REPORT OF PROCEEDINGS

OF THE

ASSOCIATION OF DOMINION LAND SURVEYORS

AT ITS

FIFTH ANNUAL MEETING,

HELD AT

OTTAWA, MARCH 15TH AND 16TH, 1888.

PRICE FIFTY CENTS.

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1888.

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To Dominion Land Surveyors.

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

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

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

"The Welfare of the Association."

5th Annual Meeting

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ADVERTISEMENTS.

ASSOCIATION OF DOMINION LAND SURVEYORS,

ORGANIZED APRIL 24th, 1882.

OFFICERS FOR 1888.

Honorary President.

CAPT. E. DEVILLE, SURVEYOR GENERAL..... .....OTTAWA, Ont.

President.

E. J. RAINBOTH, D.L.S..... .....AYLMER, Que.

Vice-President.

JOHN McAREE, D.T.S.. ... .TORONTO, Ont.

Secretary and Treasurer.

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

Executive Committee.

THOMAS FAWCETT, D.T.S.....GRAVENHURST, Ont.
J. S. DENNIS, D.T.S..... AYLMER, Que.
THOMAS BREENE, D.L.S ..... QUEBEC, Que.

Auditors.

T. D. GREEN, D. L. S.....OTTAWA, Ont.
G. E. McMARTIN, D.L.S.....ST. ANDREWS, Que

STANDING COMMITTEES

FOR 1888.

Instruments.

G. B. ABREY *(Chairman)*, J. I. DUFRESNE, J. J. McARTHUR.

Geodetic Survey.

W. F. KING *(Chairman)*, OTTO J. KLOTZ, C. MAGRATH.

Publication.

T. D. GREEN *(Chairman)*, C. A. BIGGER, A. DRISCOLL.

Land Surveying.

JOHN McLATCHIE *(Chairman)*, G. E. McMARTIN, WALTER BEATTY

Natural History and Geology.

PROF. J. MACOUN *(Chairman)*, DR. R. BELL, THOS. DRUMMOND.

Permanent marking of Surveys.

S. L. BRABAZON *(Chairman)*, P. T. C. DUMAIS, A. C. WEBB.

Photography as Applied to Topographical Explorations

W. S. DREWRY *(Chairman)*, J. J. McARTHUR, J. F. GARDEN.

Topographical Surveying.

OTTO J. KLOTZ *(Chairman)*, WM. OGILVIE, EDGAR BRAY.

CONSTITUTION AND BY-LAWS

OF THE

Association of Dominion Land Surveyors.

CONSTITUTION.

ARTICLE I.

Name of the Association.

"The Association of Dominion Land Surveyors."

ARTICLE II.

Objects of the Association.

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

ARTICLE III.

Members.

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

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

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

4. Honorary Members must be nominated by two Active Members and the nomination approved by a unanimous vote of the Executive Committee. The nomination with approval must be in the hands of the Secretary-Treasurer at least one month before the Annual Meeting. Persons nominated for Honorary Membership shall submit a Paper to be read at the Annual Meeting. They shall

be elected by ballot in the manner hereinafter provided for the election of officers of the Association. The number of Honorary Members shall not at any one time exceed twenty, and they shall be exempt from payment of dues.

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

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

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

6. Associate Members shall not vote.

ARTICLE IV.

Officers.

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

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

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

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

5th Annual Meeting 1888

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

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

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

ARTICLE V.

Meetings.

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

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

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

ARTICLE VI.

Amendments.

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

ARTICLE VIII.

Auditors.

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

ARTICLE IX.

Subscriptions.

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

2. The fees of Active Members shall be forwarded to the Secretary-Treasurer with the ballot papers for election of Officers, and any ballot unaccompanied by the fees mentioned in subclause shall not be counted in the Election.

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

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 name 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.

FIFTH ANNUAL MEETING

OF THE

Association of Dominion Land Surveyors,

Held at Ottawa, March 15th and 16th, 1888.

The meeting had been set for March 13th and 14th, but owing to a snow blockade, which happened at the time, a postponement until the 15th inst. was unavoidable. The blockade was the cause of the absence of the President and many members who had signified their intention to attend.

Programme.

THURSDAY, MARCH 15, 9.30 A.M.

Meeting of Executive Committee.
Reading of Minutes of previous meeting.
Reading of correspondence and accounts.
Propositions for membership.
Balloting for membership.

THURSDAY, 2.30 P.M.

Report of Secretary-Treasurer.
Report of Auditors.
Business of the Association.
President's Address.

PAPER—"The Yukon River and its Sources" WILLIAM OGILVIE, D.L.S., Ottawa, Ont.

THURSDAY, 7.30 P.M.

PAPER—"The placing of Permanent Marks in the field as a means to preserve information afforded by Public Surveys." S. L. BRABAZON, D.L.S., Portage-du-Fort, Que.

PAPER.—"British Government Surveys." Staff-Commander J. G. BOULTON, R. N., London, Eng.

PAPER—"Natural History in connection with the Topographical Survey." PROF. MACOUN, F.L.S., Asst. Director Geological Survey, Ottawa, Ont.

FRIDAY, 10.30 A.M.

Report of Committee on Memorial, setting forth a scheme for the inception of a Geodetic Survey in Canada. OTTO J. KLOTZ, D.T.S., *Chairman.*

Unfinished business.

Election of Officers.

FRIDAY, 2 P.M.

Meeting of Committee to amend Constitution. Biographical Sketches of the late Andrew Russell, Esq., of Ottawa, and H. H. Stephens, Esq., of Owen Sound, deceased, by J. S. DENNIS, D.T.S., Aylmer, Que.

PAPER—"Map Making." J. H. BROWNLEE, D.L.S., Brandon, Man.

PAPER—"Mining in British Columbia." THOMAS DRUMMOND, D.T.S., Kamloops, B.C.

PAPER—"Relations between Master and Man on a survey party." JOHN MCAREE, D.T.S., Toronto, Ont.

FRIDAY, 7.30 P.M.

Report of Committee to amend Constitution.

Appointment of Standing Committees.

PAPER—"Some methods of determining Geographical Positions." W. F. KING, D.T.S., Ottawa, Ont.

PAPER—"Electrical Apparatus in Longitude Work." OTTO J. KLOTZ, D.T.S., Preston, Ont.

PAPER—"Ranching and Irrigating in British Columbia." THOMAS FAWCETT, D.T.S., Gravenhurst, Ont.

Adjournment.

SATURDAY, 2.30 P.M.

Meeting of Committee appointed with regard to a Geodetic and Trigonometrical Survey of the Dominion.

Meeting of Executive Committee of the Association with reference to Memorandum on Geographical Nomenclature and Orthography.

Full discussion after each paper.

EXHIBITS.

PHOTOGRAPHIC VIEWS.

The following valuable and interesting collections of photographs were exhibited throughout the various sessions of the meeting.

1. Views taken along the line of the Canadian Pacific Railway, in British Columbia, and at Vancouver, New Westminster, and Victoria, by CAPTAIN E. DEVILLE, Surveyor General, and kindly loaned by him for the occasion.

In this collection special mention may be made of an enlarged photograph of Mt. Field, views of Mount Stephen, Cathedral Mountain, The Golden Stairs, and Albert Cañon on the Illecille-waet River.

2. A large collection taken by Dr. DAWSON, Assistant Director of the Geological Survey, and Mr. WILLIAM OGILVIE, D.L.S., along the Stickeen, Dease, Pelly, Lewis and Yukon Rivers. The most striking were views of Taiya Inlet, Miles Cañon, Rink Rapids, the Hootalinqua River and Lake Francis.

