary examination, then served under articles for three years (or completed a course of two years at one of the colleges and served one year), and then have passed a final examination, and we all know that the examinations are sufficiently comprehensive; yet to perform the very important surveys that are required for such undertakings as railways or canals no examination, course of training, or certificate of any kind, is required, although the actual field work performed by the assistant engineers, who are usually called transit-men or levellers, is, as I think the following remarks will show, identical with that which forms one of the principal branches of study, practice and examination, in order to be admitted to practice as a Land Surveyor.

I purposely do not include in the foregoing the duties of the Locating Engineer himself, because to be an Engineer qualified to undertake the location of the whole or any part of an important line of railway or canal, it is not only necessary that he should be a good Surveyor, but he should also be well informed both in the theory and practice of all matters connected with the construction of these works. In the cases of the transit-man and leveller no such knowledge is required, but they should have received a sufficient amount of training in theory and practice as Surveyors.

The preliminary steps in the location and survey of a line of railway are taken by the locating engineer himself, and generally alone. If possible, and time will allow, he thoroughly informs himself by personal inspection of all the general characteristics of the country through which the line is to run, and then decides what route or routes between the objective points of the proposed line of railway it would be advisable to survey in order to meet all the requirements, according to his instructions, or, in some instances, according to his own judgment, of grade, alignment and cost.

The first line or lines run are simply trial lines—that is, they are run in as cheap and expeditious a manner as possible; no time is spent in making permanent marks except an occasional bench-mark for future use, nor in running in the curves, and sometimes merely a compass-line is run.

An ordinary party for a railway survey through any settled parts of Ontario or Quebec is usually composed of the Engineer in charge, a transit party, usually consisting of one transit-man, two chain-men, two picket-men, and from three to five axe-men, one of whom is usually employed in preparing, carrying and driving stakes, and a levelling party consisting of a leveller and rod-man, and sometimes an axe-man; also a team and teamster, and a waggon seated to carry the whole party is nearly always a necessity.

The survey commences by a trial-line commencing at any point decided on by the Engineer, usually near one of the objective points of the railway; a small hub is driven in the ground and a point on it marked with a tack; the transit is carefully levelled in the usual manner over the tack-head; the Engineer points out the direction the line is to be run, and its survey proceeds in the following manner: a picket-man proceeds in the direction pointed out, accompanied by an axe-man, to a point indicated to him, or if it is intended to run a long tangent, to a suitable point as distant as possible—that is, to a point from which the transit-man can again take a long sight; he then calls the attention of the transit-man by any conventional sign, usually by waving his picket horizontally; the transit-man waves him and his picket, which he of course holds on the ground perpendicularly, into line; at the point indicated the axe-man drives a small hub, the transit-man again gives line on the hub, and a tack is driven at the point indicated. The picket-man then signs to the transit-man that he may come ahead, usually by planting his picket diagonally across the hub; when the transit-man sees this sign he waves up his back picket by waving his handkerchief around and around in a wide circle; when the front picket-man sees this sign he is aware that his own sign has been observed by the transit-man; he then plants his picket perpendicularly at the hub, or at some point on line, to serve as a guide to the axe-man to clear away any obstruction in the way of trees, etc., and as a guide for the chain-men who will now have commenced their work, the hind chain-men lining in the front chain-man in the usual manner. I might state at this point that on location each stake is carefully lined in with the transit, and some engineers prefer to line in the stakes with the transit even on trial lines.

Railway lines in this country consist, almost without exception, of tangents united by circular curves. Tangents only, as before stated, are usually run in trial lines, but in rough country it is very frequently necessary to ascertain approximately the position of the curve in order to ascertain the level of the ground the actual line would occupy; in such a case the curve may be run in without any precautions to ensure more than ordinary accuracy, or sometimes it is quite sufficient to ascertain by calculation the position of the point at the middle of the curve.

The chain-men commence their work at the starting point, marking it O, and plant stakes at every 100 feet on the line surveyed, marking the first 1, and then consecutively 2, 3, 4, etc. Each of the points so marked by a stake is called a station, and its number the number of the station; any point between two such stations is called a plus station. The chain used is 100 feet long, marked at each 10 feet in the same manner that Gunter's chain is marked at each 10 links. The chain-men are assisted by an axe-man, who carries and drives the stakes; these stakes, on trial lines, are small and intended only for temporary use. Near each hub or transit-point a stake is planted marked with the distance measured to the tack. If the hub is not at an even station the distance is marked with the last station number, plus the number of feet and tenths, and in the same manner is any measurement along the centre line of a railway quoted.

The hind chain-man carries a note-book in which he enters the measurements to all banks of streams, rivers, roads, houses, etc. The transit-man also carries a note-book in which he carefully enters the measurements to all transit-points, the angles of any deviations made, size of timber, the soil, rock, etc., observations regarding the width and depth of streams, to assist in determining the sizes of culverts or bridges required, and all the topography of interest that he can without delaying the progress of the line.

The leveller commences his work by first carefully examining the adjustments of his instrument; he then establishes a bench or bench-mark on any solid point that is not liable to be disturbed; a favorite way, when possible, is to cut a notch with an elevated point on it, in the root of a tree; he then assumes a datum, simply taking care to assume it at a point lower than any to be met with on the line; for instance, if he is assured that no point on the intended line of railway is lower than 200 feet below his bench-mark, it would be convenient to assume the datum to be 300 feet below; then by taking a sight on the rod held on the B.M. and adding this reading to 300, he has the height of his instrument above datum; he then proceeds to take levels along the line run. The rod is held for this purpose at all the stations and at all intermediate points when a change or the unevenness of the ground may require it; also, in the beds and at the different water-level marks of streams. When the ground is very uneven, or slopes rapidly, levels at right angles, and for a short distance across the centre line, are sometimes required.

The left-hand page of the leveller's note-book contains five columns, entitled: Station, Back-sight, Height of Instrument, Fore-sight, and Elevation; the right-hand page is reserved for remarks or topography.

The leveller keeps the levels up as nearly as possible to the transit, and especially in a rough country, in order that he may at any time be able to plot a profile of the ground when asked to do so by the engineer. In the evening the work is plotted on a distorted scale, usually 20 feet to the inch vertically, and 400 feet to the inch horizontally, on profile paper already prepared by the manufacturer, by having 20 lines to the inch ruled horizontally and 4 vertically. The engineer, by stretching a thread from point to point, can ascertain very rapidly if the line surveyed will admit the limit of gradient, and he can arrange the grades to the best advantage. Formerly profile paper was not to be obtained; the work had then to be plotted by scaling each horizontal and perpendicular measurement, a most tedious process.

When the results of the survey prove that some one route is as satisfactory as can be obtained, the line is located. The location survey differs from the survey of a trial line in the following particulars: every care is taken to project the tangents carefully; large hubs, usually about 15 inches long and 5 inches in diameter, are used, and good substantial stakes are driven at each station. The curves uniting the tangents are all carefully run in; also cross sections of bridge sites and soundings in river flats and beds are taken to afford data to determine the foundations of bridges, and the class and size of all structures are decided on by the Locating Engineer, subject to the subsequent approval or amendment of the Chief Engineer.

In setting a point on a hub in location, the transit-man carefully sights on his back picket and as carefully waves his front picket to the exact spot, then he reverses his transit and repeats the operation, the front picket-man measures carefully the distance between the two points thus taken and places the tack exactly half way between, this point is then obviously the one marking the correct production of the line. The transit-man is careful to keep his instrument in good adjustment and should not under any circumstances delay adjusting it if the two points given on a hub at a distance of about 1,200 feet are more than 1½ inches apart.

If the ground will permit, the curves uniting tangents are usually run in by first running the tangents to an intersection, the Intersection Angle is then measured, the tangents of the curve are calculated, a hub is planted at the beginning and another at the end of the curve and the curve is run in from either end, but a practice which I very much prefer is to plant a hub also at the middle of curve; the additional calculation is very simple, the delay trifling, and by running in the curve from each end of the curve to the M. C. an error is discovered when only half way around the curve, whereas without the M. C. point an error is not easily detected until nearly the whole curve is run in; errors of this kind cause serious delays in heavily wooded sections.

Any one of the many treatises on Field Practice for Engineers will give the formulæ for the calculation of curves and every Engineer and Assistant Engineer is careful to provide himself with one of these books.

To illustrate the practice of running in a curve I will give an example; suppose the transit to be standing over the intersection point, thus the intersection angle, that is the angle made by the deviation of one tangent from the other, measures 20° 20′, and the measurement on the centre line to the intersection point is 548 + 70, also that the engineer in charge has decided that a 2° curve shall be used to unite the tangents. Then to find the length of the tangents of the curve, the well known formula is Tan. = Rad. × tan. of ½ intersection angle. The books of field practice always contain tables of Radii already calculated and usually to every five minutes.

A 2° curve is a curve in which a chord of 100′ will subtend an angle of 2° at the centre of the circle, the Radius of such a circle will then be 2864·93 feet, or as usually assumed 2865 feet; then

$$\text{Log. } 2865 = 3{\cdot}457125$$
$$\text{Log. Tan. } \tfrac{1}{2} \text{ Int. An. } (=10°10') = 9{\cdot}253648$$
$$\text{Log. } 513{\cdot}8 = 2{\cdot}710773$$

The tangents of the curve are therefore 513·8 feet in length; now to find the M. C. distance it is only necessary to multiply the length of the tangents as found by ¼ of the Int. An. by log.

$$\text{Log. } 513{\cdot}8 \text{ (as above)} = 2{\cdot}710773$$
$$\text{Log. Tan. } \tfrac{1}{4} \text{ Int. An. } (=5°\ 5') = 8\ 949168$$
$$\text{Log. } 45{\cdot}7 \qquad = \bar{1}{\cdot}659941$$

The M. C. distance is therefore 45·7 feet. Half the complement of the Int. An. is $\frac{180° - 20°\ 20'}{2} = 79°\ 50'$. Therefore an angle of 79° 50′ turned from either tangent obviously gives the direction of the M. C. and 45·7 feet measured carefully from the intersection point the middle of the curve is found which is marked with a good hub, a tack is driven in it at the exact spot and a witness stake is planted near the hub.

The tangents of the curve are then carefully measured, first the one to the end of the curve then the one to the beginning, the chain-pins are carefully lined in and every precaution is taken to secure accuracy; good hubs are driven at both the E. C. and B. C., and the exact spots marked with tacks in the usual manner.

The transit-man then proceeds with his instrument to the B. C. which is necessarily at station 543 + 56·2 and runs the curve half way around that to the M. C. He then proceeds to the E. C. and runs the remaining half back to the M. C.

A little reflection will show that the length of the curve must be equal to as many hundreds of feet and fractions of a hundred feet as half the degree of the curve is contained in the half intersection angle. Therefore the length of the curve $= \frac{20^\circ\ 20'}{2} \div 1^\circ = \frac{610'}{60'} = 1016{\cdot}7$ feet, the middle of curve is at $543 + 56{\cdot}2 + \frac{1016{\cdot}6}{2} = 548 + 64{\cdot}5$, and the end of curve is at $543 + 56{\cdot}2 + 1016{\cdot}6 = 553 + 72{\cdot}8$.

The transit stands at the B. C. The first stake to be planted on the curve will be at station 544, that is at a distance of 43·8 feet from the B. C.

Angles in a circle are not proportional to the chords but to the arcs which they subtend, but the error is so small that it is always disregarded. As an angle at the circumference of a circle is one half the angle at the centre subtended by the same chord, and any angle between a chord and a tangent is also equal to one-half the angle at the centre, therefore to lay off a chord of 100 feet from any point on the curve it is only necessary to lay off from the tangent an angle equal to one half the degree of the curve, which in this case would be an angle of one degree, and as before explained for any portion of a chord of 100 feet an equal proportion of the same angle. Therefore the first angle is laid off from the tangent of the curve and is $= \frac{43.8 \times 60}{100} = 26{\cdot}3$ minutes; at the distance of 43·8 feet on the line so found is the position of the stake marking station 544; at the distance of 104′ from station 544 and at an angle with the tangent 1° 26′ is the position of station 545, and so on for each station, and similarly as above for the fractional or plus station at the M. C., the total angle to this point being necessarily equal to quarter of the Int. An. $= 5^\circ\ 5'$. Should it be necessary on account of intervening obstacles to plant one or more hubs in any convenient points on the curve between either the B. C. or E. C. and the M. C. it is simply done in the same manner by turning from the tangent the angle corresponding to the distance measured; the transit is then moved to that point, a sight is taken on the last point left, and an angle equal to the angle laid off from that point is turned outwardly from the curve, this line so found is obviously a tangent to the curve, the curve is then continued as before by laying off the corresponding angles from the new tangent.

In a rough country or on account of some obstacle, such as a lake or a river, it is frequently impracticable to run out the tangents to an intersection; in such cases one or more chords are run to unite the tangents and the resulting triangles calculated, from which the intersection angle and the point of intersection are found; the curve is then calculated and run in the usual manner. Similar problems arise from time to time which present to a good surveyor very little difficulty.

The duties of a leveller in connection with a located line are very similar to his duties on a trial line. In addition to levels taken at all the stations and necessary intermediate points, he has to establish bench-marks at convenient points near the located line at distances averaging about 2,000 feet apart, for the use of the Engineers who will subsequently have charge of the construction of the railway. He has to take close cross-sections of the sites of proposed bridges, to furnish data for the preparation of the plans of abutments and piers, and he has also charge usually of the soundings that are taken for the same purpose.

The foregoing remarks will, I hope, show that the duties of transit-men and levellers in railway surveys are very important branches of the profession of a surveyor; in the same manner it may be shown that the similar duties connected with the survey and location of canals are the proper duties of well trained surveyors.

I think that all Civil Engineers and Surveyors who have the best interests of their profession at heart will admit that it would be of the greatest advantage to both if the professions were united or federated.

If such a union or federation were effected, candidates for Civil Engineering could be compelled by law to be properly qualified in the art and different branches of Land Surveying prior to admittance to examination in one or more of the different branches of Civil Engineering. It will be then possible to secure that all the Civil Engineering and Surveying required in the various public works in the country be performed by men who have gone through a requisite course of training and examination, and the united or federated profession would have that strength and importance which is its proper due and be the better able to secure such legislation and to make such regulations as will tend towards its material and scientific progress.

SAML. BRAY.

DISCUSSION.

SAMUEL BRAY—Did not wish it to be understood that anything in his paper was intended to reflect upon the course of training in any of the Colleges or Universities.

W. S. DREWRY—Took exception to Mr. Bray's remark that Engineering was a higher branch of the profession than Surveying. The Surveyor in his profession required to know a great deal of astronomy, and other higher branches of mathematics which were unnecessary to the Engineer.

S. BRAY—This was the very point that he wished to make, viz: That the Engineer should be educated in the requirements of Land Surveying.

W. S. DREWRY—Said that lines run by Engineers as such could not be made use of in a court of law.

S. BRAY—Said that he referred only to railway lines. He thought Engineers should be competent to do Surveyor's work.

J. S. DENNIS—Mr. Bray's intention seems to be to force Surveyors and Engineers into an amalgamation as one profession. He did not consider that there was any necessity for this, each profession is able to stand on its own bottom. We did not require to take any steps to protect Civil Engineers; they had taken steps to protect themselves. In that profession it was a case of the "survival of the fittest." He thought the two branches of the profession were entirely separate, and we should not interfere with their work or try to compel them to qualify themselves as Surveyors.

S. BRAY—Did not wish to dictate to the profession and must ask permission to withdraw his paper.

VOICES—No! No!

S. BRAY—He contended that the ordinary duties of a City Engineer were best performed by a Land Surveyor.

J. S. DENNIS—As a general thing the Land Surveyor is not qualified to do that class of work.

S. BRAY—The reason he had this hobby; if so it might be called, was to widen the scope of the profession. It was narrow enough now, goodness knows.

G. A. Mountain—Thought some of Mr. Bray's points were good. All plans of railway location had to be signed by a Land Surveyor, and he thought that in this respect Mr. Bray was correct. He did not agree with Mr. Dennis that location work was not the work of a Surveyor, and he thought they should be competent to do this kind of work.

J. R. Hall—In locating the C. P. R. the railway company had employed engineers who were not surveyors, and the Department of the Interior had shewn on their maps a point located by them which, when checked by the Dominion Land Surveys, was found to be fourteen miles out of true position. He thought that to some extent railway engineers should be able to determine latitude and longitude.

Wm. Ogilvie—The higher grades of Surveying required quite as much knowledge as the higher grades of Railway or Civil Engineering. Any Engineer who undertook to determine the correct position of two points upon the earth's surface relative to each other, would find it quite as intricate a calculation as any in Engineering.

WHARTON'S GNOMONIC PROJECTION.

Captain W. J. L. Wharton, R.N., F.R.S., is the Hydrographer to the British Admiralty at the present time, and in his treatise on Hydrographical Surveying for the guidance of his officers gives the only detailed description I have met with on the graduation of a chart on this projection. I have therefore coupled his name in connection therewith, although the *principle* has no doubt been known a long time, and I daresay most of the members of this Association have seen brief allusions to it in treatises of various projections. A chart of the Gnomonic Projection is supposed to be drawn on a flat surface laid against the earth, touching it at the central point, and there only.

From the centre of the earth lines are supposed to be drawn through the various points to be shewn on the chart until they pierce the flat surface.

By this method the meridians are shewn as straight lines, and the parallels of latitude are depicted as curves, and for a district not exceeding 50 or 60 miles square there is no practical distortion of the globular surface.

This projection is very similar to that used by the United States Coast and Geodetic Survey, called the Conical or Poly-conical Projection. This, as doubtless you are aware, is the development of a similarly small portion of the globe tangential at the middle latitude, or at every parallel of latitude, and afterwards flattened out.

In both the Poly-conic and Gnomonic projections, the radiating point of the meridians, and the generating point of the parallels of latitude is represented by X (Fig. 1), being the intersection of the central meridian with the produced radius of the earth.

For the construction of charts on the Poly-conical Projection the United States Bureau of Navigation has published very useful tables of ver sines, which I have, wherewith to form the parallels of latitude, but by the Gnomonic Projection no especial tables are necessary, the top and bottom curves being drawn by means of the angular measurement of the convergence of meridians, as will be seen later on.

Let ABCD (Fig. 1) represent the chart to be graduated.

M and F on central meridian are shewn on chart at N and G. K east of meridian is shown at L. R (Fig. 2) is a point west of meridian not visible on Fig. 1.

In Fig. 2 ABCD represents the same chart facing us. LTX and ORX are the meridians of L and R.

RXL is the convergence, for it is the difference between ORL and RLX, the two astronomical bearings.

To graduate the chart I would direct your attention to Fig. 3.

D and C in opposite corners of the chart have their assumed astronomical positions marked against them, and by means of these the meridians and parallels are laid down as follows :—

First, the bearing and distance are calculated between them, and they are plotted on the scale determined on.

There are various methods, as you know, of calculating their respective bearings and distance. I find the following formulæ give fairly accurate results :—

$$\left\{\begin{array}{l} \text{Tan. Mercatorial bearing} = \dfrac{\text{Seconds diff. long.} \times \text{length sec. in mid. lat.}}{\text{Seconds diff. lat.} \times \text{length sec. in mid. lat.}} \\ \\ \text{Convergence (Scds.)} = \text{diff. long. (scds.)} + \text{sine mid. lat.} \\ \text{Distance} = \text{diff. lat.} \times \text{second Mercatorial bearing.} \end{array}\right.$$

The meridians are laid off through D and C, the convergence being exaggerated here to 6 degrees, C bearing from DN 47° E., and D from CS 53° W.

DF is drawn perpendiculary to meridian through D and CH perpendicularly to that through C.

On the polar side of these perpendiculars the angle of half the convergence is laid off by means of chords, the chord of an arc being equal to $2 \sin. \dfrac{\text{arc}}{2} \times \text{rad. } 1.$

Then G is on the parallel of D, and J on that of C, to prove which I would direct your attention to Fig. 4.

D and C are the graduating positions on Fig. 3, P the pole of projection. CG is made equal to the diff. of lat. of C and D, therefore G is on the parallel of D. G and D are joined, and the line bisected in X, and central meridian drawn through it, DF is drawn perpendicular to D's meridian, and it can now be shewn that the angle GDF is half convergence;

Because XDP = 90 - XPD
also " = 90 - XDF
∴ XDF = XPD (half convergence).

Turning again to Fig. 3, join CJ and DG, and bisect them in A and B for central meridian, and if the rectangle has been correctly projected, the line joining J and G should intersect it on the original diagonal DC.

CJ and GD are divided into as many meridians as are required, 7 in all here.

To get the curves of the parallels of latitude, the arc of half convergence is subdivided into as many parts as there are spaces between the outside meridians.

D joined to 1 gives position of the curve for first meridian eastward of D, and so on. Similarly for the northern parallel. The degree of latitude is divided on each meridian correspondingly to that of longitude (5 minutes here), and curves drawn by hand. The margin being ruled parallel to the centre meridian, the graduation is complete.

To prove that ¼ convergence intersects the central meridian AB on the parallel of D and G, we will turn again to Fig. 4.

Bisect GDF (half convergence) cutting central meridian E.
Bisect DPE (half convergence) by line PZ
then MDZ = 90 + ¼ convergence
also = DZP + DPZ (¼ convergence)
∴ DZP = 90 and PZE = 90

Consequently DZP and EZP are similar ▷s and PD = PE.

In conclusion, Captain Wharton gives the proof of the value of convergence in terms of the middle latitude and departure, which some of my brother surveyors in this room may not have come across, though the formula is familiar to all.

In Fig, 5, C is the centre of the earth, P the pole, EP and QP two meridians a known distance apart.

BL and DL are two tangents to the meridians at the middle latitude known, on the same plane as the meridians, meeting one another and the axis of the earth produced, at L.

BLD is the convergence, DLC is the middle latitude, and BCD represents departure. BD being small, differs little from a straight line, and BDL and BDC may be considered plane right angled triangles.

$$\text{Now BD} = \text{DL tan BLD}$$
$$\text{also} = \text{r tan BCD}$$
$$\text{But DL} = \text{r Cot DLC}$$
$$\therefore \text{r Cot DLC tan BLD} = \text{r tan BCD}$$
$$\text{or Tan BLD} = \text{Tan BCD Tan mid lat.}$$

And where convergence is small we may say—

$$\text{Convergence} = \text{Dep} \times \text{Tan mid lat.}$$

The parallel of 45° running through our work in Lake Huron is very convenient, as the tangent of that latitude being equal to radius, the convergence in minutes is practically the departure in nautical miles which can be taken off a graduated chart by inspection.

LATITUDE BY PRIME VERTICAL OBSERVATIONS.

In presenting this paper to the Association it is simply with the object of giving an illustration of a practical and accurate method for determining latitude; and a method that has been used by me.

Papers presented to the Association should always, I think, have a practical bearing; irrelevant theoretical prolems should be avoided.

It is not my intention to go into the whole mathematical discussion of prime vertical observations, for this would simply be a repetition of matter well discussed in Chauvent's Spherical and Practical Astronomy.

The practical application of the above method in work connected with Dominion Lands would occur in Exploratory Surveys, Timber Limit Surveys in isolated regions, and in a survey like the Railway Belt Survey through the Rocky Mountains and Selkirks which I made some years ago.

In connection with Timber Limit Surveys I desire to state that it should be made imperative by the Department that the Surveyor observe for latitude at his initial point, as it is comparatively simple to obtain at least one of the geographical co-ordinates—latitude. As it s now, we have scarcely the faintest idea, geographically speaking, where some of the surveyed timber limits are. I speak from personal experience. In the above cases the Surveyor is supposed to be provided with a 6-inch transit, D. L. pattern.

On the ordinary survey of Dominion Lands, whether in block, outline or contract work, the Surveyor has no occasion for observing for latitude, the latitude of the sections in the various townships being tabulated in the Manual.

Different it is however in the other cases. For the determination of azimuth the latitude must be known, and furthermore in exploratory work the latitude is desired for its own sake, that is, for obtaining the geographical position of places. You will now understand under what conditions I am considering the above cited method.

It may be stated at the outset that with the instrument provided it is the best method for ascertaining the latitude, and furthermore that this method ranks next to that of the zenith telescope for the most refined determinations of that element. Theoretically considered all astronomic problems that fall within our sphere are very simple.

For instance, to obtain the azimuth from the altitude of the sun, we have given three sides of a spherical triangle, to find one of the angles. When we observe on Polaris at elongation, we solve a right angled triangle; or when observing Polaris at any hour angle (method given in the Manual) we solve a triangle on which are known two sides and the included angle.

An observed meridian altitude of the sun or star for latitude is, theoretically, simply addition or subtraction.

A latitude observation in the prime vertical is the solution of a right angled triangle. And so on through the whole series. The question then arises, why is one method preferable to another, when theoretically they are equally good?

To enter into a discussion of this question is beyond the scope of the present paper. However it may be stated that whenever observations involving refraction can be avoided, they are avoided, for refraction is an unstable and undesirable element to deal with. Next, when we consider the mathematical formulæ of various methods, we find that small errors in our data will affect the result in one case more than in another, hence the adoption of the latter. And finally, the real proof of the value of any method is the work resulting from it. In this resulting work we have all the errors,—those of star places, instrumental and personal compounded, boiled together as it were, and looking at us in silent figures; and by these each method must stand or fall as a practical application of a theoretical principle. Now to return to our prime vertical observations.

If we let φ=latitude, δ=declination of star, and t= its hour angle when on the prime vertical we have

$$\tan \varphi = \tan \delta \sec. t.$$

Before we begin observing we must select our stars. The most suitable Ephemeris is the Berliner Jahrbuch, for it has the largest number of stars whose apparent places are given. Mathematical considerations tell us to take stars whose declinations are nearly the same as the assumed latitude (but less of course, otherwise the star would transit north of the zenith and would not cross the prime vertical). Those passing near and south of the zenith have the advantage too of being observed both at the east and west transits across the prime vertical.

To select stars we enter the Ephemeris with arguments,—approximate latitude (within half a degree will do) and the time we wish to begin to observe. Roughly speaking sidereal time gains on mean time two hours per month, hence if we wish to begin observing say at nine o'clock in the evening in the latter part of July, our sidereal time would then be four times two hours, that is eight hours ahead of the mean time, *i. e.* the approximate right ascension of a star whose meridian transit is at nine o'clock would be, nine plus eight hours, that is, 17^h. So from 17^h R.A. and onward we begin looking through the list for stars whose declination is somewhat less than the assumed latitude. Having selected several stars, avoiding first magnitude ones on account of the blotch of light they present in the telescope, we compute their approximate hour angle and altitude when on the prime vertical for setting the telescope; for this purpose the latitude is always sufficiently well known. The hour angle we find from

$$Cos\ t = Cot\ \varphi\ tan\ \delta$$

and the altitude from

$$Sin\ h = Sin\ \delta\ Cosse\ \varphi.$$

Having computed the various hour angles and altitudes we add or subtract the former for west or east transits to or from the right ascension of the respective star, and thereby find the approximate sidereal time of transit. We then tabulate the times of transit in the order of occurrence. The form upon which I enter them is the following :—

DATE :

Star.	Mag.	Approx. Transit.		Altitude.	Chron. Time Transit.	Remarks.
		E	W			

Now in order to make an observation two conditions are requisite, besides the adjustment of the instrument for level and collination, namely, that the instrument be in the prime vertical and that we know the true sidereal time of transit.

I always determine my chronometer correction before and after the prime vertical observations. By this means I not only determine the chronometer error but also its rate, an important consideration if the rate is great. For the determination of time I use the simple and expeditious method given in the Manual,—observing a time star in the same vertical plane with Polaris. Knowing the time now, the azimuth of Polaris for a convenient time, just before the prime verital observations are begun, is computed.

With chronometer in hand I then set Polaris on the intersection of the threads at that instant; next read one venier and turn the instrument the computed angle into the prime vertical.

When observing transits I pursue the following method for recording time: When the star is in the field of the telescope and about 30 seconds before transit I pick up the beat of my sidereal pocket chronometer (such as furnished years ago to Block Surveyors) at some even division,—say at any of the quarter minutes of the second hand, and then carry the beats forward mentally, generally within hearing of the chronometer, up to the instant of transit when I record the beat at that instant, afterwards to be reduced to seconds and fractions thereof. My chronometer has 135 beats per minute, making each beat or the interval between two beats equal to four-ninths of a second.

While observing it is essential to note the level of the rotation axis as this quantity enters *directly* as a correction to the observed latitude. When observing the east and west transits of the same star we obtain a measure of the azimuth error from the hour angle of the meridian of the instrument, which latter is evidently equal to the difference of the mean of the true sidereal times of transit and the right ascension of the star.

If we call the hour angle of the meridian of the instrument, or, which is the same thing, the longitude of the instrument λ, then the azimuth

$$d = \lambda \operatorname{Sin} \varphi$$

By taking the mean of the east and west hour angles we eliminate the azimuth error. If the time permits, when observing at a place, to observe on a second night the same star or stars in reversed position of the axis we cut out the collination error, and hence from the mean of two night's observations have a result free from instrumental errors.

A small error in time (error both of noting time of transit and of chronometer as determined) affects the latitude by a small amount, as shown by the ratio expressed in the differential of the fundamental formula

$$\tan \varphi = \tan \delta \operatorname{Sec} t$$

in which for differentiation δ is considered constant.

Differentiating we have $Sec^2 \varphi \, d\varphi = \tan \delta \tan t \operatorname{Sec} t \, dt$,

$$\text{Whence } \frac{d\varphi}{dt} = \tfrac{1}{2} \operatorname{Sin} 2\varphi \tan t.$$

In this latitude an error of one second in time, beyond which an error should not be made in observing, would make an error in latitude of about two seconds in arc.

Prime vertical observations should never be taken on one side of the meridian only, but always on both sides even if not on the same star. This is necessary to check and neutralize the error of the instrument in azimuth.

And if the collimation constant is not known, as is usually the case with the surveyor's transit, then another observation east and west should be taken with axis reversed. The principle of reversal in any and all kinds of observations cannot be too strongly commended.

Preston. ABSTRACT OF OBSERVATIONS.

March 25th, 1891. CIRCLE SOUTH. Value 1 div. level = 5″

Star.	Mag.	Setting Alt.	Transit.	Level. N.	Level. S.	Remarks.
			h. m. s.			
10 Urs. Maj.	4.0	77°.91	7-58-36.9	7.6 9.4	7.4 5.6	Clear night, very light breeze. 21° F.
μ Urs. Maj.	3.0	77°.11	9 16-24.4	6.4 8.8	8.8 6.4	
10 Urs. Maj.	4.0	77°.91	10-09-09.1	10.0 4.8	5.5 10.4	
μ Urs. Maj.	3.0	77°.11	11-35-54.2	5.9 9.7	9.3 5.7	
Polaris	For	time.	6-53-50			
ε Can. Maj.			6-56-42.0			
Polaris	"	"	11-45-05			
β Leonis.			11-51-43.6			

March 28th, 1891. CIRCLE NORTH.

10 Urs. Maj.	4.0	77°.91	7-55-50	5.8 8.0 8.2 5.8	Fine, calm night. 31° F.
μ Urs. Maj.	3.0	77°.11	9-13-29.6	6.5 7.9 4.5 9.8	
10 Urs. Maj	4.0	77°.91	10-06-41.1	8.0 6.6 4.6 10.0	
μ Urs. Maj.	3.0	77°.11	11-33-13.6	5.7 9.1 8.3 6.6	
Polaris }	For	time.	7-00-40		
δ Can. Maj. }			7-03-41.1		
Polaris }	"	"	11-41-30		
β Leonis. }			11-48-53.1		

The following is the reduction of one set of observations :—
Preston—Assumed latitude 43° 24′.

For 10 Ursae Majoris.

	EAST.	WEST.	CIRCLE SOUTH.
	h. m. s.	h. m. s.	
$T=$	7-58-36.9	10-09-09.1	
$\Delta T=$	− 9-52.7	− 9-46.2	Rate + 3ˢ per hour.
	7-48-44.2	9-59-22.9	
	9-59-22.9		
	17-48-07.1		
½ Sum =	8-54-03.55		
$d=$	8-53-34.67		
$\lambda=$	28ˢ.88		
$=$	7′.22		

	h. m. s.	h. m. s.
$d=$	8-53-34.67	8-53-34.67
$T+\Delta T=$	7-48-44.20	9-59-22.9
	1-04-50.47	1-05-48.23
	1-05-48.23	
	2-10-38.70	
$\vartheta=$	1-05-19.35	
	$=16°19'50''.3$	$\delta=42°12'57''.6$

$$\log\tan\delta = 9.9577287$$
$$\log\sec\vartheta = .0178849$$
$$\log\cos\lambda = .9999991$$

$$\log\tan\varphi' = 9.9756127$$
$$\varphi' = 43°23'31''.8$$
$$\beta = +1''.8$$

$$\varphi = 43°23'33''.6$$

The value of φ includes the correction for collimation, but as we have an observation on the same star for instrument—circle north—on March 28, we may neglect determining the collimation as its effect will disappear in the mean of the two nights.

For March 28, $\varphi = 43° \; 23' \; 48''.1$

The mean of observations on one star,—10 Urs. Maj. for two nights—circle south and circle north respectively gives

$$\varphi_0 = 43° \; 23' \; 40''.9$$

Similarly is deduced from observations on the same nights on μ Urs. Maj.

March 25, $\varphi = 43° \; 23' \; 38''.9$

" 28, $\varphi = 43° \; 23' \; 47''.8$

And the mean $\varphi_0 = 43° \; 23' \; 43''.4$

For final value we take the mean of the two stars, hence

$$\Phi = 43° \; 23' \; 42''.1$$

It will be noticed that the result given by the one star differs from that of the other star by 2''.5.

This we may consider a measure of accordance to be expected in observations taken with ordinary care, and as applicable for the field.

OTTO J. KLOTZ.

THE SYSTEM ADOPTED BY THE CANADIAN PACIFIC RAILWAY FOR THE EXAMINATION OF NORTH-WEST LANDS.

The contract made between the Government of Canada and the Canadian Pacific Railway Company for the construction of a transcontinental railway provided, as part of the consideration, a subsidy of twenty-five million acres of land.

It was stipulated that the lands should consist of such odd numbered sections as were fairly fit for settlement, in a belt extending twenty-four miles on each side of the part of the railway lying between Winnipeg and the Rocky Mountains, and in such other areas as might be agreed upon.

For the proper administration of these lands it was necessary to decide two points, viz: What, if any sections should be named as not coming up to the standard implied in the contract, and what was the relative value of each parcel to a known standard. Inasmuch as the object of the Government survey of the North-West lands was to define their boundaries accurately rather than their surface value, the field notes and reports furnished by the Dominion Land Surveyors were not found ad[illegible] for the purposes of the Company. It was therefore essential to [illegible]ze a corps of men to make such examinations in the field, the resu[illegible]f which would be sufficient to enable the Executive to come to a decision on the point at issue.

It was found impossible to lay down a system for valuing sections of land, spread over vast areas, in unsettled districts, the working out of which would show accurately the true value of each parcel. But in order that the official charged with administering the lands of the Railway Company should be able to properly interpret the minds of a large number of examiners, it was necessary that there should be one system of grading on which all were to work, the basis of which should be certain standard sections of land with which he and the examiners were alike familiar and to which all the lands reported on should be referred. This is the principle underlying the system on which I am now addressing you. Time developed a number of imperfections with regard to the details of the scheme, but considered broadly it has answered admirably the purpose for which it was designed.

In my remarks the question will be treated under two headings:—1st. The nature of the information required. 2nd. The method for obtaining it.

The characteristics of each section of land were to be given under the following heads:—

1. SURFACE—Whether level, rolling, broken or hilly. The direction of slope and general elevation above principal streams and lakes.
2. SOIL—As this serves as the basis of value it is graded according to the following scale:
   (a) Rich, deep, dark loams with clay or sandy-clay subsoils. Rated No. 1.
   (b) Shallow light clay and sandy loam with gravelly-clay or sandy-clay subsoils. Rated No. 1½.
   (c) Shallow or gravelly loams with sand and gravelly subsoils. Rated No. 2.
   (d) Sands and gravels. Rated No. 3, and lower.
3. TIMBER—Kind and character of growth. Estimate saw-logs, cords of wood, ties and rails on each quarter section.
4. WATER—Character of water, whether fresh, salt, or mineral; width and depth of streams and character of flow; location and quality of springs; rainfall.
5. GRASS—Kind and nature of growth on upland; the amount of hay per acre meadows will yield.
6. MINERALS—Kind, nature of deposit, etc.
7. CAPABILITIES—The class of farming the section is best adapted for.
8. Area of arable land on each quarter section.

Each legal subdivision is graded by numbers running from 1 to 5, based on the result of examination under the above heads, and on its relative value to the standard sections on which the examiners have been trained before entering on their duties. Having sketched briefly the nature of the information required I will proceed to its practical application. For this purpose land examiners were engaged and formed into field parties.

A land examining party consists of six men, comprising a chief, three land examiners, a cook and teamster. The chief, in addition to doing the regular work of an examiner, supervises that of the examiners under him.

Before sending the parties into the field they were brigaded in one camp, where they were employed under the direction of the chief officer of the Department for some days in working together on certain standard sections. This was done for the purpose of perfecting the examiners in pacing, in seeing that the instructions were properly interpreted, and in fixing on the minds of the examiners *the character* of the sections that were to be their guides for future work.

In order to better ensure uniformity of work inspectors were placed over divisions consisting of five parties. These inspectors made monthly rounds, comparing the reports of the various parties in their division, and gave general direction to the field work.

The chief examiner, after arriving with his party at the group of townships named for examination, makes a daily allotment to each of the examiners of the sections he desires them to report on. In an ordinary prairie country one man can examine two sections in a day. At this rate the odd numbered sections in a township are examined in two working days.

The examination is made by running at least two of the boundary lines of each legal subdivision. This work is effected by means of a four-inch Bernier compass and pacing. The examiners are drilled into using a step of 1,000 double paces to the mile. Every feature that would add or detract from the value of the section under examination must be noted. In fact the examiner is required to make a complete topographical survey of the section. The work is plotted in the field with scale and protractor on section diagrams printed and issued in pad forms for this purpose. Whatever class the examiner finds that the soil of a section belongs to, the figure representing that, as shown in the scale I have previously given, represents the basis for grading. For every ten acres of waste land in a legal subdivision the rating of that particular parcel is reduced half a grade. Thus a legal subdivison having a deep, rich soil, resting on a clay subsoil, such as we find in the Red River Valley, containing twenty acres of waste land, would rate number two. There are, of course, exceptions to be made in this rule, when, for instance, the presence of a lake or hay meadow might add rather than detract from the value of the land, the examiner must use his own discretion in grading the legal subdivision. Having completed the examination of the sections allotted to him as his day's work, the examiner returns to the camp, makes a fair copy in ink of the drawing and field-notes made during the day. This is handed to the chief, who, if satisfied as to its correctness, transmits it at the first opportunity to the head office, where it is fyled, with others, for future use

L. A. HAMILTON.

DISCUSSION.

WM. OGILVIE—Thought it would be well if Dominion Land Surveyors were instructed to adopt some such system for the classification of lands, and had some definite rules laid down as to what constituted 1st, 2nd and 3rd-class soil.

L. A. HAMILTON—Considered Mr. Ogilvie's suggestion a good one. In their examinations the classifications had been found to be very different from those determined by the Surveyors of Townships.

A NEW SIGNAL FOR MOUNTAINOUS DISTRICTS.

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

Gentlemen,—

For many considerations I ask indulgence from this Assembly.

In the first place, this is my first public lecture and I am not very conversant with the language in which I address you; French being my mother tongue.

I would add to this, that I am one of the "young" in the Association, and was strongly solicited by the Executive Committee, which, in a letter addressed to me by the Secretary, gave for one argument, that, thus far, few French Canadians had contributed to the literary part in the meetings of the Association.

My present paper is on Signals.

In the season of 1889, I served as head of the observing party, in connection with the "Triangulation of the Railway Belt" in the Rocky Mountains.

The experience I obtained showed me that much could be done to improve the class of signals to be used on such surveys.

Allow me, gentlemen, to give you an idea of the difficulties an observer meets when, with a telescope of 30 power, he looks for a signal, at a distance of 20 to 30 miles; in an approximate direction which might be 2 to 3 degrees off.

Let this signal, of pyramidal shape, be built of stones, measuring 6 feet in height and 6 feet base.

This signal covers an angle of only about 10 seconds at the point of observation.

In the given direction more than one natural pyramid resembling the signal, will probably be seen and might put you astray.

Now suppose you surmount this signal with a flag,—you hardly better the condition, for the flag might be kept in the line of sight by the wind or rolled up around the staff; or again be destroyed by the wind which is always strong at those heights.

I may add that a flag of 2 feet by 3 cannot be seen at a greater distance than 18 miles in ordinary clear weather.

I do not recommend showy colors for signals on top of mountains for long sighting, since I found by experience that colors can hardly be distinguished at a greater distance than 15 miles.

Another difficulty which the observer meets, chiefly about the end of the season, is, that the mountains and signals being covered with snow, the whole is white and do not project well on the sky.

A great hindrance to good sighting is caused by refraction, chiefly when, from the top of a mountain, the observer has to point on a signal on the "*Foot Hills.*"

In practice I found it necessary to place a reflector in some instances on such signals.

An old saw is "necessity gives means." I went to work, and found something that might do away with much difficulty in observing such signals and avoid all uncertainty.

Allow me to call the machine I propose a "Revolving Heliotrope"; it is intended to surmount the stone pyramid.

This invention is simply an anemometer, in which the cups are replaced by shining tin cones, whose bases are opened and are equal to the altitude.

The difference of construction between the anemometer invented by Doctor Robinson, Dean of Armagh, Ireland, and the Revolving Heliotrope referred to, is the following :—In the former the axis revolves with the arms and cups, in order to register the velocity of the wind, and in the latter the axis remain stationary while the cones revolve.

I replace the cups with cones, because in practice it is easier to make a cone; furthermore, the pointed shape opposes less resistance against the wind and the machine will revolve more freely.

I strongly urge the last consideration as it would be a hard job to climb several thousand feet every morning to oil the machine.

The "Revolving Heliotrope" is constructed as follows :

The arms are 1½ feet in length and made with cylindrical iron bar half an inch in diameter. The axis, three-fourths of an inch in diameter, made of steel and is twelve inches in length. It has a shoulder at its middle.

Six inches of the axis is framed on the pole built in the monument.

The hub carrying the arms is passed through the upper part of the axis.

The cones are made of tin sheets measuring one-and-a-half feet square, and are rivetted to the arms with copper rivets.

The Revolving Heliotrope is carried to the summit of the mountains in pieces, and then the arms are screwed to the hub.

The whole machine weighs only from 7 to 8 pounds.

Four iron guy wires must be attached to the top of the pole and tied to heavy stones, to prevent the shaking of the machine, which would, in time, destroy the monument.

The Revolving Heliotrope will reflect the rays of the sun on every point in a circle of 30 miles radius.

It is evident that it will work when the observer is between the sun and the signal, or when the sun is at right angles with the line of sight. The worst case would be when the object is between the observer and the sun; in that case it would still apply, for the rays of the sun are reflected by two of the cones before they are sent in the direction of the observer; the direct rays are reflected by the exterior surface of the first to the interior surface of the second, and then to the observer. In the meanwhile, the direct rays of the sun are reflected from the interior surface of the third cone to the exterior surface of the fourth, and then to the observer.

Consequently, the observer receives two reflected rays from cones which are equally distant from the centre of the Revolving Heliotrope.

As the observations at long distances are made only when the sun is shining, this Revolving Heliotrope will always be visible to the observer, and that without the help of an heliotrope.

I have made a trial of this machine for a distance of 18 miles during the month of November, when the sun has a large south declination. The result was a success, and it was so easily seen as to do away with any doubt as to its practical value.

It has been objected that the rays of the sun so reflected are subject to great variation caused by refraction, and, consequently, might be a source of error in the observations. Supposing this to be true, would not this Revolving Heliotrope be a considerable help in pointing on the right monument? It would be a good indication of the signal.

I have prepared hastily a rough model of the Revolving Heliotrope, in order that any member could see it at work, which I now exhibit.

L. ACHILLE DUFRESNE.

DISCUSSION.

J. S. DENNIS—The apparatus proposed by Mr. Dufresne is a good one. The same idea had been used on the Special Survey some years ago, but only one cone was used. It had been found, however, that the signal was not a good one to observe on owing to reflection, but the cone served a useful purpose in finding the point to be observed.

L. A. DUFRESNE—That was its only objection.

NOTES

On the Mining, Concentration and Reduction of Low Grade Ores, and the Advantages of Water-Power and Electric Transmission in Connection with the Same.

GOLD QUARTZ.