3. Dr. BELL, Assistant Director of the Geological Survey, exhibited a very fine collection, illustrating the Hudson Straits and the headwaters of the Ottawa River, and chiefly remarkable for picturesque beauty and artistic grouping.

4. Last but not least, Mr. J. B. TYRRELL, of the Geological Survey, showed by his views of the Duck and Riding Mountain District how very attractive a naturally flat and unattractive country will become if the points of view and other conditions are carefully selected. Mr. TYRRELL'S rendering of the "Noble Red Man," and his home, is simply perfect.

INSTRUMENTS.

1. Among the instruments exhibited the "Station Pointer," used by Staff Commander J. G. BOULTON, R.N., in his hydrographic survey of the Georgian Bay of Lake Huron, created much interest.

For a description of this instrument and method of use, see Commander Boulton's Paper on "British Government Surveys."

2. "The Telegraphic Switch Board," "Chronograph Battery," and "Chronometers," used by W. F. KING, Chief Inspector of Surveys, and OTTO J. KLOTZ, D.T.S., in their longitude determinations during the year 1887, were well worthy of observation, and the more so that Mr. Klotz and Mr. King gave a practical illustration of the methods used, the batteries and instruments working just the same as when in actual determination. For explanation, see Mr. Klotz's Paper on "Electrical Apparatus in Longitude Work."

FIFTH ANNUAL MEETING

OF THE

Association of Dominion Land Surveyors,

Held at Ottawa, March 15th and 16th, 1888.

MINUTES OF THE MEETING.

THURSDAY, March 15th.

Morning Session.

The Association assembled, on Thursday, March 15th inst., at St. Andrew's Hall, Ottawa. The meeting opened at 10.30 a.m. E. J. RAINBOTH, Vice-President, in the Chair.

The Minutes of the preceding annual meeting having been read, were duly approved and confirmed.

The reading of the correspondence brought forth the following resolutions:

On letter from H. H. Robertson, St. Thomas de Montmagny, suggesting that every member of the Association should receive every year the reports and maps issued annually by the following Departments of the Government: Department of the Interior, and Geological Survey, Department of Railways and Canals, and Department of Public Works.

Resolution No. 1.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved:*

That the Secretary-Treasurer be instructed to take the necessary steps to obtain, if possible, the reports and maps mentioned in Mr. Robertson's letter, and if successful to distribute the same annually to the members of the Association.

On notice from John Wiley and Sons, publishers, New York, to the effect that they had sent 50 catalogues for the use of the Association.

Resolution No. 2.

Moved by JOHN MCAREE, seconded by G. B. ABREY, and *Resolved:*

That the Secretary-Treasurer be instructed to pay the Customs duty on the catalogues from John Wiley and Sons, now in hand, and to procure the same for the benefit of this Association.

On letters from members of the Association, enquiring if any arrangements had been made with the several railway companies with regard to reduced rates to and from the place of meeting.

Resolution No. 3.

Moved by T. D. GREEN, seconded by A. O. WHEELER, and *Resolved:*

That Messrs. John McAree, G. B. Abrey, the mover, and the seconder, be appointed a committee to enquire and confer with the different Railway Companies with regard to allowing Dominion Land Surveyors reduced rates to and from the Association meetings.

Letters from Benjamin Thompson, late Secretary-Treasurer of the Ohio Society of Surveyors and Civil Engineers, enquiring if any work had been published on the construction of the Canadian Pacific Railway, also as to power of telescope most commonly used among the profession in Canada, was duly discussed, and the Secretary-Treasurer instructed to write Mr. Thompson to the effect that no known work had been published on the construction of the Canadian Pacific Railway from a professional standpoint, also that the power of telescope used had a very wide range, 19.32 for terrestrial work up to 61 for astronomical work, largest size 1½ inch object glass, focal length 11 inhces.

Letter from A. M. Burgess, Deputy Minister of the Interior, replying to Memorial regarding Railroad Right of Way Surveys, dated February, 1886, was read, and in the absence of the President, Thomas Fawcett, was put by as unfinished business. (For letter see President's Address, page 22.)

The accounts having been read were disposed of by

Resolution No. 4.

Moved by JOHN MCAREE, seconded by T. D. GREEN, and *Resolved:*

That the accounts as audited be accepted.

The remainder of the morning Session was taken up with propositions and balloting for new members.

On recommendation of J. S. DENNIS and A. O. WHEELER, two names for Honorary and nine for active membership were laid before the meeting and duly added to the roll.

Afternoon Session.

The meeting was called to order at 2.30 p.m. E. J. RAINBOTH, Vice-President, in the Chair.

On the recommendation of G. E. MCMARTIN and A. O. WHEELER, Charles T. Symmes, D.L.S., was elected a member of the Association. The Secretary-Treasurer presented his report, which was adopted. (See page 37.)

In connection with the discussion upon the Secretary-Treasurer's report, the following resolutions were passed :

Resolution No. 5.

Moved by JOHN MCAREE, seconded by R. C. LAURIE, and *Resolved :*

That the sum of fifty cents be charged for single copies of the Annual Report of Proceedings.

Resolution No. 6.

Moved by G. B. ABREY, seconded by J. S. DENNIS, and *Resolved :*

That a single copy of the Annual Report of Proceedings be sent to the Library of the Canadian Institute, to include all previous reports.

Resolution No. 7.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved :*

That the Secretary-Treasurer be instructed to effect an exchange of Reports with the following Societies :—Michigan, Ohio, Illinois, Connecticut, Colorado, and the P. L. S. Associations of the different Provinces of the Dominion. Fifty copies to be sent to each.

Resolution No. 8.

Moved by J. S. DENNIS, seconded by G. E. MCMARTIN, and *Resolved :*

That the Secretary-Treasurer, the Vice-President, W. F. King, John McAree, G. B. Abrey, the mover and the seconder, be appointed a committee to prepare a statement of the amendments required to the Constitution and By-laws, and that this report be made to this meeting, so that action may be taken forthwith to suspend the rule regarding the two months notice of amendments.

The auditors made a verbal report, stating that the accounts had been examined and found correct.

At this stage of the proceedings the President's Address should have been read, and is here inserted, although owing to the unavoidable absence of the President, the address was not received until after the meeting had adjourned. This will also account for the fact that several important points brought forward in the address were not discussed, and consequently no action taken upon them.

PRESIDENT'S ADDRESS.

GENTLEMEN,

MEMBERS OF THE DOMINION LAND SURVEYORS ASSOCIATION.

With thankfulness to a kind Providence, who has thus far prolonged our existence and permitted us to assemble at our Annual Meeting, I again greet you.

Again are we reminded of our mortality, since we last met, by the death of two gentlemen who were closely connected with our profession.

One especially, who was deservedly called the "Father of Surveying" in Ontario and in the Dominion.

Among all the officers with whom I came in contact in the Department of the Interior, there was not one who inspired so strong a feeling of attachment as did the late Andrew Russell. While he was connected with the Board of Examiners of Dominion Land Surveyors, the most timid candidate who came before him would at once feel encouraged and be inspired by his kind manner.

As Mr. J. S. Dennis will give biographical sketches of the late Andrew Russell of Ottawa, and H. H. Stephens of Owen Sound, deceased, I will drop the veil, not knowing who next will pass from the scene of action.

We gather once more as members of an important family returning from wandering to and fro in our vast Dominion, where the season has been spent in gathering information in regard to its natural sources of wealth, its fitness for sustaining a population, and its suitability for manufacturing interests; the determination of the correct geographical positions of more important localities along the line of the transcontinental railway and other points, so that the configuration of our Country will gradually approach more nearly to that degree of perfection which may finally be considered practically absolutely correct; the mapping out and picturing the vast mountain regions which extend as great monuments along the westerly border of our Country, searching out and correcting errors which had crept into the work of former years, penetrating and exploring the regions to the far Northwest and on to the Arctic Ocean, where cold and darkness prevails during the entire winter—I have no doubt, but that our comrade, Mr. Ogilvie, who is spending the winter in that dark, cold region, would be very glad if he could be with us at this gathering, and that in thought he would certainly be here if we could communicate with him at this time.

Thus, as heralds and forerunners of those who shall in future years find homes in our Country, the Surveyors have acquired a storehouse of information which others will mould into palatable shape, so that it may be available for general information to those interested.

When we consider the importance of the natural capabilities of this Continent, its mineral wealth, its fitness for agriculture, its grazing resources, its timber supply, and that in connection with every one of these the services of the Surveyors cannot be dispensed with, the knowledge which he possesses being required in every case, we can affirm without contradiction that no class of professional men are more necessary or more important in the development of a country than the class to which we belong.

Countries which have become partly developed without the services of competent professional surveyors have been involved in legal difficulties, from which all the learned professionals and the highest law courts in the land could not extricate them ; and hundreds of worthy, honest and unsuspecting citizens have been involved in ruin.

If preparatory to the settlement of a country, the information acquired by surveyors is important, so also as the country progresses he is an indispensable factor in the laying out of farm lands, villages, towns and cities, in superintending all municipal and other improvements, roads and railways, bridges, harbors and lighthouses.

In fact, there is no branch of industry in which our country can embark, that would not in some way or another affect our profession.

And this is what we want if the country, at large, is going to reap any further benefit than that of simply having their lands laid out and their boundaries defined for them.

We must extend our fields of action, make ourselves more widely acquainted with all the interests of the country, and govern ourselves accordingly.

If any thing of importance is going to be evolved in this direction, it can only be accomplished by organized and united effort.

We cannot possibly, as individuals, each acquire all the branches of knowledge which are necessary to fit us for best serving our nation ; but we can make a specialty of some branch, and become an expert in that particular one, and just here, I think, is a field upon which we may at once enter if we are going to reap any particular advantage from our organization, and I make the suggestion, that at this meeting some scheme may be adopted, by which every member shall have his attention called to some particular branch of the profession, which he will study up and make himself more familiar with, so that he will not have to consider at the last moment what subject he will bring before the next meeting and finally conclude that he cannot do anything.

A committee might be appointed to formulate some plan by which every member of the association would be called upon to contribute to the general information, and our reports in this way would be valuable works of reference, and something which would be creditable to us as well as of great value.

If such a plan could be carried into active operation, it would be an inestimable advantage to every member of the profession.

Each one would reap the benefit of his own researches, and have in the report a concise and well digested account of several branches as given by others, to which he would have access whenever required.

We have now on our roll of honorable membership several noted scientists, whom we intend to use as far as possible by asking them to contribute papers to be published in our annual reports, and to be read at our annual meetings.

We are proud to have these learned gentlemen connected with us, and trust to make our association such that they will not be ashamed of their connection with the land.

In referring to the business of the Association, I must say that our Secretary-Treasurer since his appointment has been very active in his endeavors to further our interests, and has succeeded remarkably well, considering difficulties which no one anticipated at our last meeting, would have to be contended with.

What Mr. Wheeler has accomplished this year proves that we have the right man in the right place.

In referring to the memorial re-right-of-way surveys on railroads, I received from the Deputy Minister of the Interior the following communication, which you will observe is adverse to the contention set forth in the memorial:

OTTAWA, 16th September, 1887.

SIR,

Adverting to your letter of the 25th February, 1886, and the memorial of a Committee of the Dominion Land Surveyors Association therewith enclosed, I beg to say that the whole question therein raised has been under the consideration of the law officers of the Crown, who advise this Department that under the Railway Act the Minister of Railways and Canals may accept such maps and plans or books of reference as he may be satisfied with and as comply with the express provisions of the act, whether or not the Surveys have been made and the maps and plans certified by Dominion Lands surveyors, and that such maps or plans and books of reference, if so accepted, and if certified and signed in the manner provided by the Railway Act, would be legal for all the purposes of that Act, and I am further advised with respect to Government railways, that it is clear that the Government is under no obligation to employ Dominion Land Surveyors to survey the right of way or to prepare the necessary maps or plans.

So far as this Department is concerned, there is nothing in the fact that a licensed surveyor has not made the surveys of a right-of-way, and certified the maps or plans. to prevent the lands included in a crown grant being properly described with reference to such right of way.

I have the honor to be, Sir,

Your obedient servant,

A. M. BURGESS,

Deputy of the Minister of the Interior.

THOS. FAWCETT, Esq., D.T.S.,

Gravenhurst, Ont.

I think it would be advisable to consider the communication in committee to ascertain if possible the ground upon which the advisors of the Crown arrived at the decision contained therein.

There are many questions upon which the highest legal authorities differ in their opinions, and in a case like the present it would be well for us to ascertain as far as possible the meaning and extent of all legal enactments under which our operations are carried on.

There are certain clauses which relate to timber limits, mining claims, coal lands, grazing lands, colonization companies and other corporate bodies. In all cases where lands have to be surveyed at the expense of individuals or corporations, it is laid down as a condition that the work must be done by a qualified surveyor, as it is clearly defined by act of parliament who may survey Dominion Lands.

I will now enumerate a few branches of our profession which we may investigate with profit to ourselves in addition to the methods of laying out land and dividing it into sections or lots.

We may consider Railway and Road Surveys, Topographical Surveying, including the best methods of delineating the surface of the earth, its various elevations and depressions, and the instruments best suited for the purpose and Hydrographic Surveying, which is of the greatest importance to navigation.

When connected with the Survey of coasts, harbors, lakes and rivers the Hydrographic Survey includes a Topographic one of the land, as well as all particulars in regard to depth, and location of rocks, the velocities and directions of currents, the material found beneath the water, and other information, making an extensive and interesting subject for some of our members to acquaint themselves with.

Mining Surveying differs chiefly from that of ordinary land surveying in the fact that the operations have to be mostly carried on underneath the surface of the ground, and must be conducted with the greatest possible care, so that the exact position of each chamber, tunnel, and drift be known.

As the mines in British Columbia, the Northwest and other parts of our Dominion are developed, which will be the case before many years, this field will offer employment to quite a number more than are now engaged in the work.

Some might turn their attention to Geodetic Surveying, which we trust ere long will be one of the requirements.

We hope that the astronomical work which has been carried on during the last two years by Mr. Klotz, Mr. King, Mr. Ogilvie and others will be permanently continued, and that from the basal points established the trigonometrical work will be carried on until the geographical position of every important locality in the country shall have been determined, and points of reference shall have been fixed, which shall insure the future of the country against the errors which prevail to so great a degree in the older parts of the provinces that it is impossible, until something is done, to get anything like a correct map of the country.

The subject of City Surveying, including water supply, sewerage, construction of streets, lighting, and scores of other matters of the greatest importance, all fall within our sphere, and we would do well to occupy the field.

Let us try and "spread ourselves," gentlemen.

I do not mean in the manner of making a show only, but in something which will have its effect on the progress of our country, which will develop the latent resources of knowledge that so far, in many cases, have been lost with the possessor.

There are many brilliant men in the profession, persons possessing original resources, who in practice have learned many things that would be useful to us all if we could in some way possess ourselves of their knowledge.