Two-dollar auriferous quartz, when found in large veins or lodes, can now be mined and milled in California at a profit. When this branch of mining was first entered upon in that State, fifty dollars per ton gold quartz was about as low grade as could be mined and milled profitably, and thirty dollar rock was thrown aside. This was owing to the cost of labour and the other factors of production, imperfect machinery and methods, and profound ignorance of the business. Managers and Superintendents were without knowledge, practical or technical, and the Mining and Metallurgical Engineers brought from abroad were years in learning to adapt themselves and their methods to the widely different circumstances that prevailed here. Failures were the rule, and for many years idle quartz mills and abandoned mines were to be seen all over California. This was not due to the poverty of the mines, but to the circumstances above enumerated, and hundreds of quartz mines abandoned in early days have been re-opened within the last five years or so, and with improved machinery, and under competent management, are paying large dividends; and gold mining is to-day as safe and as profitable a business as farming, fruit growing, commerce, or any other pursuit in California.

SILVER ORES.

The same remarks apply to silver and silver-bearing base metal mines. Owing to the great improvements in Mining, Milling, Concentrating and Smelting machinery and plant, the application of Electricity to the transmission of power, and the increased knowledge possessed by our Mining Engineers, Superintendents, foremen and men, of the proper methods of mining and concentrating the ores, it is a fact that concentrating ores of the above character, yielding an average of only $5 per ton in value of silver and base metal combined, can be mined and reduced on a large scale, at a fair profit, in localities where water-power can be had, and where water or railroad transportation can be reached within a few miles, and $10 silver-bearing concentrating rock will pay almost anywhere that machinery can be brought in to work it, provided the vein is large (say over 10 feet wide) and can furnish from 100 tons upwards per day of such ore.

GOLD QUARTZ MILLS AND MILLING

The modern Gold Mill is usually built in such a situation that the ore can be delivered by car or waggon at the upper part, where it is dumped against an inclined "grizzly," and the finer ore, passing through the interstices of the "grizzly," falls directly into the main ore bin. The coarser ore (too large to pass through the "grizzly") is screened off by gravitation into the coarse ore bin, from which it is drawn, by gravity, directly into the rock-breakers, or it falls upon a floor in front of the rock-breakers; by these it is crushed and falls into the main ore bins.

From the main ore bins the ore passes through gates into the "self-feeders," which supply it automatically to the batteries. Quicksilver is fed at intervals to the mortars of the battery, and, coming in contact with the native or "free" gold of the finely-crushed ore, forms with it an amalgam. This amalgam is caught partly by the copper plates in the battery, and partly upon the amalgamated, or silver-plated copper plates, on the apron and in the sluice-boxes outside, after it has issued through the screens of the mortar. The amalgam is "cleaned up" periodically and retorted. Retorting consists in the sublimation of the quicksilver, the vapors of which are condensed in water and the quicksilver collected; the residual gold is in a porous state; it is melted with fluxes in crucibles and cast in ingots. The pulp from which the free gold has been extracted by amalgamation passes over concentrators of various mechanical devices. These concentrators effect a separation of the auriferous sulphurets from the worthless gangue. In California the concentrated sulphurets are treated by the Chlorimation process. In some other sections of the country the sulphurets are sold to the smelting works.

AURIFEROUS SULPHURETS.

The gold ores of California carry, on an average, 2% of sulphurets. The concentrated sulphurets assay, on an average, from $60 to $90 per ton in gold, with from a trace to several dollars in silver. The custom Chlorimation Works in California charge $20 per ton of sulphurets (about 40 cents per ton of quartz before concentration) for treatment, and return 90% of the assay value.

Under conditions or inarily favorable, a plant treating 6 to 9 tons per 24 hours, can reduce the sulphurets at a cost of $8.00 to $10.00 per ton, extracting 90 to 94 per cent. of the assay value of the gold.

SILVER MILLING ORES, FREE AND REBELLIOUS.

Silver Milling ores are either "free", or "base," and the latter require a preliminary or chloridizing roasting. The free milling ore passes through the same process as gold ores until the battery is reached. The ores are crushed wet in the battery, but battery amalgamation is not practiced. From the battery the pulp passes through sluices into settling tanks, where the superfluous water is drained off. The pulp is then shovelled into the pans, where salt and bluestone or other "chemicals" are used. Here the ore is first ground and then amalgamated. After several hours the pulp is run into settlers, where it is diluted with water, and the heavy amalgam and quicksilver settles to the bottom; this is then collected and strained and the dry amalgam retorted.

Base or Rebellious Silver Milling ores contain too much sulphur, arsenic, antimony, etc., to be treated by free milling process. After crushing in a rock-breaker, they require a previous chloridizing roasting to adapt them to the pan amalgamation. They are dried before the stamping and then stamped dry. The mortars have double discharge. The pulverized ore discharged through the screens of the mortars is carried by conveyors to elevators which lift it to the furnace floor. There are several types of furnaces in use, notably the Buckner, the White & Howell, the Stetefeldt, the O'Hara, and the ordinary reverberatory furnace. The time of adding salt depends on the mineralogical character of the ore. When there is much arsenic or antimony present, salt is economized by a preliminary oxidizing roasting of the ore. The salt is crushed either separately or with the ore. It should be thoroughly incorporated with the pulp. To obtain a high degree of chloridation sufficient sulphur must be present to effectually liberate the chlorine of the salt. Calcspar, braunspar, and fluorspar, etc., retard the chloridation by absorbing a large part of the sulphuric acid produced. Minerals containing arsenic, antimony, tellurium, selenium, etc., increase the loss of silver arising from volatilization. Zincblende requires long roasting to convert it into sulphate. The subsequent process of amalgamation is similar to that described with reference to the treatment of free-milling ores, though the grinding process is usually omitted or curtailed in the pan-amalgamation of roasted ores.

CONCENTRATION.

A Modern Concentrating Mill encloses a good many forms of machinery by which ores are prepared for subsequent metallurgical treatment. The operation of concentration and dressing is based on the difference of the specific gravity of the mineral constituents of an ore, by virtue of which the minerals have unlike velocities falling through water or other medium. Water is preferably the separating medium. The coarse crushing of the ore is done by rock breakers, and the "screenings," or coarse stock from the rock-breakers, is further comminuted by rolls or stamps. But for this purpose rolls are preferable, inasmuch as their use minimizes the amount of slimes incident to crushing.

From the rolls the ore passes into the first (largest and coarsest) of the series of five revolving screens, or "trommels." The trommels are either cylindrical or conical in form. In the former class the conveyance of the "screenings" from the delivery end to the discharge end of the trommel is effected by the inclination given to the axis of the trommel. In the latter class this is attained by virtue of the conical shape of the trommels; the screenings drop through "spouts" into the jigs, which have sieves corresponding in mesh to those of the delivering trommels. The trommels have sheet-iron receiving aprons, into which the ore falls after passing through the perforations of the screens. Through these aprons the ore is delivered to the next finer sieved trommel of the series.

The ordinary type of jig is a trough-shaped water-box divided into two compartments by a partition extending part way down. In one of the compartments is a loosely-working plunger operated reciprocally. In the other compartment is a fixed horizontal screen on which the sized ore is fed.

The strokes of the plunger cause a pulsation of water through the sieve. The ascending current raises the mixed particles, which, in their descent through the water, arrange themselves in layers.

The sorting of the "equal-falling" minerals takes place in a series of inverted pyramidal boxes called "Spitzkasten." Water is brought to each compartment from above by a pipe, which, discharging the water downward against the bottom of the box, produces an ascending current. This ascending current prevents the deposition of the lighter particles, which are, consequently, carried over into the next box of the series. These boxes are so arranged as to cause a slowly-flowing current throughout the series.

Where the system of hydraulic classification is more extended; a series of boxes is used under proper conditions as to size, velocity of current produced, etc., for the separation of the sands. From these boxes the slimes retained in the current go to the slime classificators.

When jigging is not practicable, on account of the extreme fineness of the slimes, the pulp is worked on round tables, buddles, percussion tables, Triumph and True Vanners, etc. A sizing is effected by these machines. The largest particles (specifically lighter) being acted upon more readily by the flowing water are carried down the inclined planes and pass away as tailings, while the smaller (specifically heavier) particles remain as concentrates.

SMELTING.

Argentiferous lead, and other base ores, concentrated and unconcentrated, are smelted in Water-Jacket Blast Furnaces of from 30 to 60 tons capacity per day of 24 hours, with reverberatory furnaces for roasting or matting refractory ores. The fuel used is charcoal or coke, or a mixture of both. The consumption of charcoal, when used alone, is from 20% to 25% of the weight of the smelting mixture, and that of mixed fuel from 15% to 20%. The waste in charcoal amounts to about 12½%. One cord of ordinary pine will make from 400 lbs. to 450 lbs. of charcoal. The fluxes commonly required are silica (quartz, sandstone, etc.), limestone and iron ore. Some ores have to be roasted and melted into a matte in a reverberatory furnace before being smelted in the blast-furnace, while others, such as carbonates of lead, and lead ores associated with a sufficient amount of oxide of iron, etc., can be smelted without flux or preliminary roasting and matting. When ores are obtained from many different mines combinations can be made that will require no foreign flux.

Under the most favorable conditions as to ore, fluxes, fuel and labor, the most docile ores may be smelted for from $3 to $4 per ton, but under unfavorable conditions may run as high as $18 or $20 per ton.

WATER-POWER.

The Treadwell Mine, Douglas Island, Alaska, is said to have the largest quartz mill in the world. All the machinery, consisting of 240 stamps, 96 concentrators, 12 ore-crushers, etc., requiring about 500 horse-power, is run by a single wheel 7 feet in diameter, under a head of about 500 feet, making 235 revolutions and using 630 cubic feet of water per minute through a nozzle 3.31 inches in diameter; with a 4-inch nozzle this wheel will work up to 735 horse power. Perfect regulation is afforded by the use of a deflecting nozzle operated by a hydraulic governor. The nozzle is about 4 feet long with a ball joint at the butt end, and to the discharge end is attached, by lever connections, an automatic hydraulic regulator, which varies the amount of water applied to the wheel as may be needed to adapt it to varying loads—a device which affords a peculiarly simple, sensitive and satisfactory regulation. With such an arrangement, and in such a location, the advantage of water-power is conspicuous. Thus the wheel above mentioned weighs but 800 lbs., and the entire equipment, embracing shaft, boxes, driving-pulley, etc., only about 4,000 lbs. On the other hand, a steam machinery plant, to give the maximum capacity of such a wheel, would not weigh less than 200 tons. And the expense of running such a plant would be almost unmeasurably greater.

LOW-GRADE ORES AND WATER-POWER.

The Star Mining and Reduction Co. of Fresno County, California, furnishes a good example of Low-Grade concentrating ores worked by water-power. This Company has a lode 150 feet wide, with thousands of tons of quartz on the surface carrying galena in bunches, stringers, etc., and worth from $10 to $20 per ton in lead and silver. This ore is concentrated to about 60% lead, 60 oz. in silver, and $3 to $4 in gold, at a cost of $1.25 per ton for mining and transport, and 50 cents per ton for concentrating.

The plant consists of one mammoth Blake crusher, Cornish rolls, screens of different fineness, German jigs, etc., in a building 136 by 60 feet, 68 and 45 feet high, stone foundation. The ore is conveyed from the mine to the concentrating mill by means of a Halliday Wire Tramway 7,000 feet long.

The capacity of the concentrating works is 125 tons in twenty-four hours, and the building and machinery are so arranged as to permit of this being doubled. The total cost of the plant was $40,000.

ELECTRIC TRANSMISSION OF POWER.

It has been only about two-and-a-half years since the attention of mine operators was first called to the practicability of Electric Transmission of Power, and the advantages of substituting Water-Power for Steam, where water-power can be had within any reasonable distance, and where the conditions were such as not to admit of a direct application. Great interest has been awakened in this subject, and rapid progress made in its development, as the following examples will show :—

The Roaring Forks Electric Light and Power Co. of Aspen, Colo., affords a very interesting application of Water-Power to the production of Electric energy, and the convenient and profitable use made of it in mining operations. This was one of the first attempts, on a scale of any magnitude, to operate the various machinery required in mills and mines by Electric Transmission, and the success which has attended the venture attracted wide attention.

The power plant consists of eight 24-inch Pelton wheels, 1,000 revolutions, 820 feet head; capacity, 175 H. P. each wheel—total horse-power, 1,400; single line of pipe, 500 feet of 16-inch and 3,500 feet of 14 inch diam. pipe.

The power is made to conform to the requirements of the machinery run by the use of reducing tips, so that only as much water is applied to the wheels as is necessary to run the machinery to which they are attached. Each wheel runs a separate dynamo, the connection being made by belt direct.

Close regulation is afforded by means of deflecting nozzle and hydraulic governor attached to each wheel. The station is running 120 arc lights of 2,000 C. P. each, also 2,000 incandescent lights of 16 C. P. each, distributed over an area of some four miles square, and used for lighting streets, hotels, stores, private residences, etc., and in the mines, mills and sampling works in the vicinity.

The Electric-Power plant consists at present of one 60 H. P. Sprague Motor and six 20 H. P. Sprague Motors, which furnish power to underground pump, hoist, tramways, sampling works, etc., at distances varying from one to two miles from the station.

The wheels weigh about 90 lbs. each, and (including shafting, pulleys, boxes, gates, nozzles, etc.) the proportions would be 4½ lbs. of material to every horse-power developed.

The relative proportion in the best type of steam plant would be from 400 to 500 pounds of material to every horse-power.

This plant has been in operation for more than a year, and works in every way satisfactorily.

THE ASPEN MINING CO., COLORADO.

Capacity 200 horse-power, transmitted three miles; running pump, hoist, tramway, etc. Started up about June 1st, 1890. Reports entirely satisfactory.

CAROLINE MINING CO., OURAY, COLO.

Two Pelton wheels; capacity, 400 horse-power; head, 525 feet; power transmitted 3½ miles through two strands of OO wire, ground return. Machinery to be operated:—One Knowles' pump, 750 feet lift, 30 H. P. hoist, 100-ton concentrating mill, one saw-mill.

ECONOMY OF WATER-POWER AND ELECTRIC TRANSMISSION.

The Dalmatia Mine, El Dorado Co., Cal., owned by a London syndicate. The vein is a huge mineralized dyke of porphry with quartz seams, and is opened by tunnel and shafts which cut the ore body 200 feet deep. A cross-cut 19c feet long has not reached the wall. The ores are mined by contract and delivered at the mill for 7½ cents a ton. This is made possible by reason of the large body of ore and its loose character.

The mill is equipped with three Huntington mills, crushing 25 tons a day each, and ten stamps crushing 25 tons a day, making the capacity 100 tons in every twenty-four hours. The ore is mined and milled for 50 cents a ton. This economy in the working of the Dalmatia mine ores is due to the fact that this property enjoys the distinction of being the first quartz mine in the State run by electricity.

The plant consists of one Pelton wheel, 7 foot, using 400 miners' inches of water under 112½ feet head; one Electric generator of 126 H. P., connected with Pelton wheel; two small wires to mill, one mile away, connect with electric motor or dynamo in the mill. From pulley or dynamo a belt carries the power direct to the main shaft. The

Company are going to connect another 20-stamp with the same wires, and run it with the surplus power, making their capacity 150 tons a day.

The mill has a complete Electric Light plant, with turbine wheels, etc.

A 30-foot fall will drive a dynamo, and the same water can be used continually as it flows down the river. In this way power can be made on any stream to drive all the mills within miles.

The Electric Transmission of Power reduces the cost in every instance. It allows the placing of the mill in any locality; it overcomes the difficulties attending the operating of a mine where wood and water are scarce; it saves all the expense of water for boiler and fuel for heat, etc. There is scarcely any limit to the possibilities attending the use of Electric Power in mining.

JAMES BRADY,
Mining Engineer.

VICTORIA, B.C., February, 1891.

THE MINING PROSPECTS AND INDUSTRIES OF WEST ALGOMA.

HISTORY OF THE MINES.

Mining on the north shore of Lake Superior is of a comparatively recent date, which is somewhat remarkable, as there are numerous evidences of mining by the aboriginal inhabitants in Isle Royal, where old workings, stone hammers and other crude implements have been found. The honor of the first mineral discovery on the north shore was however reserved for Colonel Prince, who in 1845, whilst searching for copper at Spar Island, in Princes Bay, found a vein of grey copper ore carrying a high percentage of silver. In 1846 Professor Sheppard was employed by the Montreal Mining Company to explore and locate mineral lands along the north shore, resulting in the taking up of twenty-seven large blocks of land, and some islands near them, but no mining work was done on them at that time, principally owing to the extreme difficulty of reaching Lake Superior with supplies, there being then only small boats on the great lakes, and these were only available as a means of transit for about six months in the year. From this time hardly anything was done until May, 1865, when the McKellar Brothers discovered the Enterprise Mine in the Township of McTavish, of galena ore carrying lead and silver, and in the year following they found the Old Thunder Bay Mine, in the Township of McGregor, containing native silver and argentite, and the Shuniah or Duncan mine in Township of McIntyre, also containing native silver and argentite. From this date, 1866, commenced the first boom in silver mining in Algoma District, which drew a large number of American capitalists to Port Arthur, then called Prince Arthur's Landing, resulting in large tracts of land being surveyed; the discoveries being frequent and rich until 1868 when a man named Morgan, in the employ of the Montreal Company, discovered the Silver Islet Vein on a small rock included in the Company's land. In 1868 also a large deposit of Baryta was found on McKellar's Island, but nothing was done of any importance with it until the past year when considerable quantities of Baryta were taken out and shipped to the United States. The vein is about forty feet wide and of excellent quality. The next important discovery was in 1870-71, when Silver Harbour or Beck Mine, in McGregor Township, Pie Island and Cloud Bay were brought to light. Native gold was first found at the Huronian Mine, in the Township of Moss, and at Partridge Lake in 1872. Considerable work has been done on the Huronian Mine, and a ten-stamp mill has been erected, but although there can be no reasonable doubt as to the value of this mine, still it is so difficult of access that it will not pay to work until it is reached by the Ontario and Rainy River Railway, when the author believes it will become a good dividend paying mine. With the termination of 1872 came the end of the boom or second period of the mines; mining on the American continent being as yet a very crude science, and of the experts who came to Port Arthur in those days, but few understood their business, miners were paid exorbitant wages, and the general idea seemed to be to put up expensive buildings, and to drink champagne; when to all this was added the heavy cost of transport by the great lakes, it is to be little wondered at, that one by one these promising mines expended their money, and shut down; with the single exception of Silver Islet, which continued mining operations until March, 1884; when mining operations came to a close for want of coal to supply the pumping engines. The mine by that time had attained a depth of 1,230 feet, and had yielded from first to last about $3,250,000.

That one mine under able and skilful management has been able to present such a wonderful record, would lead to the belief that some of the other silver mines were capable of producing valuable results, had they been as skilfully managed. Their failure is, therefore, much to be deplored, as once a mine is closed down, there exists a considerable difficulty in raising it again to a working basis, especially as such a result can rarely be obtained except by a change of ownership, and the formation of a new company. After the close of this second period in 1872 there appears to have been but little interest taken in mining enterprise until 1882, when Rabbit Mountain was discovered by Oliver Daunais, a trapper, who was shown it by an Indian. The extraordinary richness of this mine again revived the dying interest in Algoma silver mining, which has resulted in the discovery and working of the Beaver, Badger, Silver Mountain East, and Silver Mountain West, besides numerous other claims which have been more or less developed, and many of them with very encouraging results; such as the New Thunder Bay Mine, Crown Point, Palisades, Big Bear, Elgin, Silver

Fox, and the Ottawa mine, which are amongst the most promising. The new Thunder Bay mine presenting the novelty of being the only vein that contained chloride of silver, with a very high percentage of silver; added to which it has unexceptional advantages for cheap mining operations.

In 1884 the Zenith mine containing zinc blende with 58 per cent. of zinc was discovered about eight miles north of the mouth of Steel river, on the north shore of Lake Superior, about six miles east from Rossport on the C.P.R., where some test pits were sunk and a large quantity of ore taken out. This mine could undoubtedly be sold and profitably worked, but the owners, like the dog in the manger of the old fable, will neither work it themselves nor allow others to do so. Indeed the author has tried to purchase this property, and although he made a liberal offer for its purchase he was ultimately refused it. Many veins containing zinc blende have been found in West Algoma, but the difficulty is to obtain zinc blende carrying a sufficient percentage of zinc. A single discovery of mica was also made in 1885 on Dog Lake, but it has not been considered of sufficient value to be even surveyed. Iron has been known to exist throughout a large portion of West Algoma, but nothing of any importance was done in this direction until 1885, when the author surveyed a considerable quantity of magnetic iron on the Attic Okan River for Messrs. Graham and Horne. In the year following the author also surveyed a large tract of iron lands, chiefly hamatite ore, but containing a percentage of magnatite, on Hunter's Island, and since that time very considerable areas of iron lands have been taken up, both on the Tower and Attic Okan ranges. Besides these ranges the author himself invested in iron lands to the north of the Township of McIntyre, which he has been fortunate enough to sell at a profit.

Native copper, it is strange to say, was never found in paying quantities in West Algoma until the summer of 1889, when some large deposits in the shape of veins were discovered in the neighborhood of Cloud Lake, in the Township of Crooks. To complete this abbreviated history of the mines of West Algoma it may be desirable to give a short account of the gold mines, or rather gold prospects on the Lake of the Woods, where, so far, there has been literally no attempt at legitimate mining, the discoverers appearing to consider their bare discoveries worth a fortune without making any attempts to develop them. Amongst these are the Pine Portage, which was discovered in 1880. After going down about 100 feet and putting up a ten stamp mill, it was abandoned, although the prospects were most encouraging. The Winnipeg Consolidated was discovered in 1881, a shaft sunk 135 feet, when it was shut down owing to the company getting into litigation. Near this on Hay Island is the Partridge Nest or Keewatin, and consists of two good looking veins 3 to 4 ft. wide which intersect each other at the water's edge. A little development has been done; it is a fair prospect, and free gold can be readily panned from the surface dirt. The Sultana, also near Pine Portage, is a promising property carrying free gold in paying quantities. It is somewhat remarkable that all these discoveries have been made within a very limited area which could be covered by an ordinary township of 36 square miles in area. A few other discoveries have been made such as Gold Hill, Minerva, and a location of Oliver Daunais on Clearwater Bay, but it is problematical whether any discoveries outside the Pine Portage circle or block will ever pay to operate; but, of course, it is within the bounds of possibility that some of them may prove exceptions to the general rule and turn out paying mines. One thing is, however, certain, that mining operations on the Lake of the Woods will be extremely limited and confined to a very small area, unless some entirely new field is discovered. Gold in paying quantities appearing generally to be found in contact veins, occurring between the Laurentian and Huronian formations. Whereas this condition does not appear to be necessary in the case of silver bearing veins in West Algoma. Last year several deposits of nickel, which has long been known to exist in the district, were discovered at Schrieber, equally as rich as the Sudbury ores one of which the author is a part owner.