Often the ideas thrown out by one individual are carried into effect and improved upon by some one else.

It might appear to you that it would not be fair that I should reap the benefit of your experience in some new line, and in that way compete on equal ground with yourself.

Not so! Whatever you do, if you discover some method of carrying on the work that you find valuable to yourself, don't die and let that knowledge perish with you; give it to us in the shape of a paper, leave a monument behind you, that you may live in the future.

I trust that this Association will develop itself into one of the great scientific institutions of our land, and that what progress has been made since the conception of the idea which gave origin to it, will scarcely foreshadow the dimensions to which it will in a few years attain.

When first the Dominion Land Surveyors Association was formed, there were only a few similar bodies on the continent of America; now we find organizations of the same kind in nearly every one of the United States of America, and representatives of the various institutions have many of them written our Secretary desirous of intercommunion with us in exchanging reports and visiting each other's meetings.

Some of these reports which I have received during the last two years, through interchange with the Association of Provincial Land Surveyors for the Province of Ontario, show that these institutions are flourishing in the States, and there is no reason that I can discern why this Association should not take a leading position amongst similar bodies on the continent. I am ready, gentlemen, to co-operate with you in carrying into effect this idea.

It may not be much that I can do to assist, in comparison with what some of you can accomplish, but if we all unite determined to succeed we will certainly reap the benefit. No effort which we make in this direction will be lost. Our motto, "promote the interests and raise the standard of the profession," should be the object ever kept before us. Not with the idea that such a course will at once repay us in dollars and cents. I despise the man who will do nothing for his country or for any cause whatever until he ascertains how he will be paid.

We may content ourselves with the thought that whatever sacrifice we may make in perfecting this Association will not be lost.

We know that whatever knowledge we may acquire through preparing professional and scientific papers will be a possession to ourselves and enlarge our capacity for usefulness.

As I have prepared a paper on a special subject which will be given at a later stage of the meeting, I do not want to discuss any particular point in this address, but to make it as far as possible a rallying cry, and say, "Gentlemen, the whole field is open. Shall we possess it, and absorb the best talent our country affords, or shall we leave to others what we have already begun?"

This is a question worthy of your consideration.

The more I think about it the more important it seems to me.

All we have to do is to determine individually to do something.

Let us organize so as to work systematically, and our success will be assured.

And now, Gentlemen, let me again thank you for the honor conferred upon me, during the two years past, by permitting me to occupy the presidential chair.

I shall always hold this kindness and token of your respect in grateful remembrance.

THOMAS FAWCETT,
President.

The Secretary-Treasurer read Mr. Wm. Ogilvie's Paper, entitled "The Yukon River and its Sources." The paper and the discussion that followed will be found further on.

The following resolutions were the outcome of this paper and the discussion upon same.

Resolution No. 9.

Moved by J. S. DENNIS, seconded by W. F. KING, and *Resolved:*

That the officers of the Association be appointed a Committee to consider the subject of the naming of geographical features in newly explored country, and the adoption of names generally, for publication on Government maps; and that the officers of the Geological Survey, Captain Boulton and the Surveyor General, be asked to assist the Committee in preparing a Memorandum on this subject, to be printed in the Annual Report and submitted to the Government, if thought advisable by the Committee.

Resolution No. 10.

Moved by G. B. ABREY, seconded by WILLIAM DREWRY, and *Resolved:*

That the thanks of this Meeting be tendered and forwarded to Mr. William Ogilvie for his paper on the Yukon River and its sources.

Resolution No. 11.

Moved by G. B. ABREY, seconded by W. F. KING, and *Resolved:*-

That the thanks of this Association be tendered to the members of the Geological Survey and to Commander Boulton for their valuable criticisms and remarks on Mr. Ogilvie's paper and the suggestions arising therefrom; and that this Association tender them an invitation to attend the remaining Sessions of this Annual Meeting.

Evening Session.

The meeting was called to order at 7.30 p.m. E. J. RAINBOTH, Vice-President, in the Chair.

A PAPER, "The placing of permanent marks in the field, as a means to preserve information afforded by Public Surveys," by S. L. BRABAZON, D.L.S., was read and discussed, and finally referred to a standing committee.

A PAPER, entitled "British Government Surveys," by STAFF COMMANDER BOULTON, R.N., followed.

Resolution No. 12.

Moved by W. F. KING, seconded by J. S. DENNIS, and *Resolved:*

That a cordial vote of thanks be tendered Commander Boulton for his paper on British Government Surveys.

Resolution No. 13.

Moved by T. D. GREEN, seconded by J. A. BELLEAU, and *Resolved:*

That a vote of thanks be tendered Mr. Brabazon for his able and interesting paper on the Permanent Marking of Public Surveys.

After an interesting verbal introduction, Prof. Macoun read a very practical paper, entitled "Natural History in connection with the Topographical Survey."

At the close of this paper the following resolutions were passed:

Resolution No. 14.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved:*

That after having heard the able and instructive paper read by Prof. Macoun on the subject of Natural History in connection with survey work, it is the opinion of this Association, that all large exploration or Geodetic Survey parties, sent out by the Government, should be accompanied by a person whose duties should consist of collecting all information and specimens which might be of use from a natural history standpoint, and that the Secretary-Treasurer be instructed to forward a copy of this resolution to the Minister of the Interior, the Minister of Public Works, the Minister of Railways and Canals, and the Minister of Marine and Fisheries.

Resolution No. 15.

Moved by G. E. MCMARTIN, seconded by JOHN MCAREE, and *Resolved:*

That a cordial vote of thanks be tendered the learned Professor Maconn, for his able, interesting and instructive paper on Natural History, in connection with the Topographical Survey.

Resolution No. 16.

Moved by W. F. KING, seconded by J. S. DENNIS, and *Resolved:*

That the Secretary-Treasurer be instructed to have a note inserted in the Annual Report of Proceedings, calling the attention of Surveyors to the paper of Prof. Macoun, and requesting them to do all in their power to assist the furtherance of Natural History, by collecting specimens and forwarding them to Prof. Macoun.

5th Annual Meeting

FRIDAY, March 16th.

Morning Session.

The meeting was called to order at 10.30 a.m. E. J. RAINBOTH, Vice-President, in the Chair.

The Committee on Memorial, setting forth a scheme for the inception of a Geodetic Survey in Canada, reported that no action had been taken in the matter.

Some discussion ensued as to the advisability of continuing the agitation.

W. F. KING proposed that a committee should be appointed to consider the matter forthwith, and accordingly the following resolution was passed:

Resolution No. 17.

Moved by T. D. GREEN, seconded by JOHN MCAREE, and *Resolved*:

That the Vice-President, Otto J. Klotz, W. F. King, J. S. Dennis and Wm. Drewry be appointed a committee to take such necessary steps as they deem advisable, in order to bring before the Government the urgent necessity of a Geodetic Survey of the Dominion being made; and that this Committee should if possible report to the meeting before its close.

Unfinished business brought forth the matter of members whose dues to the Association were in arrears, and after much discussion a resolution was passed as follows:

Resolution No. 18.

Moved by J. S. DENNIS, seconded by C. T. SYMMES, and *Resolved:*

That in reference to those members of the Association who are in arrears of dues, the Secretary-Treasurer be hereby instructed to forward to all such members a notice of proceedings of this meeting, with a short statement of what it is intended to do during the coming year, and notifying them that if they pay up 50 per cent. of the outstanding fees with the fees for the current year, they will be provided with copies of the annual report of proceedings and the exchanges, and in default of their availing themselves of this offer before the first of May next, their names will be struck off of the membership roll.

The Election of Officers for the ensuing year was as follows:

For *President*, E. J. RAINBOTH, without opposition.

For *Vice-President*, JOHN MCAREE, without opposition.

For *Secretary-Treasurer*, A. O. WHEELER, unanimously.

Resolutions Nos. 19 and 20 were then passed.

Moved by T. D. GREEN, seconded by G. B. ABREY, and *Resolved :*

That the Secretary-Treasurer for the past year be presented with $20 00 for the energy and enthusiasm displayed by him in his endeavours to make this Meeting a decided success, and thus further the interests of the Profession.

Moved by J. S. DENNIS, seconded by OTTO J. KLOTZ, and *Resolved :*

That a cordial vote of thanks be tendered the Secretary-Treasurer for the very able manner in which he has conducted the affairs of the Association, and the great interest he has displayed, and the large amount of time he has devoted towards making the Association a success.

On the following resolutions the Executive Committee and Auditors were elected :

Resolution No. 21.

Moved by T. D. GREEN, seconded by WM. DREWRY, and *Resolved :*

That Thomas Fawcett, J. S. Dennis, and Thomas Breene be elected to act on the Executive Committee of the Association for the ensuing year.

Resolution No. 22.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved :*

That T. D. Green and G. E. McMartin be elected to act as Auditors for the ensuing year.

The Morning Session was brought to a close by Resolution No. 23.

Moved by J. S. DENNIS, seconded by OTTO J. KLOTZ, and *Resolved :*

That the Executive Committee be instructed, and are hereby empowered to appoint Standing Committees to consist of three members, to consider and report on the following :

1 Instrument.
2 Geodetic Survey.
3 Publication.
4 Land Surveying.
5 Natural History and Geology.
6 Permanent Marking of Surveys.
7 Photography as applied to Topographical Exploration.
8 Topographical Surveying.

Afternoon Session.

The Committee, to consider amendments to the Constitution, met at 2 p.m.

The meeting was called to order at 3 p.m. E. J. RAINBOTH, President, in the Chair.

J. S. DENNIS read a letter from Mr. John B. Simpson, son-in-law of the late Andrew Russell, Esq., of Ottawa.

Also, biographical sketches of Mr. Andrew Russell, and Mr. H. H. Stephens, of Owen Sound, deceased.

In this connection was passed Resolution No. 24.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved:*

That the Secretary-Treasurer be instructed to convey to the families of Mr. Andrew Russell and Mr. H. H. Stephens the condolences of the Association.

A Paper, entitled "Map Making," by J. H. BROWNLEE, of Brandon, was read by the Secretary-Treasurer.

T. D. GREEN read an interesting Paper, "Mining in British Columbia," by THOMAS DRUMMOND, of Kamloops, B.C.

JOHN MCAREE read a practical paper on the "Relations between Master and Man on a Survey Party," and a lengthy and interesting discussion followed, closed by

Resolution No. 25.

Moved by J. S. DENNIS, seconded by T. D. GREEN, and *Resolved:*

That the subject of Mr. McAree's paper, on "Relations of Master and Man on a Survey Party," be referred to the Standing Committee on Land Surveying, for report at the next Annual Meeting as to the advisability of adopting some scheme of rules and regulations regarding the above mentioned relations.

Mr. MCAREE signified his satisfaction at this course.

The afternoon session was brought to an end by Resolutions Nos. 26 and 27, as follows:

Moved by G. B. ABREY, seconded by R. C. LAURIE, and *Resolved:*

That the Secretary-Treasurer be instructed to convey the regrets of this Meeting to our Ex-President for his unavoidable absence from the Meeting.

Moved by G. B. ABREY, seconded by WM. DREWRY, and *Resolved:*

That this Association tender a vote of thanks to Dr. Dawson, Capt. Deville, Commander Boulton, Dr. Bell, and Mr. J. B. Tyrrell, for the exhibition of photographs, and other articles kindly loaned for our instruction and entertainment, and that the Secretary-Treasurer send a copy of this resolution to each of the gentlemen mentioned.

Evening Session.

The meeting was called to order at 7.30 p. m. E. J. RAINBOTH, President, in the Chair.

The Committee appointed to consider amendments to the Constitution reported as follows :

MEMORANDUM OF AMENDMENTS TO CONSTITUTION.

ARTICLE III.

(1) The Association shall consist of active members, honorary members and associate members.

(2) Active members must be Dominion Land Surveyors, and only such shall hold office.

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

(4) Honorary members must be nominated by two active members, and the nomination approved 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 manner hereafter provided for election of officers of the Association. The number of honorary members shall not at any one time exceed twenty, and they shall be exempt from payment of dues.

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

(*b*) Provincial Land Surveyors of any Province and articled pupils of Dominion and Provincial Land Surveyors shall be elgible 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 X.

Associate Members shall not vote.

ARTICLE IV.

Sub-clause 4, to be expunged, and following inserted:

(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 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 Meeting.

(5) The letter ballots shall be opened at the Annual Meeting, and the majority of the ballots cast in each case 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, or Secretary-Treasurer, or six nominations for members of the Executive Committee, the Executive Committee shall add to the ballot paper 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.—Expunged.

ARTICLE VI.

Clause 3, amended by substituting 11 for 5 members to form a quorum.

Amend sub-clause (1), by omitting "general meeting in Winnipeg."

ARTICLE VII.—Amended.

In sub-clause 2, omit all after *general meeting* in second line, and insert, "and such amendment shall be voted upon at the said Annual Meeting, two-thirds majority of the votes cast being necessary for its adoption."

ARTICLE X.

Amended by expunging sub-clause 2, and inserting:

The fees of active members shall be forwarded to the Secretary-Treasurer, with the ballot paper for election of officers, and any ballot unaccompanied by the fees mentioned in sub-clause 1 shall not be counted in the election.

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

Resolution No. 28.

Moved by J. S. DENNIS, seconded by G. B. ABREY, and *Resolved:*

That the clause of the Constitution regarding amendments be hereby suspended and that the report of the Committee on Amendments required to the Constitution be received and adopted.

The appointment of the Standing Committees for the year was announced by the President.

W. F. KING, Chief Inspector of Surveys, read a paper, entitled 'Some Methods of Determining Geographical Positions."

OTTO J. KLOTZ read a most interesting paper on "Electrical Apparatus in Longitude Work," the paper being practically illustrated by the instruments used in actual determination.

It was arranged that the Committee appointed to consider the question of a Trigonometrical Survey of the Dominion should meet the next day, Saturday, 17th inst., at 2.30 p.m.

Also, that the Executive Committee should meet on the same day with regard to the question of Geographical Orthography and Nomenclature.

It was then moved by OTTO J. KLOTZ, seconded by JOHN MCAREE, and *Resolved:*

That the meeting adjourn until the third Tuesday in February of 1889.

NAMES OF MEMBERS PRESENT.

Honorary Members.

W. F. King, D.T.S., Chief Inspector of Surveys;

Alfred R. C. Selwyn, C.M.G., LL.D., Director of the Geological Survey of Canada.

George Mercer Dawson, D.Sc., Associate R.S.M., Assistant Director of the Geological Survey of Canada.

Robert Bell, B.A.Sc., C.E., M.D., Assistant Director of the Geological Survey of Canada.

Prof. John Macoun, M.A., F.L.S., Assistant Director of the Geological Survey of Canada.

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

Active Members.