SILVER ISLET MINE

Is situated on a small rocky islet about a mile out in the lake off Thunder Cape in the Township of Sibley. The vein strikes N 35° W and dips to the S E. at an angle of 70° to 80°, averaging in thickness about 8 to 10 feet, varying in some places from 20 to 30 ft. of solid vein. The gangue of the vein consists of calcite, quartz and dolomite, the latter varying in color from cream to pink, according to the amount of manganese; it carries native silver, argentite, galena blende, copper and iron pyrites with marcasite; it is also said to contain Rodochrosite, Tetrahedrite, Domeykite and Niccolite and Cobalt-bloom, and a peculiar mineral called Macfarlanite containing arsenic, cobalt, nickel and silver, two new minerals, called by Dr. Wurtz, Huntelite and Animikite, have also been found in the ore, and the latter three were in 1881 the principal silver ores of the mine.

The rock on the Islet intersected by the silver vein is a chloritic Diorite forming a dike. It differs somewhat from the rocks of the other dikes of this locality amongst which may be mentioned Corsyte and anorthite porphyry. The mine attained a depth of 1230 feet before it was closed down for want of coal, and it was then still yielding silver, the total yield from first to last was about $3,250,000. Numerous attempts have been made to trace out the vein—but without success until last summer, when a vein was discovered on Edward's Island, 9½ miles from the. Islet, averaging from 3½ to 4ft. in width, and which is supposed to be a continuation of the famous Silvet Islet vein. It crosses a series of horn-blend porphyritic trap dykes, each one of which has faults, and it has been traced across the island, a well-defined outcropping shows on the north point of the island. The ganguc of the vein in the shaft is composed chiefly of calcite, with some quartz and baryta, heavily mineralized with galena, blende; iron and copper pyrites and nickel. At a depth of 20 feet a seam of arsenical silver and nickel came in, and is continuing down as depth is attained. Selected samples assayed from 40 to 130 ounces of silver to the ton. The shaft is now down to the level of Lake Superior, and is making 30 barrels of water daily. The vein is in many respects similar to the Islet. The same graphite dyke and again Macfarlanite have been found, together with rich minerals of cobalt and a new peculiar discovery, native arsenic in all its forms, crystalline and reniform or shelly. This arsenic contains a varying amount of silver, from a few ounces to hundreds.

The arsenic in itself is not new, but where it has been weathered by exposure, the skeleton of native silver stands out on the black arsenic in mossy or dendritic masses of beautiful appearance.

It seems this vein was known to the Indians who resorted there for "medicine," carefully hiding the place on leaving, which, perhaps, may account for this veing not having been found before.

OLD THUNDER BAY MINE

Is situated in the Township of McGregor, not far from the eastern limits of the Township of McIntyre. The vein strikes N 34° E, and dips at a high angle to the North-West, and consists of closely reticulated veins of white granular quartz, the largest being about one inch thick, and the aggregate average perhaps ten feet long. It carries native silver and argentile accompanied by galena blende and iron pyrites. The ore occurs in bunches three to eighteen feet thick by six to forty feet in length, the silver being in strings, leaves, grains, &c., irregularly distributed through the vein stone which constituted the greater part of the bunch. The silver often forming ten per cent. of the mass. The work done consists of four shafts sunk on the vein and a cross cut driven north-west at the ten fathom level, and some drifting between the two deepest shafts. No. 1 shaft is about 70 feet deep; No. 2 shaft is the same depth, 300 feet north-east of it, whilst 150 feet further on is another shaft 35 feet deep, and again 150 feet to the north-east on the strike of the vein, another shaft has been sunk to a depth of 25 feet. A very considerable quantity of ore was taken out of this mine, much of which was stolen, so that it is difficult even to approximate the amount. Unfortunately in addition to this the mine was mismanaged from the first, and had it been otherwise it is thought by many that it might have even rivaled the Silver Islet Mine.

THE SHUNIAH OR DUNCAN MINE

Is situated in McIntyre Township, the vein strikes nearly east and west, and has a general dip to the south at a high angle from the horizontal. The total width on the surface is 20 to 30 feet. Several cross lodes intersect or run into the main vein. The gangue is quartz holding small quantities of galena, blende and pyrites and also calc spar. There is no pink spar as at Silver Islet, but there is a considerable amount of purple amethyst. The formation of the enclosing rocks is almost precisely similar to that of Old Thunder Bay Mine. There was a considerable quantity of silver taken out of it, but mismanagement resulted in the vein being lost, and it has been estimated that when the mine was shut down that they were fully 400 feet off the vein.

THE BECK OR SILVER HARBOUR MINE.

This mine is situated in McGregor Township, farther east than the Old Thunder Bay Mine, the vein runs E N E, dipping at a high angle to the N W. It has a brecciated character, and is about five feet thick. The gangue consists mostly of white granular quartz, but barite, calcite, fluor and amethyst are present with much iron pyrites, galena and blende. The silver occurs mostly as argentite, but also in the native state. The country rock is much the same as Old Thunder Bay Mine, and consists of smoke colored cherts and dark argillaceous shales, running nearly horizontally under what appears to lie a bed of coarsely crystalline trap. The junction of the Animikie and Huronian lies about half a mile to the north of the mine. The vein showed a considerable quantity of silver at a depth of 40 feet, but it was badly mismanaged and was shut down without having ever had a fair tuial.

THE THREE A MINE.

This property hardly deserves the name of a mine. The vein strikes N 75° E, and dips slightly away from the vertical. It is from 18 inches to 2½ feet thick. The gangue is mostly quartz with a little calcite through which are irregularly distributed ores of iron, copper, lead, zinc, nickel and silver with some cobalt and gold. The ore was very rich and one sample assayed 1.4 per cent. of cobalt and 25 per cent. of nickel. The silver was however very pockety and eventually played out after about $2,000 worth of ore had been taken out.

JARVIS ISLAND MINE

Is situated westward of Silver Islet. Considerable work has been done on it. It runs across the island in a north-westerly direction and dips N E at 50° to 55°. Contrasting thus with the nearly vertical dips of the veins on other islands; three shafts have been sunk respectively 160, 31 and 73 feet. Unfortunately it appears to have been mined solely because of its proximity to Silver Islet, which it somewhat resembles, both with regard to the vein matter and enclosing rocks, with the single exception that it is almost barren of silver, and it has always seemed to to the author that that it was a great pity that so much money was wasted on a comparatively barren vein, whilst numerous promising veins have remained untouched. This, however, happens in almost every mining district, and it is a wonder that the selections in Port Arthur district have generally been uniformly good.

THE ENTERPRISE MINE

Is situated in the Township of McTavish in Black Bay. The vein is six to eight feet wide, the gaugue being quartz and calcite with a paying streak three to four feet wide of galena and copper pyrites with a small quantity of gangue. Prof. Chapman gave an assay from a selected specimen, lead 47 per cent., copper 8 per cent., silver $40.00 per ton.

Owing to there being but little demand for lead at that time this mine was shut down, but now, with the probable demand for galena ores to assist in smelting the silver ores of the Beaver and Silver Mountain districts, it is likely that more attention will be paid to the lead ores of this district, especially as there are one or two promising properties notably the "Ogema," situated in the northern part of the Township of Dorion, and which contains a purer galena with a large percentage of lead and silver. This part of the country has, however, been but little explored.

RECENT DISCOVERIES ON THE NORTH SHORE.

Although not in the order of discovery a brief account may here be given of the explorations which have taken place during the past two years over the lands on the north shore of Lake Superior. These researches have been carried on principally on the lands of the new Silver Islet Company; and also in the neighborhood of Cloud Lake, in Townships of Crooks and Pardee, and consist principally of copper, although some silver has been found. Near Mamainse on the North Shore the district is one vast bed of native and copper ores. The geological structure being similar to that on the south side of the lake in the Keweenan district.

This belt carries amygdaloid and conglomerate lodes in veins and sandstone. The great upheavel of nature manifest in the structure of the country has lead to so great diversity of opinion regarding the degree of mineral wealth possible in such a formation, and during last summer there has been found no less than twelve distinct veins of rich copper, of which eight are rich enough to form as many distinct mines of a most promising character.

The dip of the country is at an angle of 22° to 30°, and the trend of the strata is south-east and north-west, inclining more northward inland. The strata of the veins run north and south, cutting an angle of about 40° to 45°.

The ores found are those known as the horse flesh and the peacock, gray ore and native copper.

These discoveries are all made on the lands belonging to the Silver Islet Mining Company, who own 10,000 acres in that vicinity alone, besides immense tracts of other valuable mineral land in the western sections of Algoma district. So thoroughly have the American mineral men informed themselves of the natural resources of the north shore that they have acquired possession of these grand deposits, while Canadians have been snivelling about them as "a God-forsaken country full of barren rocks." It may also be interesting to note that in this section have been discovered several articles of antiquity, such as ancient hand-made pottery, ornamented with indentations of the thumb and thumb-nail of the potter, copper hammers and other rudely constructed tools and implements of a long since forgotten race of miners who came from no one knows where. But, like the traces left by these early miners at Isle Royale and other places along the shores of Lake Superior, it shows that Mamainse did not escape the keen eyes of the copper hunter of those early days, who may have forgotten more about that section of country than the whole of Canada has yet been able to learn about it.

With eight richly laden veins of copper in sight and half as many more of a lower grade ready for operation the Silver Islet Company will begin work next spring for developing some of the long hidden wealth. Mamainse is 12 miles west of Batchewanin lighthouse, and about 40 miles west from the Sault.

In the neighborhood of Cloud Lake in the Townships of Crooks and Pardee, a number of copper bearing veins have been found during the past two years. They occur in bands of amygdaloidal trap which carries the metal in a fine state of division of native copper. The country in the neighborhood of Cloud Lake is high and hilly, rising up to a height of 300 ft. and consists of the black slates of the Animikie formation heavily capped with trap sometimes to a depth of nearly 50 feet. Average samples of copper ore from this locality assay as high as 12 per cent. Silver-bearing veins have also been found in this locality, and some of them have assayed well, so that there is every prospect that it may develop into one of our most promising mining fields.

RABBIT MOUNTAIN MINE.

With the discovery of this mine in 1882, mining in this district came once more to the front after a lapse or rest of ten years (the natural result of inexperienced, and one may almost say, dishonest mining).

The conditions of this group are somewhat different from former discoveries, in being further removed from the northern boundary of the formation and from the outcrop of the lower siliceous division. They are all in the upper argilaceous division with its associated trap sheets, the argillites being soft and black.

The vein of the Rabbit Mountain strikes N 35° .45′ E, and dips at an angle of about 65° to 70° to the N W. The vein is a composite one consisting of number of branches and stringers interlaced, and is about four to six feet thick, although much wider in places. The ore consists of native silver and argentite accompanied in considerable quantity by blende with a little iron pyrites and galena, and occasionally copper pyrites in a gangue composed of quartz, calcite and green and purple fluorite. A good show of rich ore was found on the surface and caused considerable excitement in the district.

Several shafts were sunk on this property and a stamp mill erected with a capacity of 15 tons per diem. Capt. McComber, who was manager in 1886, claimed that the concentrates ran as high as $4,000 to the ton and averaged $1,500, the milling ore averaging $80 to the ton. In addition to this a considerable amount of ore was rich enough to be shipped in barrels, parts being almost pure silver. Although more silver has been taken out of this mine than would repay the entire expenditure, the mine was closed down, in the fall of 1887, owing to a disagreement amongst the owners, with the view of freezing out some of the weaker owners, and from that date this very promising property has remained idle.

BEAVER MINE.

The next mine of importance is the Beaver, which was discovered shortly after Rabbit Mountain, and work was commenced in 1884. The work was continued on a small scale until it was sold to an American capitalist in 1885. Two veins have been worked in this mine; the main vein cuts in a north-westerly direction across a ridge about 200 ft. high, having a steep bluff to the north-west, whilst it is intersected about 300 ft. in from the face of the ridge by a cross vein running in a north-easterly direction; the cross fissure is very irregular and hard to follow varying from a few inches to almost nothing. It was followed for about 350 ft., but as it carried but little mineral it was left. The main vein averages 4 ft. The gangue of the vein consists of yellow and dark colored blende with some iron pyrites and a little galena calcite amethystine quartz and a little fluorite, which is mostly green but sometimes purple. The silver occurs in the ore bunches chiefly as argentite in nugget sheet and leaf form with some native silver. This mine has been worked longer and more extensively than any other mine in that district. It has always been owned by private capitalists, who, owing to its extreme richness have been loath to place it upon the market. It is consequently rather hard to get reliable information regarding it, but suffice it to say that the vein has been followed with the diamond drill for over a mile, and although it has been extensively worked, it still continues to turn out large quantities of bonanza ore, which is shipped away to the smelters, besides a large quantity of milling ore for which purpose they have an excellent mill about one-half mile from the mine. This winter is the first that they have attempted to work it all the year-round, the mine having previously been shut down during the worst of the winter. The monthly shipments from this mine varies from $2,500 to $40,000.

THE BADGER

Is the next of this group, in importance. It is situated in the Township of Gillis, in near proximity to the Beaver and Rabbit Mountain. It is an exceedingly rich property, being very rich and full of black nuggets of silver, and has more than twice paid for the money expended by the original shareholders. It was discovered about the same time as the Rabbit Mountain, but it was so capped over with trap that it was only fairly brought to light by Mr. Eishweiler, an American explorer, who, in 1886, sunk a shaft on the property, which resulted in a good looking vein being found, and which has resulted in the formation of the mine into a stock company, when, under vigorous development, it soon asserted itself as one of the most wonderful silver ore producing mines on this continent. In 1890 the Porcupine, an adjoining property, was purchased for $50,000, containing the continuation of the vein, which is about 3½ feet wide, and extends on the property for a distance of about 3,000 feet. The vein consists of argentite, black blende and galena, with large nuggets of black sulphide of silver, calcite, amethystine quartz, and a little fluorite, mostly green, but sometimes purple. The vein has been pretty thoroughly explored by means of shafts and adits. The mill puts through about 35 tons daily.

SILVER MOUNTAIN—EAST END.

The next in order is the Silver Mountain, East End. It was discovered in 1884, but, although some $12,000 was spent in trying to develop it under option by some Cleveland capitalists, they failed to discover anything of value. After they had given it up the original owners discovered native silver in large quantities a few feet from where the Cleveland company had left off, resulting in the sale to an English company in 1887, who have since that date been continuously working it. They have now discovered no less than nine veins on the property, all bearing silver, and at 800 feet down they have discovered immense bodies of native silver. The main vein is about 4 feet wide, and consists of native silver blende, black and brown, a little galena, with a gangue of calcite and amethystine quartz, with a little fluorite, mostly green.

WEST END SILVER MOUNTAIN.

West End Silver Mountain is a continuation of the same vein as the East End. The average of the vein is about 6 feet here, the nature and composition of the vein being almost identical with the East End. This property has been sold during the past year, and developments are being rapidly pushed forward. The author may here remark that there are numerous valuable locations and veins in the Silver Mountain and Beaver Districts which the space at my disposal would not permit me to describe in detail, amongst which are notably the New Thunder Bay Mine, owned by a company in Minneapolis, the Crown Point, and others. But suffice it to say that in this district there is not a single instance of a failure where any development has been made outside of the most superficial character, which speaks much for this but little known district, especially when the history of the mines in the East around Port Arthur has, with the single exception of the Silver Islet Mine, been one continuous record of disaster and failure.

THE OGEMA.

As Lead ores are of importance in the smelting of silver it may be interesting to note that there are several good sized veins in the neighborhood of the Townships of Dorion and McTavish, notably the Ogema, which has been recently bought by Philadelphia capitalists, who propose putting up a smelter on the property next summer. The vein is a very strong one, running parallel with a high granite ridge, and occurs along the line of contact of the granite bluff, and the gneiss that forms the valley below. The vein outcrops about half way up the bluff, and is partially covered by fallen rocks and debris. Its strike is a little north of east, and south of west. The pay streak is about fourteen inches wide at the surface, and nearly solid galena. About twenty feet below the outcropping an adit has been run, cutting the vein at this point two feet in width, and carries richer ore than at the surface. The galena is of a very high percentage. Assays from the surface outcropping showed it to carry 24 ounces of silver to the ton.

MANGANESE.

Before entering into a description of the iron ores of this district it may be interesting to note the discovery of manganese in paying quantities, an ore which is so much wanted in the production of the higher grades of mill steel.

The following is an account of the discovery made during the past summer by the employees of the New Silver Islet Co.: At Cape Gargantua they discovered a vein of hydrated *black oxide of manganese* 7 to 10 feet wide. It rises out of the lake and crosses a large island. The vein rises up like a dyke from 4 to 10 feet above the surrounding country rock. In many places the quartz is weathered out, and the manganese ore left standing. The manganese is on both walls of the vein, and a strong seam or band is distributed through the middle of it. The ore assays 45 per cent. metallic manganese. The importance of this discovery can be appreciated when the quantity of iron already known to exist in this district is taken into consideration.

Last, but not least, in the list of Algoma minerals, stands forth the iron ores of the Thunder Bay and Rainy River Districts, which bid fair to take the lead of the iron mines of the world whenever facilities are opened up with the United States for the free transhipment of iron ore. Amongst these the Attic Okan Iron Beds are the most remarkable. The first of these locations were surveyed in the summer of 1886 by the author for Messrs. Graham and Horne, lumbermen of Fort William. The property was shortly afterwards examined by Mr. D. H. Bacon (now superintendent of the Minnesota Iron Co.), and on his report bonded for a long term to a Cleveland party represented by Major Pickands. No active operations having been begun, the discovery of the iron did not attract general notice in any way, until the finding in 1889 of another rich deposit, several miles further west on the same range. The result of this was the starting of numerous exploring parties and the discovery of still other outcrops of the same ore farther westward, until now these rich deposits have been traced by outcrops for a length of thirty odd miles along the belt.

Nothing more than a superficial examination of the deposits has been made, in the way of a few cross cuts, and an occasional shot to secure unweathered samples; but in many places the ore outcrops boldly, showing a varying width of from 10 to 50 feet.

These outcrops occur in veins or lenticular beds in the Huronian formation lying between the Huronian trap and chloritic schists which are nearly vertical, having a dip of 86 degrees north, and a strike of N 75 degrees east. The surface showings indicate that there are several of these beds, the intervening rock having a width of from five to thirty feet. Whether these beds will unite at a depth or maintain their separate identity, is a problem for development to decide. The Huronian belt has an average width of eight miles, and rests comfortably in the folds of the Laurentian rocks, so we may presume its depth (and that of the interbedded magnetite) to be very considerable, practically unlimited.

The Graham property is the most easterly on the range, and its most conspicuous outcrops occur on the summit and both faces of a bluffy ridge running nearly east and west 100 feet above the level of the Attic Okan River. Mr. D. H. Bacon sampled the surface showing, taking samples at three inch intervals; and for an aggregate width of 80 feet, these samples gave 63½ per cent. metallic iron, without more than a trace of phosphorus, and little more than a trace of sulphur and no titanium. The outcrops here showed three beds of ore.

Immediately west of the Graham property is Sabawe Lake, a sheet of water three miles in length. For some distance west of the lake, in the course of the iron belt, a considerable depth of soil covers everything; this extends to location R400, on which, and R401, other outcrops occur very similar to those on the Graham property. A similar ridge traverses these locations, and in many places, especially on the southern exposure, which is very steep, large outcrops occur. The ore throughout this range varies but very slightly in character or grade—it is virtually identical throughout, though in some places where greatly exposed to atmospheric action it is of course leaner. On location R400, where a natural exposure of ore some twenty feet in width occurs, a large number of samples taken at random gave from 66 to 68½ per cent. metallic iron. On the location west of this, R401, a surface cross cut was made this summer which showed 46 feet in width of ore; the full width was not ascertained as the cut was abandoned on account of the depth of overlying soil and large boulders: some of the ore from this cut, when protected by deep soil, gave as high as 71 per cent. metallic iron.

A little more than half a mile west of this the ore again outcrops on the south face of a ridge about fifty feet in height, the intervening ground being low; samples from here gave 65 per cent. Half a mile further west a short trench dug in the low ground showed rich ore at a depth of only three feet; no attempt was made to uncover the width of the deposit, the sole object being to locate it. A mile beyond this numerous showings are found along the top and south face of a ridge about 100 feet high; the surface showings here are very extensive, and the ore of the same high grade, 66 to 68 per cent. For nearly three miles beyond this the ground in the line of the deposits is very low, and no attempt to locate the ore by test pits, etc., has been made. As the ground rises, the ore again outcrops and shows at the crossing of the Attic Okan River, which is very rapid at this point. About 1½ miles farther west lies the Garland Locations, on which there is an outcrop of magnetic iron ore uncovered from 25 to 28 feet in width across the ore formation, and about 400 feet in length. Owing to the small amount of work done the walls on either side have not been found. This outcrop is about 10 feet above high water mark and on the bank of the Attic Okan River. Assays from this ore body made by the Sharon Iron Works, Pa., gave the following results:

Metallic Iron	68.76
Silica	1.41
Phos	0.006
Sulphor	0.185

Mr. Hill, assayer, Port Arthur, gave a result of test of same ore of 67.75 metallic iron. Mr. Rossman gave 70.8 metallic iron. The formation of iron range is invariably almost vertical. On lots 111E and 118E there is a very large ore body of magnetite. This outcrop, or bluff, which is situated about half a mile north of Attic Okan River, rises to a height of from 125 to 175 feet, and is in most parts covered with vegetation. A trench about six feet wide extended from the top and across the ore formation 135 feet and measured from the top to the base gave 210 feet at an angle of 45 degrees. The length by survey is almost half a mile. The ore body presents the same characteristics as 109 and 110E, and results from an assay made by Prof. Hays, of

Toronto, gave 68.67 metallic iron. The surrounding country is well timbered with tamarac, spruce, birch and pine.

These four 80-acre locations extend along the range for one and a-half miles. Exploratory work has only been done in two places, but the ore body is plainly visible in many places on each of the locations.

The author has also surveyed three more locations for Mr. Garland in which the ore changes over part of it to hamatite, but still of the same high quality, and to give a faint idea of the value and extreme purity of these ores, annexed is a short report by Mr. J. C. Thomas, an American expert, together with copies of assays over different parts of the belt, and it may here be remarked that they show conclusively by the entire absence of titanium and the low percentage of sulphur, phosphorous and silica, that they are essentially high grade Bessemer ores.

DETROIT IRON MINING COMPANY.