Abrey G. B.
Beatty Walter,
Belleau J. B.
Bigger C. A.
Breene Thomas,
Dennis J. S.
Drewry Wm. S.
Driscoll Fred.
Green Thos. D.
Klotz Otto J.
Laurie R. C.
McAree John,
McLatchie John,
McMartin G. E.
Rainboth E. J.
Rauscher R.
Snow J. A.
Symmes C. T.
Wheeler Arthur O.

Visitors.

J. B. Tyrrell, Geological Survey,
Jas. McEvoy, " "
Jas. White, " "
P. B. Symes, Dept. of the Interior,
J. H. O'Hanley " " "
J. Macara, " " "
Arthur Genest, " " "

NEW MEMBERS.

Honorary.

Staff Commander J. G. Boulton, R.N., London, Eng.
Prof. Galbraith, School of Practical Science, Toronto, Ont.

Active.

William Drewry, D.L.S.....Belleville, Ont.
R. C. Laurie, D.L.S.....Battleford, N.W.T.
Henry W. Selby, D.L.S.....Stayner, Ont.
J. A. Belleau, D.L.S.....Ottawa, Ont.
Fred. Driscoll, D.L.S.....Aylmer, Que.
J. H. Brownlee, D.L.S.....Brandon, Man.
Geo. Montague-White, D.L.S...Toronto, Ont.
H. J. Bowman, D.L.S.....Berlin, Ont.
W. Gordon Forlong, D.L.S.....Montreal, Que.
Chas. T. Symmes, D.L.S.....Aylmer, Que.
Louis B. Stewart, D.L.S.....Banff, N.W.T.
H. De Q. Sewell, D.L.S.....Port Arthur, Ont.
Chs. Eug. Bourgault, D.L.S.....St. Jean Port Joli, Que.

Associate.

Eugene Coste.....Geological Survey, Ottawa,
William H. Chatterton Smith..Geological Survey, Ottawa.
Alfred E. Barlow.....Geological Survey, Ottawa,
D. B. Dowling.....Geological Survey, Ottawa,
Louis N. Richard.....Geological Survey, Ottawa,
Henry P. Brumell.....Geological Survey, Ottawa,
James White.....Geological Survey, Ottawa,
James McEvoy.....Geological Survey, Ottawa,
Arthur Stephen.....Sault Ste. Marie, Mich.

NOTE.—This list is complete to June 1st, 1888. For full names, diplomas and addresses, see list of members at end of Report.

Those wishing to become Associate Members of the Association will please to forward their names, recommended by any one active member, to the Secretary-Treasurer, who will submit the same to the Executive Committee for approval.

Obituary.

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

Gentlemen,

Among the many changes which time brings are those caused by death among the members of our profession. I wish briefly to refer to two of our brother surveyors who have passed away since our last meeting.

Mr. Andrew Russell, in many ways the father of our profession in Canada, died at Toronto on Friday, the 24th of February last, at the ripe old age of eighty-five.

He was born in Glasgow, Scotland, and entered active life in this country in 1829. His life up to within a few years of his death was one of busy employment, and he filled many important positions of trust. Who among us but has experienced his extreme kindness and never failing courtesy, and his willingness to entertain with reminiscences of surveying in his early days. A few years since an address was presented to him by this Association which fully set forth the feelings of the members, so I will close this short sketch by remarking that any profession would be honoured by having had among its members a man like Mr. Russell, whose name was synonymous with honesty and true christianity.

Another member of our profession who has passed away is Mr. H. H. Stephens, of Owen Sound, who died at Lindsay on the 16th September last. He had contracted a severe cold while engaged in surveying operations, and suffered for many months before his death.

He was a Provincial Land Surveyor for Ontario, and becoming a Dominion Land Surveyor in 1883, conducted contract Surveys in the Northwest during the years 1883 and 1884, and had since been carrying on a local practice in Ontario. He has passed away after faithfully performing his duty during a number of years of professional life, and what higher praise can be bestowed on any man than to say "he performed his duty well."

J. S. DENNIS.

LETTER FROM MR. ANDREW RUSSELL'S SON-IN-LAW.

344 Maria Street,
OTTAWA, March 12, 1888.

J. S. DENNIS, Esq.

MY DEAR SIR,

I received your kind note of last week, and before giving you the data you asked for, I wrote Mrs. Russell for her consent, knowing, as I did, Mr Russell's antipathy to anything of the sort. Mrs. Russell, in reply, desires me to convey to the Dominion Land Surveyors Association her deep sense of their great kindness and appreciation of Mr. Russell's public life and service, so beautifully expressed in their testimonial. It was so gratifying—yes, comforting, to him during his years of feeble health, when unable to take part in those scientific pursuits he loved so well.

The recipient of your testimonial, if alive, would only ask in a similar case to have it recorded "that one of our members has gone before." Let it be so in his own case.

And believe me, yours respectfully,

JOHN B. SIMPSON.

REPORT OF SECRETARY-TREASURER.

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

Gentlemen,

I have the honor to lay before you the report of proceedings during the past year, and venture to make a few suggestions for the coming one.

Reports of the United States Coast and Geodetic Survey to date were applied for on behalf of the Association, and were received from the years 1871 to 1885 inclus ive, also copies of the "Coast Survey Regulations," "Report of the American Association for 1857," "Historical Sketch of Coast and Geodetic Survey," and "Notes on Transfer of Coast Survey, by Admiral Jenkins, U.S. Navy." These volumes have been placed in the library of the Association.

Two hundred copies of the report of proceedings at the last Annual Meeting were printed and distributed to the members of the Association and gentlemen interested in the doings of the same.

A request by circular was sent to each active member and by special letter to each honorary member, asking them to prepare a paper on some suitable scientific topic to be read before the meeting. The results may be seen in the programme.

I would suggest that in future no honorary member be admitted to our roll, until he has shown himself worthy of such election by preparing a paper to be approved at the Annual Meeting. I believe the Royal Society adopts this method in the election of ordinary members.

With regard to future exchanges. I have written during the year to the Surveying and Engineering Associations and Societies of Missouri, Illinois, Nebraska, Connecticut, Michigan, Ohio, Indiana and Colorado, ask ing their views with regard to an exchange. Replies were received from the Societies of Michigan, Ohio, Illinois, Connecticut, and Colorado, all expressing not only willingness but in some cases anxiety to do so.

I regret to have to mention that death has made two blank spaces in our membership roll, Andrew Russell, Esq., of Ottawa, and H. H. Stephens, Esq., of Owen Sound.

Another serious matter claims your attention, viz., what is to be done with members in arrears? A great many of the arrears go

back as far as the year 1885, the sum total amounting to over $250.00. That the annual dues should have got into such a state of backwardness must be largely owing to the fact that the payment of fees has not been properly looked after.

By the appended statements of receipts and expenditures for the last two years, you will see that we have a balance on hand of $243.26.

It now rests with you to say what price shall in future be set upon each copy of the proceedings of our Association. Numerous applications were received during the past year, and I was at a loss to know how to charge for them.

There are a number of Provincial Land Surveyors, Civil Engineers, and other gentlemen, practising and taking an interest in surveying, who would be glad to join us as Associate Members, did our constitution admit of such membership. Independently of the assistance and strength these members would lend to us, they would materially add to the financial resources of the Association.

Numerous enquiries have been made by members wishing to attend the meeting, as to whether reductions in railroad fares could be obtained, and it would be well that in future such a concession should be sought from the different roads likely to be used. I believe it is customary to give the return fare at one-third and for the Association or Society to issue a certificate entitling to such reduction.