MR. LEE BURT, Manager, Detroit, Mich.:

DEAR SIR,—On my return from Port Arthur I give you a report of my examination of the iron property in the Rainy River District, on the Attic Okan River, known as the Garland property. I was very much surprised to find such fine outcroppings of iron ore. It was beyond all expectations. The iron range running about east and west outcrops at an elevation of 125 to 175 feet and 1,000 to 1,500 feet in length, showing very fine quality of ore, such as you will see by the samples. Sample No. 1 was taken from about half way up and partly across the top of the bluff a distance of about 135 feet on the ore formation. Sample No. 2 was taken from ten feet above the surface of the river a distance of 25 feet across the ore formation. The exact width of the ore can't be given, as there is not enough work done to uncover the ledge. If in case these samples should not go as high in iron as may be expected, I don't think it ought to be any set back to the property, as better results would be reached in opening up the ore body. These samples were taken from the surface of the ledge. The results of the samples you will please add to this report. If the property should open up as well as I expect it will, and I have every reason to think it will, the ore can be mined and put into the cars for 35 to 50 cents per ton at a large output. No definite estimate can be given as to the size of the ore body, or to the amount of ore that can be produced, until more work is accomplished.

Yours, respectfully,

J. C. THOMAS.

ISHPEMING, Mich., August 25th, 1890.

ASSAYS OF ATTIC OKAN MAGNETITE.

GRAHAM LOCATIONS.

	Averages by Mr. D. H. Bacon. (1)	(2)	(3)	Chapman.
Silica	6·60	7·30	5·89	2·43
Alumina	1·09	1·80	0·98	0·67
Ferrous Ox	....	....	....	23·32
Ferric Ox	87·66	86·90	88·36	46·74
Manganesic	trace.	trace.	trace.	....
Calcic	1·28	0·90	1·40	....
Magnesia	0·75	0·60	0·75	....
Phosph. Acid	·0079	0·069	0·025	....
Titanic Acid	none.	none.	none.	none.
Total	94·46	97·57	97·41	....
Metallic Iron	63·47	62·84	63·97	70·06

The first three are averages from the three beds sampled by Mr. Bacon, and the last is a single specimen given Prof. Chapman of Toronto.

LOCATIONS R400 AND 401.

Assayed by	Minnesota Iron Co.	F. Hille, Port Arthur.	H. M. Currie, for Carnegie Bros.
Metallic Iron	68·50	65·90	65·702
Silica	2·90	5·80	4·20
Phosphorous	0·015	0·001	0·003
Sulphur	0·052	0·16	Not specified.
Titanic Acid	None.	None.	None.

ASSAYS BY SHARON IRON WORKS, PA., OF SAMPLES FURNISHED BY CAPT. M. N. GARLAND, AS FROM PROPERTY MARKED "GARLAND LOCATIONS."

Metallic Iron	68·75
Silica	1·41
Phosphorous	0·006
Sulphur	0·185

ASSAYS OF ATTIC OKAN ORE BY GEOLOGICAL SURVEY OF CANADA.

Dr. Hoffman, Assayer.

1. Magnetite from R402:

Metallic Iron	68·579
Titanium	None.

2. Magnetite R400 :
   Metallic Iron .... 68·027
   Titanium.............................. None.

3. Magnetite from R403 :
   Metallic Iron .... 64·551
   Titanium..... .... None.

4. Magnetite from Line between Mining Locations 10E and 11E, collected by Smith :
   Metallic Iron .... 65·710
   Titanium.............................. None.

There is also a very fine deposit, or rather vein about 30 feet wide, which occurs on the line of the Port Arthur Du'uth and Rainy River Railroad which is part owned by the author, and contains magnatite carrying 56 per cent. from average assays of the surface. Nor are these the only deposits of Bessemer Iron ores to be found in this district, there being heavy deposits on Hunter's Island, on Gun Flint Lake, and near Kaministiquia Station which are all reported as being valuable.

MEANS OF COMMUNICATION.

Railroad communication is of course absolutely necessary for almost any kind of mining so as to afford the means of cheap transit, but this is particularly so with regard to iron ore. For this purpose the Port Arthur Duluth and Western Railroad is being constructed from the shores of Lake Superior at Port Arthur to the American boundary at Gun Flint Lake, and branching from this road the Ontario and Rainy River Railroad is being surveyed to communicate with the gold fields in the Township of Moss, and the iron fields on the Attic Okan River.

With regard to the market for these ores, and the cost of delivering them thereat: Mining will cost from 75 cents to $1.00 per ton, say $1.00 as an outside estimate. Railroad freight to Port Arthur or Fort William, $1.00 per ton from the Attic Okan. Lake freight to either of the principal ports on Lake Erie, Cleveland or Ashtabula, may be taken as the same ore as that from Ashland or Two Harbors, the shipping ports of the Gogebic and Vermillion Districts. The rate last year and during the past season has been about $1.25 per gross ton, and there is no reason to think this will be exceeded in the future, considering the continual increase in numbers and tonnage of vessels built on the lakes. Shipping charges, insurance, etc., may be taken at 30 cents per ton; duty going into the

United States 75 cents per ton. This will give the total cost delivered at a Lake Erie port of $4.30 per ton. The present value of a high grade Bessemer ore, such as this under consideration, delivered on the docks at Cleveland or Astabula is $6.00 per ton, which would leave a net profit of $1.70 per ton.

In conclusion, the author thinks it is safe to predict that before the lapse of many years West Algoma will take a prominent place amongst the ore-producing districts of the world. So far the diversities of ores that have been found are great, and there can be but little doubt that when the country is more carefully explored by practiced explorers, many ores that have hitherto been unsuspected will be found, and with development numbers of rich mines will be discovered. Canada as an ore-producing country has in the past been sadly neglected, and although our neighbors south of an almost imaginary line have been developing and bringing to the fore the mineral wealth of that great country, we, with far richer mineral wealth, have so far hardly touched our resources. This, we might almost say, fatal national apathy can hardly last much longer, indeed, it is in a measure fast disappearing, and when it does disappear the author is confident that West Algoma will produce almost untold wealth. In dealing with so large and extensive a subject the author has found it necessary to condense considerably the the information he has obtained regarding the mines, for to describe some of them properly they would afford a fit subject for a paper alone. But the author will always be happy to afford any information in his power to anyone seeking information on this very interesting subject.

Silver shipments from Port Arthur District from January 1st, 1890, to January 1st, 1891, to the United States as per United States Consular Agency reports :

Beaver Mining and Milling Co.	$ 80,000 00
Badger Silver Mining Co.	95,500 00
West End Mining Co	2,750 00
	$178,250 00

N.B.—East End Silver Mountain Co. ship all their ore direct to England. The amount shipped is not known, but it is safe to estimate it as not less than $50,000.00.

THE RELATION OF MOUNTAIN FORMS TO GEOLOGICAL STRUCTURE.

The following is an abstract of a paper with the above title which was read by Dr. G. M. DAWSON :

The dependence of topographical features on the geological structure of a country has long been recognized as an important branch of geology, but this branch of study has of late years made great advances, becoming specialized and provided with a nomenclature of its own, which assists in arriving at precise definitions. It has been truly said that the geologist studies the past in the light of the present, while the geographer studies the present in the light of the past. Thus regarded it is apparent to how great a degree the respective fields of the geologist and the geographer tend to overlap, and this overlapping is particularly obvious in that division of geograpical work which is nown as topography.

It is, therefore, almost necessary that the topographer should combine some knowledge of geology with that which may be regarded as more distinctly in the line of his profession. It is true that a topographical survey may become so complete and exact that it may ultimately be made to portray all the features of the relief of the country; but for one such perfectly finished survey, there are hundreds in which the main points having been fixed, the details must be filled in to a greater or less extent by freehand methods. In such cases especially a knowledge of the mode of origin of the features dealt with, and what would artistically be described as a "feeling" for these becomes important. But even in the first case, such knowledge adds greatly to the intelligent interest with which the topographer will carry on his work. In the few remarks here made, it is impossible to do more than emphasize the above general statement of the case by referring to some of its bearings on mountain forms, in which it finds its most striking expression, though the history of the development of plains, plateaux and other less prominent features is not less important, and in some cases is found to be even more intricate and difficult of solution.

The old idea that all the bold features met with in nature owe their origin to tremendous cataclysms has long been known to possess little basis in fact, though it lingers in popular descriptions of scenery, and, more particularly, in literature of the guide-book class, in which we are apt to find every cliff or canon set down to earthquake convulsions or "volcanic action," and many an innocent lakelet is classed unhesitatingly as a former crater. While it is obviously true that crater-lakes exist, that high mountains have been built up by volcanic forces, and that the crust of the earth has been rent and cracked by earthquakes from time to time, the noteworthy effects of such causes are really confined to regions small in area as compared to those to which other explanations must be applied, and throughout the whole of Canada they play so inconsiderable a part in giving form to the actual surface, that in a general view of the topography of the country they may almost be disregarded.

Our one great mountain region is that of the Pacific border, the several ranges of which are collectively named the Cordilleran system, and this, like most similar mountain axis, is primarily due to the crushing and crumpling together of a zone of the earth's crust, and to the elevation and ridging up a part of the surface in consequence of this action. We know that this did not take place at once, but by recurrent processes separated by long periods of rest, and while it is possible that the action when it occurred may have been sudden, it is equally possible that it was rather gradual, and that even the profound faults and dislocations of the solid rocky strata may have occurred progressively, and by no very great steps at a time.

In any case, however, it is certain that all this primary crumpling and elevation happened at a period so remote from the present, that we have now none of its immediate results to study. The mountains, as we find them, are but the stubs and edges of the original great folded masses, which have since been unequally worn down in correspondence with the varying hardness and other circumstances, which we must examine into when we endeavor to explain the cause of the existing topography.

Rain and rivers, acting both chemically by solution and mechanically, aided by the disintegrating effects of frost, have been the chief agents of waste which have been effective in sculpturing the relief of the mountain regions. These agents are still actually at work, and it would thus be a mistake to regard mountains, as we see them, as finished products. They have grown out of the darkness of the past to what they are, and they are still to-day in a state of flux and change in conformity with the same laws by which they have been produced. Poets have attached the idea of permanency to mountains and the "everlasting hills," but it requires only a little familiarity with mountain regions to realize that these, more than others, are wasting rapidly away. As an evidence of permanence, if the ocean is insufficient, we might take, rather than the mountains, the great plains through which rivers meander with little fall, and consequently with inappreciable powers of erosion.

Turning to the various mountain systems which compose the Cordillera in Canada, we find first the Rocky Mountain proper, largely composed of massive beds of limestone in which there are two main directions of action of the disintegrating forces,—that parallel to the bedding planes and that at right angles to these, along planes of jointage. Bearing this in mind, and taking also into consideration the positions into which the beds are themselves thrown, all the typical forces assumed by the mountains of this system become explicable. The Selkirks are also composed largely of bedded rocks, but these are here less massive and more complicated by geological disturbance, and the forms assumed by the mountains do not admit of the simplicity in explanation found in the first-mentioned system. In the Coast Ranges of British Columbia, and in other mountains largely composed of granitic or other massive crystalline rocks, the forms of the mountains are found to depend principally on the direction and character of the jointage planes.

The structure of the Rocky Mountains was then treated in some detail as an example of the dependence of mountain topography on geological structure, the general trend of the range being compared with the subordinate trends of different parts of its length, and the dependence of these on the strike of the rock pointed out. The parallel ridges of which the range is composed, with their overlapping character and the systems of longitudinal and transverse valleys were noted. Passing on to the types of mountains found conspicuously illustrated in this range, it was stated that the *Escarpment ridge*, of which one side is very steep or almost perpendicular, while the other slopes down gradually and uniformly, following the dip of the rocks, is the most common. Mount Rundle is perhaps the best known of such mountains. A second type is the *Block-like* mountain, representing part of a nearly horizontal bed of limestone, broken down on all sides along jointage planes.

Crow-nest, Chief, Bee-hive and Castle mountains are good examples of this. A later stage in this type is found in chimney-like and spire-like and isolated crags. A third type is that of the regularly *Seratred range* which is produced from beds of limestone standing on edge or very nearly so, and of which the Sawback and Opal Mountains are examples. Mountains like those of the Van Horne Range, and the Slate Mountains north of Laggan, assume still another distinctive character. They are composed of slates and quartzites in rather thin beds and shattered throughout by jointage-planes so that they disintegrate with almost equal facility in any direction. Such mountains thus tend to wear down rather uniformly, and become trenched by systems of radiating gullies which are separated by buttress-like ridges.

DISCUSSION.

WM. OGILVIE—Is there any evidence of the gradual upheaval going on now—any direct evidence?

DR. DAWSON—No, not that I know of from inspection or from taking levels, but there certainly is from topographical observations.

WM. OGILVIE—Said he would like to know if erosion would eventually do away with mountain scenery altogether?

DR. DAWSON—There is no fear of that.

A. O. WHEELER—In speaking of the Rocky Mountain Range, Doctor, you mentioned that from the 49° Parallel northerly the mountains lay in parallel ridges separated by valleys, first trending in a direction 35° from North, then changing to one 12° from North, and again to 35° from North, and that these ridges were intersected by cross valleys; that there were different theories as to the age of these respective sets of valleys; would you mind giving the reasons for the different theories?

DR. DAWSON—Said the matter was one that was by no means settled as yet, and that it would be a very lengthy matter to go into at the present time. The subject would, in fact, furnish a paper of itself, and he hoped, at the next meeting of the Association, to hear papers from some of the members on the subject.

FIELD OBSERVATIONS FOR AZIMUTH.

By W. F. King.

My object in this paper is to make a few remarks upon methods of determining the direction of a line by azimuth observations with a small instrument, such as the six-inch transit theodolite, of what is known as the Dominion Lands pattern.

The methods may be classed as (1) azimuth by one star, and (2) azimuth by two stars in the same vertical plane.

(1). If the error of the chronometer be known, the horizontal angle between the star observed at a given time and a terrestrial reference mark will give the azimuth of the mark, the angle between the vertical plane of the star and the meridian being calculated from the spherical triangle formed by the star, the pole and the zenith. The required angle is one of the basal angles of the triangle, two sides, the co-latitude and the co-declination, and their included angle, the hour angle, being given.

The result is subject to the effect of errors of observation, and instrumental errors. The principal errors of observation are the error of the assumed correction of the watch, and error in noting the time at which the star is observed. These errors are combined, being practically one and the same, and their effect on the result is to be avoided, or, at least, lessened, by a proper selection of the star to be observed. The most favorable position for the star is when its azimuth changes least in a given time. For this reason Polaris, the closest bright star to the (northern) celestial pole, is usually observed, and at the time of its greatest elongation east or west of the meridian; for then the apparent path of the star, in its small circle about the pole, touches the vertical circle which is traced out by the cross hairs of the instrument. The azimuth of the star, therefore, at the very instant of elongation, is not changing at all, and, owing to the star's proximity to the pole, its departure from this verticle circle is very slow—so slow that it takes three or four minutes from elongation to change the azimuth as much as one second of arc.

The observation at the elongation has, further, this great advantage, that a knowledge of the error of the watch is not necessary, for the star can be followed in azimuth by means of the tangent screw until it ceases to move in azimuth. The star is then at its greatest elongation. The observation is precisely analogous to that for determining the latitude by the meridian altitude of a star, where the star is followed until it ceases to rise. The instrumental errors to which the azimuth observation is subject are inclination of the axis, collimation error, and errors of the graduated circle.

The error of inclination is corrected for by multiplying the actual inclination as read by the striding level by the tangent of the star's altitude. The error of collimation is eliminated by taking two observations of the star in reversed positions of the instruments. (The effect of the collimation on the azimuth is equal to the actual collimation error multiplied by the secant of the altitude, which, of course, is different in the two observations however close they may be taken, and therefore the collimation will not be absolutely eliminated by reversal, but still so nearly so that the residual error will be inappreciable if the observations be taken not very far apart in time, and the collimation error be not excessive.) The effect of the error of graduation of the circle can be diminished by repeating the observations, so that the vernier readings come on different parts of the arc. With a two-vernier instrument, the instrument may be moved 120° in azimuth, by lifting it from the tripod and changing the places of the foot screws. These six observations will make a complete set, viz., three pairs on parts of the circle differing 120° in azimuth.

While this procedure has the advantage of cutting out the greater part of any periodic error of graduation which the circle may have, as well as much of the accidental error of a single graduation, it cannot very well be applied to the greatest elongation observation, since it is impossible to take more than one or two observations on Polaris before the star passes perceptibly from the elongation position.

POLARIS NEAR ELONGATION.

A modification of the strict elongation method may be applied, which may be called "Reduction to Greatest Elongation." The error of the watch must be known, but not with such accuracy as is necessary in observing the star in other parts of its path.

A number of pointings on the star are made within half an hour of the time of elongation, before and after, the time of each being noted. The observed times are corrected for watch error, and the differences taken between each time and the computed time of greatest elongation. Calling any of these intervals of time from elongation θ, the difference of azimuth of the star at the corresponding instant from its azimuth at the greatest elongation is equal to

$$\tan A \frac{2 \sin^2 \frac{1}{2} \theta}{\sin 1''}$$ very nearly, this result being

in seconds of arc. A denotes the azimuth of the star at its greatest elongation. So that the azimuth of the star at the time of observation east or west of the meridian is

$$A - \tan A \frac{2 \sin^2 \frac{1}{2} \theta}{\sin 1''}$$

$\frac{2 \sin^2 \frac{1}{2} \theta}{\sin 1''}$ is tabulated in many collections of tables under the head of "Reduction to the Meridian" (it being ordinarily used in reducing circum-meridian altitudes of stars to determine the latitude.) See Chauvenet's Astronomy, Vol. II. Tables.

This formula is an approximation. Its validity depends on the assumption that the spherical triangle whose angular points are the pole, and the positions of the star at the time of elongation and at time of observation, is so small that it can be treated as a plane triangle. It must therefore only be used with Polaris or other very close circumpolar star.

By differentiating this formula we find that the error in azimuth caused by an error in the watch correction is equal to the error in time multiplied by the factor 15 tan A sin θ. If then we are observing in latitude 50° where A is a few minutes over 2°, and if the time from elongation be 30 minutes of time, or 7½°, an error of 10 seconds in the time will cause an error of about ¾ of a second of arc only, while if the star is only 15 minutes from elongation it will take 28 seconds of time to make one second of arc. And if the observations be arranged in pairs at equal times before and after elongation, even this small error will be cut out.

As stated above the formula

$$\tan A \frac{2 \sin^2 \frac{1}{2}\theta}{\sin 1''}$$

is not rigid.

The error is nearly equal to

$$\tan A \, \frac{2 \, \text{Sin}^2 \tfrac{1}{2}\theta}{\text{Sin} \, 1''} \times 2{\cdot}308 \;\; \log. \;\; \sec. \, \theta$$

For on observation of Polaris in latitude 50°, at 30 minutes from elongation, we find that this error amounts to (approximately)

$$7{\cdot}0'' \times 2{\cdot}308 \times {\cdot}0037 = 0''.6 \times .60$$

Hence the formula given may safely be used within half an hour of elongation.

POLARIS AT ANY TIME.

If the watch error be known within a few seconds Polaris may be observed at any time, and the observations reduced by the rigid spherical formula (Napier's Analogies). The labor of computation is of course greater than in the last method.

The error of the watch may be determined by observing the altitude of a star some hours east or west of the meridian, or the time may be determined by transits of a star over the same vertical as Polaris according to the method set forth in the Manual of Surveys, or by transits in the meridian.

The azimuth may also be found by reading the altitude of a star, at the same time as its horizontal circle reading. We have the three sides of a spherical triangle, from which to determine the angle at the zenith. To carry out this method successfully, we must choose a star whose altitude is changing somewhat quickly. Hence a star some distance from the pole must be taken, and the result will not be so good as that from Polaris. The method is useful, however, for day observations on the sun.

In all these methods we depend upon the accuracy of a graduated arc for our results, which are consequently subject to the effects of graduation errors, and more especially to accidental errors of vernier reading, and have their accuracy limited by the fineness of the divisions of the verniers. It is, however, well known to observers that with a good telescope, on a second instrument, multiplication of observations will bring the error down to much less than the least count of verniers.

(2). The observation of two stars in the same vertical plane, or the method of transits, enables us to determine the azimuth of a reference mark without reading the verniers at all. Besides this, it has the further advantage that the watch error and the azimuth are determined from the same observation, and an independent observation for the former is not necessary. It requires, however, a knowledge of the rate of the watch, and the instrument must be handled very carefully. Practice is needed to count the beats of the watch and accurately record the time of the transit, for a second or two of error in time in this method is a serious matter when precise results are desired.

TRANSIT INSTRUMENT IN THE MERIDIAN.

I suppose the direction of the meridian to be approximately known, and a reference mark planted on it at a convenient distance north or south of the instrument.

The instrument is well levelled, and its collimation error reduced as much as possible. It is then set by means of the mark, and the times of transits of two or more stars over the middle thread noted.

It is shown in works on Astronomy that the adjustment errors of the transit instrument are three in number—error of azimuth or deviation from the meridian, commonly denoted by the letter a—error of inclination of the axis (b)—error of collimation (c).

Also, the effects of these errors upon the time of transit of a star are Aa, Bb, Cc, where A, B, and C, represent the factors $\sin(\psi - \delta) \sec \delta$, $\cos(\psi - \delta) \sec \delta$, and $\sec \delta$, respectively, ψ representing the latitude of the place, and δ the declination of the star.

a is positive when the instrument points to the east of south or west of north.

b is positive when the west end of the axis is higher than the east end.

c is positive when the line of sight of the centre thread is to the east of the true line of collimation of the instrument, so that a star above the pole reaches the thread before it reaches the true centre of the field.

Then if a star be observed to transit at the watch time τ and $\delta\tau$ be the watch correction, the true sidereal time at which the star crosses the meridian of the place is

$$\tau + \delta\tau + Aa + Bb + Cc,$$

which must be equal to the right ascension (d) of the star.

In this Bb is a correction determined from the readings of the striding level, and, therefore, known. T + Bb then is known. Let T + Bb=t.

Then we have the equation

$$\delta\tau + Aa + Cc = a - t = d,$$

d representing the difference between the right ascension and the observed time corrected for inclination of the axis, and being, therefore, known, we have three unknown quantities, $\delta\tau$, *a*, &c., A and C, the co-efficients being known numbers.

It is then a simple equation involving three unknowns, and since each star observed will give rise to a similar equation, the observation of three stars (if we are safe in assuming that *a* and *c* remain the same throughout the observations—that is, in other words, that the instrument is stable), will give three equations involving these three unknowns, and their values can, consequently, be obtained by the ordinary algebraic process.

We assume that $\delta\tau$ remains the same—that is, that the watch has no rate on sidereal time. If it has a rate (which can be found by a rough preliminary computation of observations some time apart) the observed times must be corrected to some one instant by applying the rate.

It is to be noticed that it is necessary, in order to determine the collimation error *c*, to take some of the observations in the reversed position of the instrument, thereby throwing the collimation error to the other side, and giving the correction for it the opposite sign. If this is not done, and all the observations are taken on one face, it is true that the solution of the three observation equations will give a value for *c*, but the difficulty is, that in the algebraic elimination *c* will come out with a very small co-efficient, so that the smallest error in the term *d*, that is, in the observed time, will so affect the result as to make the value of *c* very erroneous. Reversal, however, avoids this by making this co-efficient large, so that the effect of the error of observation is reduced by the division. When the instrument has been reversed, *c* has opposite signs in the two positions. This is taken notice of in the formation of the equations by changing the sign of *c*, so that if the observation equation for a star in one position be

$$\delta\tau + Aa + Cc = d$$

the observation equation of a star observed on the other face is

$$\delta\tau + A_1\, a - C_1\, c = d.$$

In the above it is assumed that the reversal is done as with the astronomical transit, viz., by lifting the instrument out of the V's, and changing the pivots, end for end, without disturbing the azimuth of the axis.

With small instruments, however, this is difficult, and besides the principal object is usually to determine the azimuth of a terrestrial mark. It is usual therefore to set the instrument on the mark and after the observations on that face have been completed, to reverse by turning the instrument 180° on the azimuth plate, and setting on the mark again. The actual azimuth of the collimation axis of the instrument is thus changed by twice the collimation error. This renders necessary a modification of the above formulæ.

Suppose the reference object to be to the north (nearly) and to be in azimuth a (west of north, suppose, so that a is *plus*).

Let the collimation error c be positive. Then the collimation axis is west of the thread, and consequently west of the reference object, when the thread is set on the mark.

Therefore if $a_{,}$ be the true instrumental azimuth deviation, $a_{,} = a + c$.

And when the instrument is reversed, the azimuth becomes $a_2 = a - c$.

Instead of the equation

$$\delta\tau + Aa + Cc = d$$

we must therefore write

$$\delta\tau + A(a + c) + Cc = d$$

or, bringing together the co-efficients of the unknown,

$$\delta\tau + Aa + (A + C)c = d$$

The form of equation for a star observed in the reversed will be, similarly,

$$\delta\tau + Aa - (A + C)c = d$$

If then we have a number of stars in each position, we shall have a series of equations thus,

$$\delta\tau + Aa + (A + C)c = d$$
$$\delta\tau + A_{,}a + (A_{,} + C_{,})c = d_{,}$$
$$\cdots\cdots\cdots\cdots\cdots$$
$$\cdots\cdots\cdots\cdots\cdots$$
$$\delta\tau + A'a - (A' + C')c = d'$$
$$\delta\tau + A'a - (A'' + C'')c = d''$$
$$\cdots\cdots\cdots\cdots\cdots$$
$$\cdots\cdots\cdots\cdots\cdots$$

These, if more than three in number, may be solved by the method of least squares. Their solution gives a, the azimuth of the mark, directly.

It is easily seen that if the reference mark be south, instead of north, of the instrument,

$$a_{,} = a - c, \text{ and } a_2 = a + c$$

and consequently $C - A$ must be substituted for $A + C$ in the equations.

This method gives very good results, though it involves a large amount of work in the formation and solution of the normal equations, where more than three stars have been observed, and the method of least squares is used.

The following is a simpler method of solution, by which a close approximation can be arrived at. Four observations are to be taken, two on each face.

Then for the first position we have:

$$\left.\begin{array}{l} \delta\tau + Aa + (A + C)c = d \\ \delta\tau + A_{,}a + (A_{,} + C_{,})c = d_{,} \end{array}\right\} \text{Reference object North.}$$

Neglect c altogether, so that the equations become

$$\delta\tau + Aa = d$$
$$\delta\tau + A_{,}a = d_{,}$$

Whence $a_{,} = \dfrac{d - d_{,}}{A - A_{,}}$ This is an approximation value of a; call it $a_{,}$

$a_{,}$ being thus found, its error is

$$c - \frac{C_{,} - C}{A - A_{,}}\, c$$

so that,

$$a = a_{,} - c + \frac{C_{,} - C}{A - A_{,}}\, c$$

Similarly, from the two stars on the other face, we first get the approximate value a_2, from the formula

$$a_2 = \frac{d' - d''}{A' - A''}$$

and

$$a = a_2 + c - \frac{c'' - c'}{A' - A''}\, c$$

The factors $\dfrac{C_{,} - C}{A - A_{,}}$ and $\dfrac{C'' - C'}{A' - A''}$ may be calculated from the declinations of the given stars.

Calling $1 - \dfrac{C_{,} - C}{A - A_{,}}$, m, and $1 - \dfrac{C'' - C'}{A' - A''}$, n,

we have
$$a = a_1 - c\,m$$
$$a = a_2 + c\,n$$
whence
$$a = \frac{n\,a_1 + m\,a_2}{m+n}$$
by which the true azimuth a is determined from the two approximations a_1 and a_2.

If the stars be so chosen that
$$\frac{C_{,} - C}{A - A_{,}} = \frac{C'' - C'}{A' - A''} \text{ then } m = n \text{ and } a = \tfrac{1}{2}\,(a_1 + a_2).$$

If m is nearly equal to n, this last formula may also be used. That is, the collimation may be neglected in the computation.

Results from this method are not precise, though close, because four equations have been used to determine three unknowns. For the best results the method of least squares should be applied, as it gives the *most probable* value of the unknown quantities.

Since, when the collimation has been determined and allowed for, the azimuth is found by the formula
$$a = \frac{d - d_{,}}{A - A_{,}}$$
the error in a caused by a given error in $d - d_{,}$, that is, by a given error of observation, is made less by increasing $A - A_{,}$. Hence a star above the pole combined with one observed below the pole gives a good result for A and $A_{,}$ are of opposite signs, and both large, if the stars are not far from the pole, and $A - A_{,}$ is then arithmetically the sum of A and $A_{,}$.

TRANSITS IN ANY VERTICAL PLANE.

A great many methods have been suggested for field observations in vertical planes out of the meridian.

The general formulæ are given in Chauvenet's Astronomy, Vol. II. They are, however, of little practical use, the computation of the observations being so tedious that few persons would care to undertake them, when simpler methods are available, even at a sacrifice of time. The solution is simpler when Polaris is one of the stars. The best method which I have seen is that of Capt. Deville, which is given in the Manual. One star is observed besides Polaris. The computation is very simple, more so in fact than in any of the methods I have spoken of except that of Polaris at greatest elongation. The time and azimuth are both determined by the observation. It requires, however, that the angle be read on the horizontal circle. If the instrument be set on a mark, the observer must wait until Polaris crosses the thread, and he loses the advantage of the quickness of which otherwise the method is capable, and besides he cannot repeat the observation on reversed face without moving his instrument from the mark.

In this observation the observer should take care that his instrument is well adjusted both as to level and collimation, because correction further complicates the computation.

In conclusion, I will give a graphical method for determining the star constants A, B and C for transit observations. The calculation of these constants may be considered the most tedious part of the work of reducing transit observations.

On a sheet of paper draw two straight lines AB and BC at right angles to one another. Take AB of any convenient length equal to 100 divisions on any convenient scale. If a scale of 40 to an inch be used, AB will be 2½ inches. BC is to be of indefinite length. Lay off along it, beginning at B, a scale of natural tangents, with AB as radius. Mark off the degrees along BC, and parts of a degree, if desired. Let D be the point of BC corresponding to the latitude of the place, so that $BD = AD \tan \varphi$

Join AD and produce it indefinitely. Take a set square, and lay it on the paper so that one of the sides including the right angle lies along AD, and the other side intersects BC in the point corresponding to the declination of the star. Then the distance from this last point to the right angle of the square will be equal to A (to be measured on the same scale as that of AB). The distance from A to the right angle of the square is B. The distance from the point of BC marking the declination to the point A is C.

W. F. KING

SOLAR ATTACHMENT TO THE TRANSIT INSTRUMENT.

In the following paper I do not propose to make a full description of the Solar Apparatus as a means of determining the hour, latitude and azimuth; nor do I intend to give you a narrative of its discovery as a Solar Compass, as first invented by Burt, and its comparatively recent adaptation to the modern field transit. In some periodicals, and works on Surveying, these topics are ably treated; here I want to make merely a few remarks as to its use and degree of precision. Several forms of Solar Attachment to the Transit are in use; of these I will mention two, viz.:—The Saegmuller Solar Attachment, manufactured by Fauth & Co., Washington, D.C., and one patented and manufactured by W. E. Gurley, Troy, N.Y.

The manufacturer of the Saegmuller attachment claims the following advantages over other forms:—

1st. It is more accurate.

2nd. It is simpler and easier of adjustment.

3rd. It can be used when the sun is partly obscured by clouds, when the ordinary "solar" fails altogether.

4th. It can be used when the sun is quite close to the meridian.

5th. The time can be obtained with it to within a few seconds, with perfect ease.

In my opinion the fourth advantage claimed is very questionable, for, in practice, any solar apparatus will lack in precision when the sun comes near the meridian. In order to secure good results azimuth observations should not be taken from half-past ten a.m. to half-past one p.m.

I am not prepared, however, to discuss these advantages claimed for the Saegmuller attachment, since the only form of solar attachment I have used is the Gurley's patent.

Of this last, however, I can say, from experience, that it is quick and easy of manipulation, and, if one is careful, surprising results are constantly obtained.

The solar apparatus solves, mechanically, the solar problem. If any one of the three quantities—latitude, apparent solar time, or azimuth—be known, and also the declination of the sun, as affected by refraction, the two remaining parts can readily be found.

Moreover, if the declination alone is known, the latitude can be obtained by observing at the meridian transit of the sun.

I will make no further remarks as to the description of the solar attachment, but will proceed at once to give a few practical hints for its use, and speak of its degree of precision in the determination of azimuth.

One of my transits, with solar attachment, is exhibited in this room for further information of members wishing to examine its construction in detail.

It is necessary in practice to observe for latitude at every available opportunity.

The observations are made at the meridian transit of the sun.

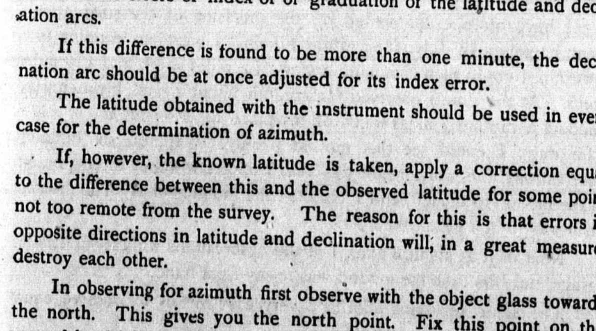
The declination of the sun at its transit, as affected by its meridianal refraction, being set off on the declination arc. If the latitude be known, the difference of this last with the observed latitude gives the combine errors of index or of graduation of the latitude and declination arcs.

If this difference is found to be more than one minute, the declination arc should be at once adjusted for its index error.

The latitude obtained with the instrument should be used in every case for the determination of azimuth.

If, however, the known latitude is taken, apply a correction equal to the difference between this and the observed latitude for some point not too remote from the survey. The reason for this is that errors in opposite directions in latitude and declination will, in a great measure, destroy each other.

In observing for azimuth first observe with the object glass towards the north. This gives you the north point. Fix this point on the ground by driving a hub at a distance of five to ten chains from the instrument, and place a mark on the hub to locate this point exactly. Now repeat the observation, the eye-piece towards the north; you thus determine the south point. Fix the point as before; now transit the instrument, if the line of sight falls on the point first determined, all right; if not, and it strikes not too far off, proceed as follows :—



Let I be the place of the instrument, A and B the points determined; if these points are not in a straight line with I they will lie on the same side of the meridian sought, if the observations were carefully taken.

Produce B to A′ and A to B′, using, in each case, the instrument in both positions as referred to its clamp. Bisect AA′ and BB′, and IN joining these two points of bisection will pass through I, and will be the meridian sought.

If AA′ are 2 to 3 inches apart, at a distance of 10 chains, you might be safe to conclude that IN is within 30″ of the true meridian, for 30″ represents a difference on AA′ of a little over one inch at that distance.

If you have a good instrument, you keep it well in adjustment, and you handle it in a skilful and careful manner, you are safe to claim still more precise results.

I have often experimented on the precision of the solar attachment, namely: In July, 1889, while running a meridian exterior to a township, I could then command a view of 4 miles south and 1½ miles north. At the time I observed for azimuth, about 4 p.m., my men were building a mound 4 miles south of my place of observation; it was a clear day; I could see this mound plainly. Well, on six different observations, the worst result was that I once saw about three-quarters of the mound to my left, and I bisected the mound twice. The greatest error was then a little over 15″.

Next day, at about 8 a.m., I made observations with about similar results, but this time the mound was to my right hand.

The solar apparatus affords a very easy means to observe equal altitudes of the sun for azimuth.

It is not necessary, however, that the altitudes be exactly equal, for each result is independent by itself. If you observe at about equal altitudes of the sun, changing the reading on the declination arc to what it should be for the afternoon hour corresponding to the morning observation, you will have a result with an error, if any, the same as at the forenoon observation, but lying in opposite direction. The mean of these two observations is the true meridian.

This last result is, however, subject to any error arising from the handling of the instrument; to avoid these one cannot be too careful.

It is evident, by the results obtained in observing at equal altitudes of the sun, one can at once ascertain whether his instrument is in good adjustment or not. The solar attachment is specially useful for any kind of survey where azimuth must be determined frequently, either as a check or from the nature of the work performed.

There is also a Solar Theodolite, manufactured by Mr. Holmes, Batavia, N.Y., which appears to me, from the description I have read of it, to be a valuable instrument.

I hope, at our next meeting, Mr. Holmes and other manufacturers and inventors of new forms of instruments will make an exhibit of their various instruments, and this will, undoubtedly, give valuable information to the members present at the next meeting.

If these few remarks be useful to some members of the profession I will be satisfied of having taken some of your precious time, and justified in being exposed to your criticism.

J. I. DUFRESNE,

D. T. S.

MARÉES, VAGUES, RESSACS, COURANTS ET VENTS.

Monsieur le President, Messieurs les membres de l'Association des Arpenteurs fédéraux :

Depuis 1884 j'ai eu l'honneur d'être employé par le départment des Travaux publics du Canada à faire l'examen de havres dans le but d'y faire des constructions, et j'ai eu occasion de faire des observations sur les marées, les vagues, les ressacs, les courants et les vents, et je prends la liberté de venir vous soumettre quelques considérations sur ces sujets.

DES MARÉES.

Ayant eu à m'occuper du phénomène des marées, j'en donnerai la définition suivante : la marée est l'exhaussement ou l'abaissement périodique des eaux de la mer et des fleuves qui y aboutissent, mouvements dus aux attractions combinées de la lune et du soleil.

Je ne parlerai que du champ ou il m'a été donné de faire des observations. L'action des marées est très marquée dans l'Atlantique, mais généralement insensible dans les lacs ou mers intérieures.

La mer s'élève et s'abaisse deux fois pendant le retour de la lune au méridien ; dans beaucoup d'endroits elle met autant de temps à monter qu'à descendre, soit, six heures et douze minutes ($6^h\ 12'$) ; mais il n'en est pas de même dans le Saint-Laurent et la baie des Chaleurs, etc., où l'action de la mer montante est plus longue, dans la partie supérieure, assez souvent jusqu'à une heure.

On appelle la mer montante, flux ou flot ; la mer descendante, reflux, ebbe ou jusant.

La mer monte plus dans les syzygies ou renouveau et à la pleine lune, et moins aux quadratures, ce qui fait que nous avons les marées de vive-eau aux syzygies et les marées de morte-eau aux quadratures, de même que nous constatons les hautes mers de vives-eaux les plus hautes et les basses mers les plus basses aux temps des équinoxes.

L'accroissement des marées et leur diminution, quoique non constants en allant aux syzygies et quadratures, parce que les deux marées du même jour diffèrent, font qu'on doit prendre la moyenne des deux pour avoir ce qu'on est convenu d'appeler la marée totale pour un jour.

Les vents ont pour effet d'augmenter ou de diminuer les marées, suivant leur direction, pour le port d'obsevation où l'on se trouve.

Les astronômes, par leurs calculs, ayant égard aux positions relatives de la terre, de la lune et du soleil, nous disent à quel temps de l'année auront lieu les plus fortes marées des syzygies.

Partout où il m'a été donné d'observer, la plus haute marée n'a pas eu lieu le jour de la syzygie, mais deux ou trois jours après. La forme des côtes, les courants et d'autres circonstances influent sur ce retard, mais pour le même port ce mouvement est constant.

Les marées d'un jour arrivent toujours plus tard que celles du jour précédent, se conformant au passage de la lune au méridien, soit une moyenne de quarante-huit minutes (48') par jour.

L'ondulation qui se produit dans l'Atlantique a une vitesse de mille pieds à l'heure, d'après étude faite sur ces eaux. Ce qui fait que la marée nous arrive plus tard en certains endroits, ce sont les courants et les pointes qui protègent les golfes, et l'action de l'eau qui descend d'un fleuve ; les vents ont aussi leur influence, suivant qu'il viennent de la mer ou de terre. Les vents qui font que la mer monte plus sont ceux qui viennent du large, parce qu' ils ne rencontrent aucun obstacle ; cependant, on observera à queques centaines de milles de distance une marée plus forte à un endroit qu'à l'autre ; mais d'après les observations, il est vrai que les mêmes vents qui empêchent la mer de monter dans un port la font ordinairement baisser davantage.

Il est à observer que dans les endroits où les marées sont moindres, les vents sont beaucoup plus à craindre. Nous constatons que les vents ont beaucoup à faire avec les marées.

La mer montante n'est pas toujours constante, comme nous l'observons dans la baie du Fundy. Il y a ce qu'on appelle une première et deuxième eau. Ainsi, les perturbations apportées aux marées par la forme des côtes, par les courants, par les vents, ne pouvant être déterminées par la théorie, c'est à l'observateur à y suppléer. Les relations entre les temps et les hauteurs de la mer, ou les courbes des marées, sont des données non moins utiles à l'ingénieur chargé des constructions d'un port qu'aux marins qui le fréquentent. C'est donc un des premiers documents qu'il doit chercher à se procurer.

Pour celui qui est chargé de faire l'examen d'un port dans le but d'y construire quelque chose, soit une jetée ou un brise-lame, il lui est difficile de donner le zéro des marées des syzygies, car il en dépend d'un concours des astres qui ne se rentcontrent qu'en plusieurs années, puisïqu'il faut la concidence des vents et d'une certaine position des astres pour amener le zéro à la même position. Cependant, pour celui qui a l'habitude de faire l'observation du phénomène des marées, il peut arriver assez facilement, sur nos côtes du golfe, à determiner ce zéro des marées à quelques dixièmes d'un pied, en exceptant cependant la baie de Fundy.

Si je ne me trompe, je crois qu' après ces quelques considérations sur les marées, on constatera qu'il est de la plus hauts importance de savoir bien les apprécier pour ceux qui s'occupent de constructions à la mer.

DES VAGUES.

Le mouvement des vagues mérite toute l'attention de celui qui s'occupe des ouvrages à la mer. Il faut distinguer les mouvements du large de ceux qui se produisent sur les côtes ; car les vents produisent l'agitation de la mer au large, et souvent à terre on n'a que l'ondulation parce que les vagues sont produites par le vent, lorsque l'atmosphère est calme, il n'y a pas de vagues, si ce n'est celles produites par l'ondulation.

Les vagues observées au large ne présentent qu'un soulèvement des eaux de la mer et n'avancent que très lentement dans la direction du vent. On dirait que la vague s'enfuit avec rapidité ; mais pour constater le contraire, on jette un corps flottant qui suit le mouvement des flots, et il s'éloigne très peu de la verticale, fait que l'on constate facilement dans une embarcation légère et qui ne donne pas prise au vent et quand il n'y a pas de courant. Les vagues peuvent être comparées aux ondulations d'un drapeau. La hauteur des vagues dépend : 1° de la violence du vent ; 2° de la profondeur et de l'étendue du bassin où elles se propagent. J'ai observé dans le golfe Saint-Laurent des vagues de vingt pieds de hauteur ; sur le lac Supérieur, en 1882, par une tempête, il y en avait qui pouvaient avoir une quizaine de pieds de hauteur. Il a été constaté qu'il n'y avait que la tranche supérieure qui soit agitée. Suivant la profondeur de l'eau, l'action sensible des vagues va jusqu'à trente pieds, mais là où l'eau n'est pas profonde, elle est beaucoup moindre ; on constate ce fait par des observations sur les fonds sablonneux. Telles sont en général les ondulations de la mer au large ; sur les côtes les effets sont différents. La mer agit sur le fond lorsqu'il se rapproche de la surface ;

Ainsi, près du rivage, son mouvement se complique de la réaction du fond ; les vagues interrompues dans leur développement inférieur, frappent la plage, glissent sur le rivage où on les voit s'élancer à des hauteurs plus grandes que celles de leur sommet. C'est ici que le mouvement vertical d'ondulation se transforme en vitesse horizontale. Le constructeur qui met un obstacle à ces vagues doit calculer avec cette action horizontale, car c'est ce mouvement aussi bien que la pression due à l'élévation qu'elles acquièrent par ondulation qui ruine les ouvrages à la mer et les renverse.

Il y a ce qu'on appelle la lame de retour. Après avoir monté sur le plan incliné d'une plage, elle en descend et rencontre celle qui vient du large ; alors les deux masses animées se dressent l'une contre l'autre : celle qui vient du large ayant plus de volume que l'autre, la dépasse, s'arrondit et tombe en déferlant sur le rivage ; elle enveloppe l'air dans sa chute et produit cette écume blanchâtre qu'on remarque si souvent.

On constate toujours la présence d'un haut fond par la réaction de la vague, car celui qui est en observation quand le vent commence peut voir de suite là ou le fond est plus haut, car c'est la que la mer commence à s'agiter, et dans les tempêtes on peut juger par la réaction des vagues qu'il existe à tel ou tel endroit un haut fond. Un haut fond agit toujours assez sur les vagues pour produire un changement quelconque dans leur forme, qui signale sa présence même à des profondeurs considérables. La vague clapoteuse indique au navigateur qu'il est sur le banc de Terreneuve, quoiqu'il soit à plus de quatre milles pieds de profondeur.