In conclusion I would like to draw your attention to the fact, that the valuable collections of photographs now on exhibition have very kindly been loaned by our Honorary President, Capt. E. Deville, Surveyor General, and by Dr. Dawson, Dr. Bell, and Mr. J. B. Tyrrell, of the Geological Survey, and this mark of the interest these gentlemen take in our affairs deserves our warmest thanks. I may further state that the views have been taken by the gentlemen themselves.

I have the honor to be, Gentlemen,

Your obedient servant,

ARTHUR O. WHEELER,

Sec.-Treas.

RECEIPTS AND EXPENDITURES

FOR YEAR EXTENDING FROM FEBRUARY 16TH, 1886, TO MARCH 8TH, 1887:

RECEIPTS.

By Balance on hand	$274 08	
" dues for current year	58 00	332 08

EXPENDITURES.

To rent of room for Annual Meeting	$ 5 00	
" Lithographing for Annual Report	25 00	
" Postage	2 00	
" Secretary-Treasurer for services	20 00	52 00
Balance on hand	$280 08	

FOR YEAR EXTENDING FROM MARCH 8TH, 1887, TO MARCH 14TH, 1888:

RECEIPTS.

By balance on hand	$280 08	
" Arrears of dues for 1885	4 00	
" " " 1886	14 00	
" Dues for 1887	69 00	
" " 1888	13 00	
" Advertisements in Annual Report	30 00	
" Sale of Annual Reports	50	410 58

EXPENDITURES.

To Rent of room for Annual Meeting	$ 5 00	
" Type writing	1 65	
" Lithographing for Annual Report	10 00	
" Printing	147 50	
" Postage	1 67	
" Stationery	1 25	
" Telegrams	25	167 32
Balance on hand	$243 26	

For 1886
Receipts - 58.00
Exp - 52.00
Cr. Bal'e 6.00
1885 Bal'e 274.08
1886 Bal'e 280.08

For 1887
Receipts - 130.50
Exp - 167.32
Debit bal'e 36.82
Bal'e from 1886 280.08
Cr. Bal'e 243.26

AUDITOR'S REPORT.

J. S. Dennis reported on behalf of the auditors that the accounts of the Association, for the years 1886 and 1887, as presented by the Secretary-Treasurer, had been duly examined, and had been certified to as correct.

NOTICE OF SIXTH ANNUAL MEETING.

The Sixth Annual Meeting of the Association will take place at Ottawa, commencing on the third Tuesday in February, 1889.

It is hoped that the necessary arrangements, to enable members to travel to and from the place of meeting at reduced rates, will be made with the several Railroads.

Members of the Association are urged most earnestly to lend their assistance towards making this meeting a success, and to co-operate as far as possible with the Committees having the matters to be presented at the same in hand.

A circular will shortly be issued, asking the members individually to prepare a paper to be then read, or to bring some matter of interest to the profession, before the meeting, and it is sincerely hoped that those in a position to fulfil this request will not be found wanting.

Queries, problems or data, relating to any of the subjects on which standing committees have been appointed, if sent to the Secretary-Treasurer, will immediately be forwarded to the Chai r-man of the Committee concerned, or can be sent direct to the Chairman of such Committee.

Remember! every little helps, and that any encouragement, no matter how slight, is a great assistance to those who are working for the welfare of the Association.

NATURAL HISTORY NOTICE.

In accordance with Resolution No. 16, passed at the Fifth Annual Meeting of the Association, special attention is called to Professor Macoun's paper on Natural History, in connection with the Topographical Survey (to be found farther on). All members of the Association and Surveyors, or others whose chances are abundant, and who may read these pages, are particularly requested to do all in their power to assist in the furtherance of the Science of Natural History, and to lose no opportunity of collecting specimens and forwarding them to Professor Macoun at the Geological and Natural History Museum of Canada, Ottawa, Ont.

At the close of Professor Macoun's paper will be found practical instructions, for preparing and preserving the skins of small animals and birds, issued by Dr. C. Hart Merriam, of Washington, D.C.

This appeal is made in view of the fact, that the Surveyor, in the prosecution of his profession, is rendered more than usually liable to meet with species or classes of the smaller mammals or of reptiles, that will if procured be not only interesting but extremely valuable from a scientific point of view.

Memorandum.

Prepared by a Committee appointed at the Fifth Annual Meeting of the Dominion Land Surveyors Association, held at Ottawa, March 15th and 16th, 1888, to consider the question of a Trigonometrical Survey of the Dominion, to draft a scheme for its inception, and to take such steps as they might deem advisable to bring the subject under the notice of the Government, and of others likely to be interested in this much needed work.

The Committee beg to submit the following in reference thereto:

The Dominion has now arrived at that stage when the wants of the country demand a more exact system of survey than that in vogue.

The question of the value and utility of a trigonometrical survey has been so settled by almost every civilized nation, that it is hardly necessary to advance proof of the statement that it would be of immense practical value to the whole Dominion; but for illustration, and in support of the statement, the following facts are offered.

The surveys of this kind, which have been made by other countries, may be briefly referred to.

First and foremost is the Ordnance Survey of Great Britain and Ireland, covering nearly 111,000 square miles, which was begun in 1784 and is now nearing completion. Then comes the great Trigonometrical Survey of India, inaugurated at the beginning of the present century by Colonel Lambton, which is still in progress, and of which the beneficial results have been inestimable. Belgium is carrying on a survey which, when completed, will furnish 450 sheets of map on a scale of $\frac{1}{20,000}$ with contour lines one metre apart.

Prussia is carrying on an extensive survey, and since 1849 has introduced new and more perfect methods. Russia, with its enormous territory, about twice the size of the United States, including Alaska, has been for many years engaged in prosecuting trigonometrical surveys.

Norway, although a comparatively poor country, has set itself on having a good topographical map, on a scale of $\frac{1}{10,000}$ compiled from trigonometrical surveys.

Austria has completed a new map of the Empire, comprising 715 sheets also compiled from data furnished by trigonometrical surveys.

Denmark, Switzerland, Spain, Portugal and Italy are all carrying on trigonometrical surveys, to enable them to map their territories accurately.

France has completed her survey, and the result is shown in 276 sheets of map.

On this continent surveys of a high order of precision have been made by the United States Government, and the work of the Coast and Geodetic Survey is going steadily on, having been extended along the sea coast and also along the Great Lakes, and many of the States and Territories have been covered by its operations, including some in the far West, viz.: Nevada, Colorado, Utah, New Mexico, Montana, Idaho and part of Arizona.

Several of the states have conducted independent trigonometrical surveys of their own territory, including Massachusetts, California, New Jersey and New Hampshire, and in other states they are in progress.

All the foregoing surveys are based on triangulation.

It may be asked what are the practical benefits to be derived from a trigonometrical survey, and what is there to justify the expenditure of the large sum of money which a survey of this kind would ultimately cost. To make the point of practical benefit clear, the following will be readily understood by all:

It is stated by an eminent American Engineer that "if the State of Massachusetts had had a good topographical map in 1836, some $20,000,000 would probably have been saved in its public railway expenditure."

Mr. Sandford Fleming, C.M.G., in his report to the Minister of Public Works, dated April 5th, 1879, says: "If the railways of Ontario had to be established 'de novo,' a careful study of the requirements of that Province would enable any intelligent engineer of ordinary experience to project a new system which at one half the cost would far better serve the public, and would meet every demand of traffic, would more fully satisfy every expectation, and which would not result in disappointment and loss to those who have been induced to invest their means in that which has proved to many an unprofitable undertaking."

If to-day a railroad is projected in England, or any other country possessed of a good topographical map, preliminary surveys

such as we are obliged to make are unnecessary, for from these plans the lengths and grades of any proposed line can be determined with sufficient accuracy to enable a final location to be made.