Quoique l'on constate que le mouvement de translation des vagues au large n'est en grande partie qu'apparent, cependant par les grands vents elles sont animées d'une vitesse horizontale notable, car la marche de la lune est dans la direction des grands vents et change avec elle. Néanmoins nous constatons presque partout que la lame vient du large, quelle que soit la direction du vent.

La vague présente un plan incliné à la direction du vent. L'action de l'air se décompose en deux forces, l'une perpendiculaire à cette surface qui augmente la profondeur de la vague au moment ou elle s'abaisse, et par suite sa hauteur, et l'autre parallèle à la surface de la mer, qui communique un mouvement de translation dans le sens du vent. On dit que la mer moutonne quand le sommet de la vague, poussé avec plus de vitesse que la partie inférieure, tourne en volute, renferme de l'air et produit une eau blanchatre ; cet effet se produit surtout quand les lames sont entraînées par un grand courant et qu'elles marchent dans le sens opposé au vent : c'est ce qu'on remarque dans les rivières quand le vent souffle d'aval en amont. Je crois au mouvement de translation par l'effet du vent sur les côtes : ce fait se constate par l'amoncellement du sable en certains endroits.

Pour celui qui veut des travaux à la mer, l'étude des vagues est très importante ; il lui faut apporter le plus grand soin à calculer leur force, afin de savoir si une construction pourra résister à tel ou tel endroit, quelle forme lui donner, quelle protection lui sera nécessaire.

La théorie montrant que l'action de la mer sur des blocs de forme semblable croissait comme les carrés de leurs dimensions, tandis que leur stabilité croît comme les cubes de ces mêmes dimensions ; mais il a été constaté que ce problème n'est pas résolu, car la partie de la construction qui se trouve sous l'eau perd une partie de son poids qui ne doit pas entrer dans la valeur du frottement.

DES RESSACS.

Ce qu'on est convenu d'appeler de ce nom, ce sont plusieurs effets secondaires des vagues. Pour mieux préciser ce que j'entends par cette définition, je dirai que c'est une agitation qui n'est pas transmise *directement* du large.

Les chocs qui ont lieu à la surface de la mer contre les travaux qui leur sont opposés brusquement, comme le parement d'un quai ou d'une jetée, ou d'un brise-lame, ou une côte sont des effets que l'on, reconnait à la simple inspection. Ces mouvements irréguliers doivent se transmettre vers le bas de l'obstacle comme vers le haut, en diminuant d'intensité avec la profondeur de l'eau, de manière que si le parement d'un quai ou d'une jetée, par exemple, est fondé un peu au-dessous de la mer basse, le terrain naturel sera plus ou moins attaqué par ces mouvements de transmission que l'on appelle ressacs ; et s'il peut être entamé, il en résultera un affouillement, ainsi qu'on le voit généralement au pied des musoirs des jetées.

Ces affouillements n'existent pas toujours immédiatement au pied des ouvrages, car nous remarquons souvent que le ressac laisse dans l'angle d'une jetée, construite en deux parties, une partie de fluide peu agitée où s'accumulent tous les matériaux qui y sont poussés ; c'est pourquoi on constate que l'affouillement provenant du ressac est à une petite distance de l'ouvrage sur la base duquel s'appuie un très petit talus.

Ces ressacs sont les ressacs verticaux, qui ont toujours plus ou moins lieu au pied des obstacles abrupts ; mais la résistance de ceux-ci produit aussi des agitations qui se reflèchissent horizontalement et se transmettent quelquefois à des distances assez grandes.

Je n'ajouterai que quelques observations générales sur les ressacs. Ainsi, nous remarquons que par un certain vent les affouillements se produisent de telle et telle manière, et arrivant que le vent change, les affouillements se produisent ailleurs ; c'est pourquoi, avant de choisir le point où doit reposer une construction, il faut bien étudier ce qu'en tel endroit pourront produire les ressacs. Il faut pour cela bien suivre le mouvement des vagues et des courants, et voir quelle peut être l'influence du vent sur les vagues,et étudier avec soin la composition du fond,afin de voir s'il peut y avoir affouillements. A l'entrée d'une rivière dont les eaux charroient du sable, il faut être de la plus haute particularité, car il y aura toujours affouillement, le courant se trouvant modifié dans son cours.

Je crois que ces quelques remarques sur les ressacs feront comprendre l'importance qu'il y a de les étudier lorsqu'on est chargé de faire l'examen d'un havre.

DES COURANTS.

Il y a aussi les courants qui agissent directement ou médiatement sur les ouvrages à la mer. Il est important de bien connaître ceux qui règnent le long de la côte à une certaine distance, parce que d'eux dépend en partie la marche des alluvions.

Il y a généralement un courant littoral allant suivant la direction de la côte ; il y a aussi les courants généraux qui agissent au large, mais ils ont peu d'importance pour les travaux des ports, sur leur entrée et leur sortie, sur la marche des alluvions. Ce sont les courants dus aux marées, lesquels, considérés près des côtes, sont nombreux, variés et souvent alternatifs comme la cause qui les produit.

Rien de plus changeant que leur direction, qui offre des révolutions périodiques avec les marées, et dont la régularité est souvent troublée par les vents ; on constate à l'extrémité des pointes des courants différents de ceux des anses.

La vitesse des courants n'est pas altérée par la marche des corps :

que la mer soit calme ou agitée, ils sont entraînés avec la même vitesse ; mais le vent, suivant sa direction, a quelque influence.

Les courants à la surface n'ont pas toujours la même direction que ceux du fond, car il a été constaté en certains endroits, par un temps calme à l'entrée d'une rade, qu'un canot entrait par l'action du courant à la surface, pendant qu'un navire sortait.

L'intensité des courants varie beaucoup ; il est d'ailleurs remarquable que le renversement des courants relatifs au changement de la marée est généralement postérieur à celle-ci, car on constate que le courant de flot continue encore quoique la mer baisse. Quant au temps, il varie suivant les endroits.

Les courants varient d'ailleurs de direction près du rivage. On y remarque quelquefois des remous, des tournants, des contre-courants. Nous voyons que ce fait a été formulé ainsi : " Toute saillie ou renfoncement brusque dans le fond du lit ou sur les bords donne lieu à des tournoiements, à des changements de direction ; ces effets ont d'autant plus d'intensité que la vitesse est plus grande."

Les caps, les baies, les îles, les mouvements prononcés du fond, agissent sur les forts courants de la mer et produisent les effets dont nous parlons. Ainsi, il existe quelquefois sur les rivages des courants contraires à ceux qui existent au large. *Venturé* a appelé ce phénomène "communication latérale du mouvement des fluides."

Ainsi, tout obstacle peut contribuer à produire un contre-courant et à la formation de remous, une île, une jetée, etc. ; mais c'est principalement la grande vitesse qui détermine l'existence des remous. Ainsi, en certains endroits, dans les basses eaux on ne voit point de remous, mais on constate les contre-courants et les tournoiements des eaux de la mer, qui semblent ne presque pas exister dans les petites marées, tansdis qu'ils sont très prononcés dans les fortes marées.

DU VENT.

Le vent a une très grande influence sur les marées, l'agitation de la mer, la formation des vagues, le régime des côtes, l'entrée et la sortie des ports. Rien de plus inconstant que la direction et l'intensité des vents ; ce n'est que vers les tropiques qu'ils offrent quelque régularité pour les époques et les directions.

Dans un port on nomme vent régnant celui qui souffle le plus souvent ; cependant, les vents qui soufflent le plus violemment viennent souvent d'une autre direction.

Les vents les plus violents sont généralement ceux qui viennent du large, dans la direction de la plus grande ligne droite que l'on puisse tirer sur la mer.

Pour celui qui s'occupe des travaux à la mer, il doit noter jour par jour la direction et l'intensité du vent, car c'est très important en vue de la construction qui sera faite.

Je termine ici cette lecture peut-être trop longue.

On remarquera que je n'ai fait que parler des choses que l'on constate, sans avoir parlé des causes qui les produisent ; je n'ai voulu m'attacher qu'au côté pratique du sujet.

Je n'ai parlé des vagues, des ressacs et des courants que là où on constatait des marées. L'étude de ces sujets, quant aux rivières et aux lacs, diffère souvent de beaucoup et mérite un très long espace ; c'est pourquoi, sans en donner la garantie, je vais vous dire au revoir sur ce sujet.

J. E. SIROIS.

SURVEYS OF RIGHT OF WAY FOR RAILWAYS.

Though it might appear at first sight a very easy matter to prepare a correct Right of Way Plan, the writer's experience goes to shew that, unless considerable care be taken, numerous mistakes will be made. The writer remembers one plan furnished him as a basis of operations, and made by an Engineer who is also a Provincial Land Surveyor, which had so many mistakes in it that more time was lost in vainly trying to reconcile the measurements afterwards made, and information obtained on the ground with the plan, than would have been required to make a complete survey of the line from the start.

Another plan which the writer had to deal with, and which was prepared in altogether too short a time by the Surveyor, rendered it necessary for another Surveyor and the Railway Company's Notary to go over the line and meet the various proprietors in order that they might point out their respective properties.

And still another plan, furnished as a basis of operations by a very able Engineer, was so full of mistakes that the writer could, from his own knowledge of the locality, before going on the ground, point out an error on almost every lot.

On another occasion the writer was asked to verify a plan made by a very competent Engineer, being assured that it was all right; on examining this plan with a view of finding out how it had been prepared it turned out that the line shewn on the plan was in some places not that run on the ground, but that the line had been only shifted a short distance in those places; enough, however, to throw the line out of one concession into another at a few points.

The writer, after examining the plans and field notes, decided that all places where these changes had been made would have to be gone over again on the ground; and that measurements should be taken in other places to verify the work.

On making these measurements it was found that errors had been made on the plan in every place where the line had been changed; in some cases the plan shewed land taken from farms which were not touched; and in other cases farms which were actually crossed were shewn as being outside the Right of Way.

These errors had crept in partly from mistakes in the Cadastral Plans, which had been used to fill in boundaries a short distance from the line; and partly because the bearings of the fences had been taken with too small a compass.

Where the line had not been altered the plan was correct, but it was found necessary to verify all the calculations of areas.

It would appear, therefore, that it is not so easy a matter to make correct Right of Way Plans, or as Engineers generally call them, "*Land Plans*," by which name the writer proposes to call them in the rest of this paper.

Land Plans may be said to serve for three purposes:—

Firstly—For the use of the Engineers;

Secondly—For the use of Arbitrators, Notaries and Valuators; and

Thirdly—For retracing the limits of Right of Way in the future.

The original land plan, or as it is often called, "*The Registered Copy*," is used for the first and second purposes, while the final land plan, generally known as the "*Plan of the line as built*," should be referred to for the third purpose.

For the use of the Engineers of construction the land plan should show the position of every tenth station along the line commencing at number 0, or at the first even multiple of ten on the section covered by the plan; (a station being 100 feet long) the chainage at the commencement and end of the plan, also at the beginning and end of each curve, and at points of compound curve, the beginning of curve being marked "B.C.," the end of curve "E.C.," and a point of compound curve "P.C.C." Some Engineers mark the beginning of curve "P.C." for "point of curve," and the end "P.T." for "point of tangent," but since the beginning of a curve is as much a "point of tangent" as the end is, the writer prefers "B.C." and "E.C." as being less liable to be misunderstood.

The plan should also show the bearings of all tangents, the degree of all curves and their direction, whether to the right or left of the observer when looking along the line in the direction in which the chainage runs, the degree of curvature being marked, for example 3°R or 2°L.

A Land Plan would be much more complete if the lengths of the sub-tangents and the intersection angle of all tangents were also entered at each curve, but as the bearings of the tangents and the degree of curve give the information necessary to calculate the lengths of the sub-tangents, and as land plans have often to be completed on short notice, the bearings of tangents and degree of all curves might be considered sufficient information on that point.

As to the bearings of the tangents the writer does not wish to convey the impression that they should be taken with a compass only, for then the intersection angles could not be depended on, but that, after the bearing of one line had been established by the compass, all the remaining angles should be read with the transit, always keeping the north half of the plate towards the north, by which means the transit readings will always correspond with the compass readings, due allowance being made for local attraction due to minerals in adjoining rocks or similar causes.

The question has been raised as to whether the bearings entered on land plans should be astronomical or magnetic. No doubt it would be much more satisfactory were they astronomical.

In the Province of Quebec, according to the Surveyor's Act, bearings in general must be Astronomical, when referred to in *Proces Verbaux*, but neither the Act nor the Consolidated Statutes of Quebec give any rule as to the bearings on ordinary plans.

Chapter 146 of the Revised Statutes of Ontario which came into force on the 31st December, 1877, in section 70, relating to subdivisions states that plans of subdivisions shall shew the astronomical or magnetic bearings of certain lines, but makes no mention of bearings on plans in general.

The Dominion Act of 1888, Sec. 123, states that a map or plan of the railway "*and of its course and direction*" shall be made; this is rather vague and may refer only to its general direction.

It would appear therefore as if it was not necessary to put even magnetic bearings on the lines so far as the Acts relating to the subject are concerned.

Since Railway Surveys are traverses which do not close, it would seem advisable to run them as suggested above in order that the compass may check the vernier readings, in such case, since in rough ground the courses change very frequently, it would entail considerable labour to alter all the bearings from magnetic to astromonical, and it would seem quite sufficient if the variation of the compass were determined from an astronomical observation on each section and entered on each plan.

The information above referred to, as regards the curves and the bearings of the lines, can generally be obtained from the Locating Engineer.

In addition to this, for the use of the Constructing Engineer, the land plan should shew the width to be taken on each side of the centre of the track or tracks, and where extra width is to be taken the stations where it commences and ends should be shewn.

The reasons for referring the widths to the centre line of the track are, firstly, that that line is almost always the line run by the Locating Engineer, and, secondly, that it is much easier to measure from the centre line of the track or tracks in the future.

These widths on each side of the centre line of track should be plainly figured at each end of each change of width, and, when the same width is carried for a considerable distance, at such short intervals, say of about eighteen inches, as will enable anyone, who has occasion to consult the plan, to find out the width without unrolling too much of the plan.

With regard to the amount of topography which should be shewn for the use of the Constructing Engineers, all farm roads which cross the right-of-way should be indicated, for farm crossings have generally to be constructed to take the place of these roadways; all ditches should also be shewn in blue lines, whether they cross the right-of-way or run alongside of it, and the direction in which the water flows should be indicated by an arrow.

All streams and rivers that cross, or run, say within 200 feet of the right-of-way, should appear on the plan, in order that the general direction of the drainage may be seen; and the top and foot of all well-defined slopes or banks should also be shewn.

All the above mentioned detail may be said to be for the use of the Railroad Company, and the exact amount to be surveyed and shewn on the plan should be ascertained from the Company's representative.

For the use of Arbitrators, Notaries and Valuators, one would expect that the various Railway Acts would define what should be shewn on the plan; these Acts are, however, very vague in their wording and loose in their description as to their requirements in that respect.

The Provincial Acts seem to follow the Dominion Act pretty closely.

This latter Act, being 51 Vic., cap. 29, in sec. 123, requires that a plan shall be made of the lands to be taken, and that a book of reference shall also be made, in which shall be set forth :—

"(*a*). A general description of said lands."

"(*b*). The names of the owners and occupiers thereof as far as can be ascertained."

"(*c*). Everything necessary for the right understanding of such map or plan and profile."

The writer would remark here that he *never knew* a book of reference to throw any light on a profile.

Section 128 shews how mistakes may be rectified, and section 134 requires that plans of the line, as built, shall be filed within six months after the completion of the line.

Section 135 provides that "every map or plan and profile shall be "drawn on such a scale, and on such paper, as are from time to time "designated for that purpose by the Minister, and shall be certified and "signed by the President or Engineer of the Company."

So far as the scale of a plan, or the paper on which it is to be drawn, is concerned, the writer has never seen any instructions whatever issued by the Minister.

This vagueness in the Acts in regard to plans might lead either to companies being allowed to file plans which contain altogether too little information, or to their being compelled to furnish unnecessary detail.

In the Province of Quebec it is illegal for any one not duly licensed as a Provincial Land Surveyor to make surveys or prepare plans, but once the plans are made there is no Act to prevent their being received by the Minister of Crown Lands.

The writer's experience, as mentioned in the beginning of this paper, goes to show that only Provincial or Dominion Land Surveyors should be allowed to prepare the Right of Way plans, and that all said plans should be signed by such Surveyors.

Though it does not seem that any particular information is required by law to be shewn on land plans, yet it would seem that the following information is necessary, viz. :—

1. The dimensions and area of the parcel of land to be taken from each proprietor along the line, and, if the same person owns two adjacent lots, the particulars of the portion taken from each lot should

be given. A number is also given to each lot taken, the numbers being consecutive.

2. The cadastral number, where such number exists, as, for instance, throughout almost the whole of the settled parts of the Province of Quebec; or the numbers of the lots or sections, and also the name or designation of each Parish, Municipality, Concession, Township, Range, Ward, Village, Town or City through which the line passes.

3. The name or names of the owners of all lands to be taken so far as they can be ascertained from the Registrars of the districts or from the secretaries of the municipalities or towns, or from information obtained on the ground.

4. All buildings within about 300 feet of the centre line, or at least those that are within the distance from the track at which extra insurance has to be paid.

5. Wells or springs, and yards for live stock, especially when the right of way passes between them and the dwelling to which they belong.

6. Orchards, gardens, sugar bush and patches of land in an extra high state of cultivation; and

7. Clearings in bush lands, as these clearings often show the lines between lots.

In addition to the information noted above it is the custom in the North-West and in Manitoba, and also generally in Ontario, to give the distance from the centre line to the nearest section corners; these distances are necessary in making the descriptions to insert in the deeds.

In the Province of Quebec this does not seem to be the practice, and the consecutive number of the lot to be taken is usually assumed to be a sufficient designation of the *location* of the land to be acquired.

Recourse must then be had to the land plan referred to in the deed to locate the limits of the Right-of-Way in case of dispute as to their location.

Now, where there are no measurements to the lot corners, or bearings on the tangents it is almost impossible to retrace the original line.

In the Province of Quebec, where the farms are very long and narrow, it would entail a great amount of extra work to measure to each lot corner, especially when the line crosses about the centre of the farms. It would seem sufficient, therefore, to measure the corners at intervals of about a mile; or at or near the commencement or end of long tangents.

In places where the property lines cannot be found the owners should be called upon to point them out or to show their titles.

Where they cannot do so, the cadastral, township or concession plan may be referred to, and the limits of the various properties included between the two nearest well defined lines laid down on the plan, any surplus or deficiency being divided up between the various undefined lots in proportion to their size.

Where neighbors cannot agree as to the line between their properties, it would be imposing altogether too much responsibility on a Railway Company to compel it to establish the line which should be either decided on by the parties or fixed by the courts at the request of one of them.

Very great accuracy, however, is seldom necessary in fixing the lines between the properties crossed since the land to be taken is generally so narrow that a foot one way or the other does not make much difference in the area; and in the country where damages are small the land is cheap; while in towns, where the land is dearer, the damages are generally much greater in proportion, so that the compensation to be awarded does not depend so much on the land as on the building, and on the question of damages. When odd inches occur in the length along the centre line it is well generally to return the next highest foot so as to be sure to return the full area of the land to be taken.

In making the survey of lands to be acquired for Right-of-Way it is advisable to get, beforehand, copies of the cadastral or township plans of the lands traversed, and, if possible, lists of the names of the proprietors of the various lots; for, with this information in hand, the necessity of returning again to the ground to reconcile any discrepancies which may occur is often avoided.

It is also well to have copies of any subdivision plans of vacant properties, so that lot pegs may be looked for in the proper place; and sufficient measurements made of the entire block to shew what allowance, if any, has been made in the dimensions of each lot, and to enable the Surveyor to lay down the lots in their proper place in the plan.

In making the survey, since the line is almost invariably staked out by the Locating Engineers, by driving a stake at the end of each 100-foot chain (these stakes being often only ranged in by eye), and by planting hubs or larger pegs driven close to the ground and having the line marked with a tack, wherever the transit is set up, the Surveyor will seldom require a transit.

In that case, two chainmen and a man to carry three poles or pickets, and to take tape measurements when required, form a sufficient party.

To get the distance along the centre line it is generally sufficient to measure from the nearest chain-peg to the boundary line in each case.

The chain-pegs, however, should be counted in crossing each lot, to see that no mistake has been made in numbering them, and they should also be examined to see if there has been any break in the chainage, which often happens when the first location has been changed in part, in which case the stations on the unchanged portion remain unaltered to avoid confusion in referring to the plans and profiles.

The breaks in chainage should be shewn on the plan somehow thus, for example, $-103+67$ from West $= 104+29$ to East, shewing that the line had been shortened by 62 feet.

For taking the angles of the various lot lines which may be crossed, or for setting off short survey lines to take up the position of buildings or other details, the writer prefers a box sextant to a prismatic compass.

The principal advantage of a compass over a sextant is that isolated bearings may be taken by it; on the other hand, angles can be read or laid off much more accurately with a sextant, and a compass is often very considerably affected by local attraction, the writer having seen local attraction in a rocky district cause a variation of about eight degrees in the bearing of a line at two points only about two hundred feet apart.

Buildings, streams, river banks, and other topography, when more than one hundred feet distant from the centre line, can generally be located accurately enough by pacing the offsets, or by taking the angles and pacing to the different points from the centre line, as errors of a few feet in position would scarcely shew enough to make any practical difference on a scale of 400 feet to the inch, which is the usual scale for land plans.

The size of buildings, however, should be taken by tape for reference, if necessary, in the future.

Should a small triangular piece of land be taken it is well to measure the three sides, as well as the length, if any, on the centre line, and the height, since a triangle can be best described for a deed by giving the length of each side.

In the case of irregular parcels of land, the writer has always found it much more satisfactory to make enough measurements on the ground to enable the area to be calculated, without depending on a plot of the survey, which would have to be made on a large scale to calculate the area from it. In a general way, with only a chain and sextant, the irregular piece can readily be divided up into triangles, leaving the irregular outline to be taken up by offsets.

Where the boundaries are very irregular—as, for instance, along a stream—the area can be very accurately found by making a plan on a large scale and taking out the area with a planimeter.

Where the line crosses the corner of a lot on a curve, especially if it be sharper than 2°, it becomes necessary to lay out both boundaries of the Right-of-Way adjoining each fence, since the length on the centre line, multiplied by the width, would not give the area.

Care should be taken to ascertain beforehand, from the Locating Engineer, whether the line staked out is the actual centre of Right-of Way, or only the centre line of a north or south track, since all triangular and irregular pieces, and lands taken where the side lines of a property are not parallel, depend for their areas on the position of the line run on the ground as regards the widths to be taken on each side.

When the side lines of a property are parallel it does not matter whether the line run on the ground be the centre of the Right-of-Way or not. When the side lines are not parallel the writer has found it a saving of time to lay out the centre of the Right-of-Way, should it not be staked out, and to measure its length.

In making surveys in towns the centre line and both side lines of the Right of Way should, if possible, be marked out across all lots and measurements carefully made to adjoining buildings, and to the lot lines on each side of the line; so that when all buildings on the Right of Way are demolished, the limits of the Right of Way as first laid out may be retracted. This precaution often avoids litigation, and where property is valuable, repays the expense incurred.

Even where there are many buildings the lines, when straight, can usually be run out over the roofs of the buildings, but when the line is curved, it is often impossible to mark it out without incurring too much trouble and loss of time.

In such cases the tangents should be run out or connected so that their point of intersection may be calculated and a careful survey should be made of all lots through which the line cannot be marked out, and this survey should be connected with the tangents in such a manner as that a large scale plan, say of 20 feet to the inch, can be carefully plotted and the curve laid down on it.

In general, where curves occur, it is well to follow up the tangents to their intersection so as to get the proper position of the fences and the angles which they make with the tangents, or if more convenient, one or more chords of the curve can be laid out and angles taken from them. In bush, where changes of direction of the lot lines occur, some of the lot lines on each side of the change should be run out in the most suitable places, and their direction obtained from the tangent.

In such cases a plan of the lots in the locality comes in very handy.

Small pieces of property left on one side of the Right of Way, and thus detached from the rest of the property should be measured and their areas calculated, and sketches sent in to the Chief Engineer to see if they will be acquired, as their purchase often saves farm crossings, or farm bridges and gates, and they can generally be bought for less than the damages that would be awarded for isolating them from the rest of the property.

With regard to the municipal plans the writer's experience is that even when they are on a scale of 50 feet to the inch, they can seldom, if ever, be relied on to calculate the areas of lots from after laying down the location on them.

For convenience in plotting it is well to obtain from the Locating Engineer the intersection angle of all tangents and the degree and length of sub-tangents of all curves.

In coloring Right of Way plans the usual practice seems to be to color the whole of the land to be taken in red.

When this is done it is extremely difficult, in many cases, to shew plainly exactly how much land is to be expropriated from each proprietor.

The writer always puts a tick or oblique cross at the point of intersection of the centre line with each property line, but even then he has often been asked, by lawyers and others, how one is to know what are the limits of the land to be taken.

The writer would, therefore, suggest that the various lots should be colored, alternately, red, yellow and green; that all buildings should be hatched in black round the sides, that being the best method of shewing buildings when they are on the Right of Way; that Prussian blue should be reserved for streams, ditches and lakes, and that brown or burnt sienna should be used to color roads and farm crossings.

The location numbers, or "consecutive numbers," as the writer prefers to call them, might be shewn in cobalt blue; and it should be noted here that it is well to put a consecutive number on all public roads or streets in case the part where the railway crosses should have to be acquired for Right of Way.

The cadastral numbers, or numbers of lots, concessions, sections, townships or ranges, and the owners' names, might be written in black.

All dimensions, areas and distances, referring to the new work of the railway, might be shown in red, as also the stations, and the chainage of the beginning and end of curves.

With regard to the plans which have to be made after the railway has been completed, these are usually prepared by the Engineers in charge of the work, but as it is these plans which must generally be referred to in case of disputes in the future, the writer thinks that they should also be prepared by a Provincial or Dominion Land Surveyor.

The land taken from each owner should be obtained from the title deeds, as very often small pieces are bought which are not shewn on the first land plan.

The centre line might be shewn in cobalt blue, and the fences of the Right of Way in black.

Care should be taken to ascertain if the track or tracks have been shifted from that originally intended. This is often done on side hills; in such case the original centre line should be shewn in red and the centre of tracks in blue, and the widths from each line to the limits on each side should be clearly shewn.

Any changes in the beginning and end of curves should also be shewn, the old points being figured in red and those existing in blue.

Complete information as to all curves should be entered on these final plans; this might be entered as follows:—

2° CURVE.

B.C. – 223 + 45
E.C. – 240 + 45
Intersection angle = 34°.00′.00″
Length of curve = 1700′
Subtangent =

It will often save trouble in the future to shew the area and dimensions of extra land taken, in addition to that shewn on the original registered plan, separately; in this way all changes from the original plan are clearly shewn. Indeed, it is well to shew land outside the regular Right of Way, that may possibly not be taken, such as small detached portions, separately from the rest, on the original registered copy.

The position of farm crossings and farm bridges should also be shewn, and stream and road diversions, as well as the dimensions and areas of the land taken from each proprietor.

H. IRWIN.

MONTREAL, 17th February, 1891.

SUB-DIVISION WORK.

MR. PRESIDENT AND GENTLEMEN,—

Allow me to state, by way of introduction, that in attempting to prepare a sort of address for this occasion, I found it somewhat difficult to decide as to what particular phase of the Surveyor's work I should confine my remarks. Knowing that much has been said and written on the subject of "Active Field Work" by men far better able to grapple with the difficulties of the situation from a literary point of view than I, I take for granted that it will not be expected of me to let in a very dazzling flood of light on the question. I have therefore resolved to deal with a few minor details, each of which individually would perhaps be regarded as a matter of little concern, though taken collectively the failure of attending to which, often results in much vexation, as well as no small amount of profanity on the part of those entrusted with the management of a survey.

Long before any Surveyor who is likely to be fortunate enough to receive employment, has obtained his instructions, he will be besieged by numerous applications from would-be friends, health-seekers, tourists, and general good-for-nothings all of whom evidently think that surveying is one grand pic-nic, lacking in nothing except the genial influence of the fair sex to make it the *ne plus ultra* of enjoyment to the pleasure-seeker. Hunger, thirst, the terrors of the slough, the mosquito brigade etc., etc., are trifles light as air in the estimation of these braves. Regarding all such worthies I would say, take Mark Twain's advice to those about to marry,—"Don't Invest."

Some years ago Winnipeg was the general supply depot both for men as well as provisions. Now, however, this order of affairs has become reversed—men of a better stamp can be obtained in any of the small villages along the line of railway, or even in some cases, in the very locality where the Surveyor may be working. Allow me to state just here that I would strongly advise the enganging of a good chain-man, picket-man and cook (and be sure they are good) before arriving at the point where you intend completing your party. Men can be obtained more easily and cheaper when they see you are not entirely dependent on them.

Much has been written on the management of a party and I hope I may not be guilty of a 'chesnut' in adding my little quota to what has already been written. My custom has been to take the lead in everything. He who leads is the man to whom attention is paid. When a man puts his hand to the plough (in our case a pack-strap or brush-hook) and says 'come' instead of 'go,' he gives such an assurance as can be given in no other way. His following is sure of him, and he is sure of his following, for the majority of mankind have always needed, and always will need a leading spirit. Pay your men well, feed them well, and take the lead in all the work, then if they do not take their share discharge them. They are no good. Never sit on a hill or around a smudge while your men are being devoured with mosquitos in a hollow or bluff. Move up amongst them and let them see you can share their misery with them. Never sit in your buck-board and watch them lifting their carts out of some slough. Get down and give them a lift; you will wet your feet of course but the carts will come twice as quickly. Perhaps a few Surveyors may not agree with me on some of these matters. They may think that by doing this they would lose the respect which men should have for their chief. Well, to my notion, the bond of confidence and universal good-will thus established will fully atone for the absence of that dignified respect, which serves no other purpose on the survey than to take money out of a man's pocket.

Regarding provisions I would say buy them in Winnipeg, have them shipped at once to the nearest point on the railway to your work and be sure to leave plenty of time for their arrival at their destination before you engage your party. Few things are more annoying to a surveyor than to have to lie idle with his party for a week or ten days waiting for the arrival of his provisions.

In the matter of transport, after leaving the railway I would recommend the purchasing or hiring of a couple of horses, a buck-board and a cart. From my own experience this is amply sufficient for the transport of your camp equipage and for camp shifting after reaching the work. Your provisions may be taken in at so much per hundred or at so much for the trip, and cached at some convenient place on your limit, from where supplies may be drawn from time to time as you may require them.

Regarding the actual work itself, let it be the Surveyor's first and highest ambition to do it well. Supervise everything yourself from the digging of the pits upwards, and neither leave anything yourself nor let your men leave it until it is exactly up to the mark. Now, of course, it cannot be denied that the almighty dollar troubles us all more or less, and hence it must be admitted that the main object of every surveyor in taking a contract is to make money, and it is my firm belief that there is no surer way to attain this object than by doing the work well, This may necessitate a little direct loss in some cases, but depend upon it the reward will come later on. It has been my experience in running out meridians that it is well to feel the way by running one or two east or west lines to some established meridian. This will be a check both on the course as well as the chainage. I have also found it a good plan to leave the mounding on any meridian until the work of establishing it is completed. This is not so convenient and may be a little more expensive than mounding as you go along, but it may save you from such awkward mishaps as the necessity of rebuilding the whole line. The Manual says that the posts are to be driven a certain distance into the ground. Now this is an easy thing with the iron ones, but with the wooden ones it is different. To attempt to drive a wooden post the regulation distance unless in wet-weather only ends in its destruction. The difficulty may, however, be easily overcome by the use of a little water. Drive your post a few inches, then apply the water, and the post may be driven down any distance by hand.

Much more might be written on the minor details of a survey, but as every surveyor is conversant with them it would be wasting time to do so.

In conclusion, allow me to state, that while I fully recognise the importance that should be attached to the theoretical, yet I am fully persuaded that unless a man possesses the necessory amount of tact to enable him to cope with the emergencies that he is sure to meet with in the course of his work he certainly lacks the most essential elements for success. It is therefore on the basis of this assumption that I have endeavored to advance a few thoughts on some of these subordinate matters, which are to some extent, outside of the ordinary routine work of the Surveyor, and yet, which have so important a bearing on the results of his work, that he who is guilty of negligence in matters of this kind must be prepared in the trying moment to call upon the gods for assistance, and content himself with the unflattering response, "The gods help those who help themselves."

JOHN VICARS.

CANNINGTON.

PHOTOGRAPHY IN COLORS—A PROBLEM NOT YET SOLVED.

The problem of photographing colors direct by the camera in the same easy way in which light and shade is now secured, is one that has attracted many minds of late, but nothing has been discovered which was not accomplished thirty years ago. Light, as is well known, has three distinct qualities, illumination, heat and actinism. This latter is the chemical ray and is that which affects the sensitive plate. There are three systems in use by experimentalists: one may be called the chemical method, in which the colors are produced by various tints assumed by the different silver compounds under certain conditions: the second may be styled the physical, in which the component parts of light are separated, and while separated made to produce negatives, then colored positives or prints are made from these negatives and combined together so as to imitate the colors of the original subject; photo-lithography is the bases of the third process.

This is accomplished as follows: let us take for example the reproduction of oil paintings; first of all a negative is taken by the ordinary process, and this is re-copied from four to seven times, according to necessity on silver emulsion plates, it is thus possible to have the same number of diapositives; these diapositives are coloured with transparent coatings, so that whilst faithfully preserving the photographic reproduction, we produce on the positive image or glass, all the depths and the means for the colors, red, yellow and neutral black. These diapositives, thus prepared, are recopied on silver emulsion plates, and we obtain in this way negatives adapted to the corresponding colors, which after retouching gives negatives well developed for the production of photographic plates of yellow, blue, black, etc. The *printing plates* produced by means of the negative, for example, for the yellow color is printed in yellow, and all the others are printed in their corresponding colors; these plates coming from the same original negative coincide perfectly, and the printing may be done with great certainty by means of presses. I should describe this process as the Mono-chromatic photolithography.

Mr. F. E. Ives, who is writing the history of photography in colors, states as follows : Heliochromy, meaning sun-coloring, has been settled upon as a name for processes of photography in natural colors, or in the colors of nature. There are two kinds of heliochromic processes, in one the light itself produces the colors by direct action on the sensitive plate, in the other light does not produce the colors but is made to regulate their distribution and combination. Some of the colors of the spectrum were imperfectly reproduced by a process of the first kind, nearly thirty years before the discovery of the Daguerreotype process. Seebeck of Jena in 1810 found that chloride of silver after preliminary exposure to white light is colored a brick red, and by prolonged exposure to the light of the spectrum, a metallic blue, by the blue light. After the discovery of the Daguerreotype process several experimentalists tried so to modify the preparation of chloride of silver plates as to make them capable of reproducing all the colors of nature. In a photographic text book published so long ago as 1853 I find the following statement : "Even the long debated question of the "reproduction of the natural colors by the agency of light seems on "the point of solution. M. Niepce de St. Victor, from whose well "known character as an experimental philosopher much might be "expected, has forwarded to London as we understand specimens of "proofs in which every color is reproduced with a vigor and richness "truly wonderful."

Similar announcements have been made since that time, but the best results ever actually shewn, were nothing more than interesting curiosities. Dr. W. H. Vogel recently had an opportunity to compare some of the latest and most-talked-about of these photographs in natural colors with the original pictures from which they were printed by contact. He says the original is one of these transparent window pictures in bright colors, representing Cupid; these were brought into the market by Grimme and Hembel, in Leipsic, as a substitute for glass painting. He further states the blue fields are not blue, but greenish grey, the ground of the yellow squares and the green of the border decoration appear neither yellow nor green but have a greyish red tone.

"It is most singular that several parts are reproduced in red which "actually are not red at all but a brown yellow. As, for instance, the "hair, the wings, the cross-bow, the thistle, etc., the resemblance of the "new photographic pictures to natural colors is theretore not very fav- "orable. Only two colors can be recognized in the copy, of which red "is the best in a less degree the blue, which is weaker as far as the "picture is concerned, the blue in the ornamentation around the border, "and all the other colors either have not been reproduced at all, or are "entirely unlike the original. If we compare the sample before us with "the pictures by Dr. Zerker in 1867, we must confess that those much "older productions were richer in color, although the tones deviated "likewise considerably from the natural ones."

Mr. Carey Lee asserts that chloride iodide and bromide of silver is capable of combining with the bichloride, biiodide, bibromide produced by the reducing action of light, or by the reducing action of the different known reagents. He calls these compounds proto-chloride, proto-iodide proto-bromide of silver, these are changed according to the different colored lights to which they are exposed. So far Mr. Lee has not been able to produce anything but a name for his process.

I shall now give a short description concerning the alleged discovery by an eminent photographer who was supposed to be photographing in colors, and which gave an electric shock to photographers at the time.

A gentleman visited this artistic studio, and confessed that he was surprised at the result exhibited as the outcome of twelve years of study and research. He was led into a dimly lighted apartment where the pictures were to be seen. Here were a few indifferently hand-colored photographs, such as are done in colors for 25 to 50 cents in most establishments. After coloring they had evidently been, as we term it, glazed, or given a fine finish by being laid down on a piece of glass with hot gelatine, and then, when cold, stripped off, the same process which the fraternity in America discarded a long time ago owing to the instability of the anilline colors. This process has been described by the inventor as the Hydro-carbon.

The wonderful rumors which have appeared in the press during the last few years cannot be substantiated, as no chemical process has been discovered that will give to us the beauties of nature by photography as it is used at present; the chemical method referred to is the only one we can look to for success in the future, but those who are not advanced in the higher branches of science must, of course utilize the mechanical process. Fifteen years ago I succeeded in obtaining three colors (spectroscopic) by photography. The colors were purplish-red, green and yellow. I found it impossible to fix them as they were so unstable.

Even had I succeeded in making a permanent picture, the finished results would have been unsatisfactory, as the colors were irridescent. It would be unwise for me to say that the reproduction of colors is impossible, but I have no hesitation in saying if it is discovered it will be through an entirely new principle of photography; apart from the present fundamental basis, the SALTS OF SILVER.

The nearest approach to perfection at present in photography, is with the isochromatic process by which we are able to photograph from twenty to sixty miles. It also gives the relative gradations of color, as you will notice in this picture. Here is black, two reds, brown, three greens, two yellows, two greys and two blues. You see the clouds are perfect and the foliage stands out in good relief, which cannot be done by the ordinary bromo-gelatine process which is now in general use.

A POINTER.

I am sorry to say that the photographers in America have not availed themselves of this opportunity by using a process which has been brought to such perfection in Europe during the last two years.

In conclusion, I think the future name of photography in colors should be styled the Mono-photo-isochromatic process, because every opportunity has been given for the various interactions, actinic, photo-chromatic, monochromatic and isochromatic, selective or otherwise, to receive the original vibrations of color to be transferred in a molecular condition which forms the latent image of future colors in a photographic plate. I fear that photography in natural colors is the "hidden mystery" for future scientists to unravel.

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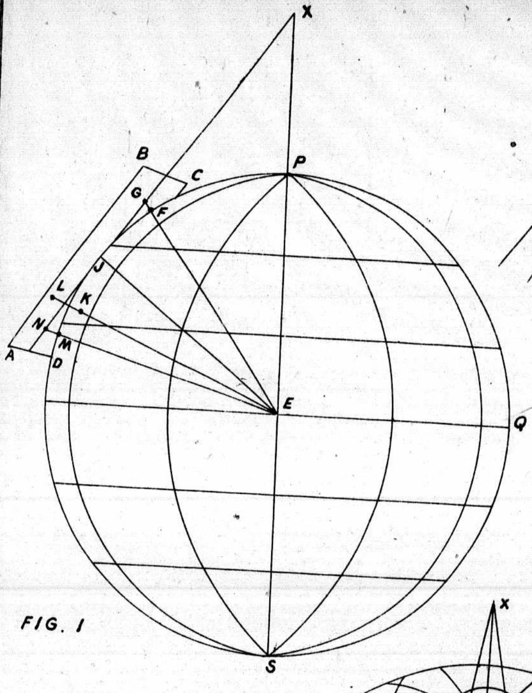

FIG. 1

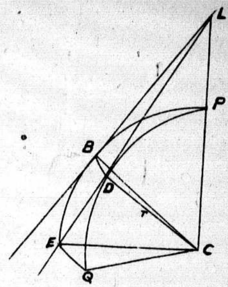

FIG. 5

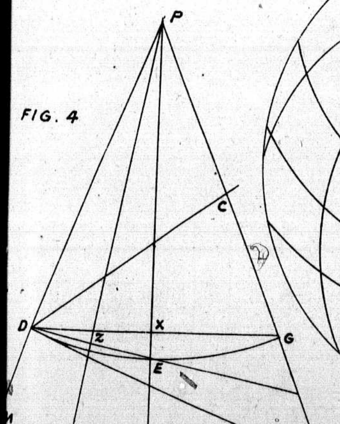

FIG. 4

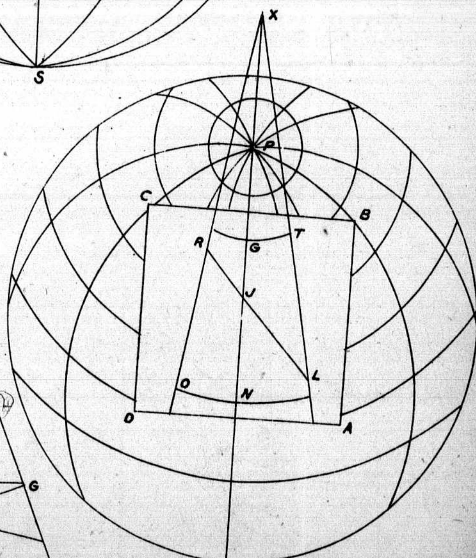

FIG. 2

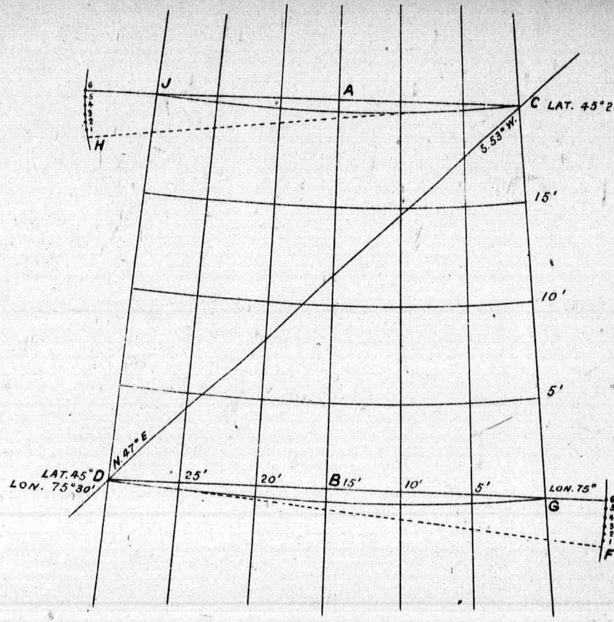

FIG. 3

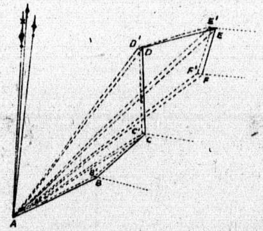

FIG. 7

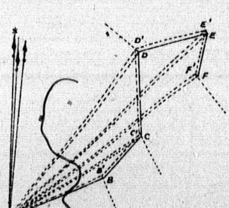

FIG. 6

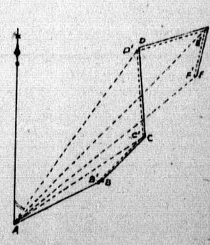

FIG. 8

BELL,

BOULT

DAWSO

DEVILL
c

GALBRA
S

HARRIN
C

KING, V
M

MACOUN
D

MAGRATI
D

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I

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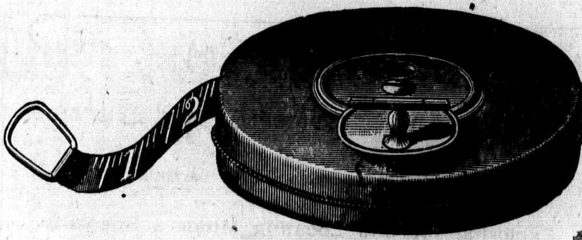

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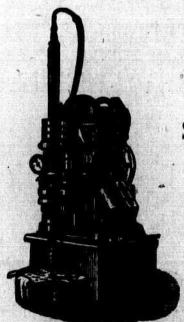

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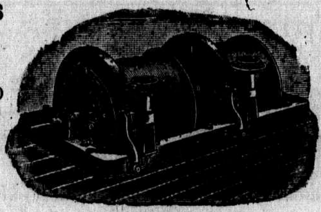

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