In carrying on a survey of the character contemplated, it is necessary to run lines of exact levels from station to station, and thus we would have the elevations of points all through the settled portions of the country, and in future operations, in which levelling is a feature, all levels could be referred to a common datum line (sea level for instance), and when railway lines are pushed back into the wooded interior, the physical character of which is but little known, we would then have some definite idea of main watersheds and valleys, to guide future operations, instead of relying, as is at present done, on guess work and hearsay evidence.

Among other benefits to be derived from a survey of this kind, are the following: Our extensive coast line both in the Gulf of St. Lawrence, on the Atlantic and Pacific seaboards, and also in our inland waters, has been very roughly determined in many places, and in consequence many disasters happen to shipping, and many valuable lives are lost annually, which would in a great measure be avoided were we in possession of reliable charts of our waters; and one of the first requisites in making the hydrographic surveys, necessary to provide the data or compilation of these charts, is that certain points on the shore should be accurately fixed. It may be mentioned in connection with the Hydrographic Survey of Georgian Bay, at present being carried on under the direction of Staff Commander Boulton, R.N., that Commander Boulton stated before the D. L. S. Association, at its last annual meeting, that in making his survey he had not been able to connect his work with any point accurately determined by Canadian authority, but had to use points established by the United States Coast and Geodetic Survey.

On our inland lakes and waters large sums are annually spent in harbor and other improvements, and yet the geographical positions of these harbors and waters are not accurately shown on any map or chart.

A large sum has been spent in building the Murray Canal, between Lake Ontario and the Bay of Quinte, but there is no correct chart of the Bay, and a stranger attempting to navigate a deeply laden vessel in its waters would probably meet with disaster. This

has happened time and again, and will continue until we have an accurate chart of the Bay, and as has already been said the work of making these charts would be greatly expedited by having points along the shores established by a trigonometrical survey from which to begin the hydrographic survey.

Numerous isolated surveys have been made under various departments of the Government, at points on the Atlantic coast, the Gulf of St. Lawrence, and in the Great Lakes; it is also proposed by the Militia Department to make a series of reconnaissance surveys at different points; all these surveys, made, or to be made, give valuable results, but they cannot be considered complete until they are connected. To this end a carefully executed triangulation is necessary.

Again, with the increase in the value of real property, any work having in view the permanent marking of points which would definitely fix the positions of boundaries of real estate, is for the public good. In many of the Provinces the boundaries of valuable properties are in most cases dependent on the durability of wooden posts, a few marks on trees, or the testimony of a few of the oldest inhabitants, and as a consequence expensive litigation often arises, in fact it may safely be said that the amount annually expended in litigation regarding boundaries would go a long way towards paying for the cost of a trigonometrical survey.

Were the boundaries, especially those of large areas, such as counties, townships, and concessions, accurately defined by a trigonometrical survey, similar to that made by the countries herein referred to, all doubt as to their position would be forever set at rest.

At the present time, throughout the Dominion, every city and many of the towns and villages are looking about for means of obtaining a good water supply or of improving the supply they have.

Gravity being the best method of utilizing a water supply, is generally first sought after, but the information necessary to determine the availability of a supply by this means, can now only be had by expenditure of large sums in surveys, as has been lately seen in Toronto.

Had there been a good topographical map in existence, that expenditure would have been unnecessary.

In drainage work the information derivable from a survey of this kind would be invaluable, and as our agricultural population

is waking up to the benefits arising from proper drainage, no time should be lost in giving them this aid. The maps would enable any engineer to determine by a simple calculation the area of any basin to be drained, and to know accurately the size of drain necessary, and its proper location, and the survey would do away with all litigation arising from parties claiming that their lands do not lie in the basin to be drained, as a reference to the map would show at a glance the natural drainage outlet for any piece of land.

These maps would also be exceedingly valuable in assisting an equitable assessment of real estate for taxes, and in providing the necessary information required in locating and building public highways, and would save large sums of money which are now expended in finding out where roads should be built; and the sum so saved might be expended in making the roads more solid and permanent.

The information afforded by the maps provided from a survey of this kind, in reference to our inland waters, and the possibility of their utilization for navigation which is becomng every day of more importance, would be of vast benefit to the country.

Many large public works are now being agitated, and will no doubt in the near future be undertaken, as, for instance, the "Ottawa Ship Canal," the "Trent Valley Canal," etc., the possession of good topographical maps would very naturally assist in settling the question of the feasibility of these and many other schemes for the improvement of navigation, etc.

Instances might be cited indefinitely to prove the value, not only to the Government, but to the people at large of a trigonometrical and accompanying detail survey of the kind herein referred to, but it is thought that enough has been said to conclusively show the benefits which would accrue therefrom.

The survey should be undertaken by the Federal Government, as it is pre-eminently a Dominion work, and we now come to the important point of a basis or scheme for its inception.

In a work of such proportions as a survey of this kind would ultimately assume, it is primarily essential that a well matured and carefully considered scheme be first laid down, upon which to develop the whole; and being guided by the experience of other countries, it is evident that a primary triangulation is necessary as a ground work for all detail surveys.

For the inception of the work, and that a beginning may be made, it is suggested that the work should be commenced on the St. Lawrence River near Cornwall, where the U. S. Lake survey

ended, and be continued down that River to the Gulf. The work would first consist of a primary triangulation, with sides of from 10 to 30 miles in length, as circumstances permitted, and would then be extended by carrying on a greater or less amount of interior topographical work, levelling, etc.

COST.

The cost would of course vary with the extent of survey, but it is thought that a sum of, say, $15,000 would be sufficient to start the primary triangulation, which is the basis of survey. This amount would cover the cost of two observers, one on each side of a main chain of triangulation, and two station setting parties, and would pay all expenditure of the above for transport and travelling expenses.

Of course a much larger sum than that mentioned could be advantageously employed, but the annual expenditure of this small amount would provide a large quantity of valuable information, and would lay the foundation for more extensive prosecution of the work, when the circumstances warranted it.

The advantages accruing to the country by a geodetic survey would not be confined to the definite material advantages gained in topographical knowledge, and the coast and sounding surveys based upon the triangulation.

An additional and not inconsiderable advantage would be the stimulus given to scientific research. It has been the experience of other countries that men employed on geodetic surveys, having their attention drawn to the numerous branches of science involved, have, by their scientific and mechanical inventions, added greatly to the sum of knowledge in these branches, and indirectly to the material wealth and progress of the countries.

The Association of Dominion Land Surveyors has long felt that the time had arrived when a trigonometrical survey of the country should be begun, and the question has frequently been discussed at their annual meetings. In 1886 they took action in the matter by preparing a memorial on the subject, and submitted the same to the Hon. the Minister of the Interior; and recognizing the

necessity for keeping the matter alive, they appointed this committee, as has already been mentioned, to prepare a memorandum on the subject.

In submitting this memorandum for your consideration, the committee feel that the subject is one which should appeal strongly to all who are interested in the welfare of our Dominion, and they think the facts herein contained should be sufficient to show the necessity for a beginning being made towards a geodetic survey of our country.

They earnestly ask you to do anything you can to assist the Association in bringing this matter to the notice of any who are likely to be interested in seeing this much needed work begun, all of which is respectfully submitted.

W. F. KING,
O. J. KLOTZ,
W. S. DREWRY,
E. J. RAINBOTH
J. S. DENNIS.
} Committee.

OTTAWA, April 13th, 1888.

Memorandum,

Prepared by the Executive Committee of the Dominion Land Surveyors Association, in accordance with a resolution regarding Geographical Nomenclature and Orthography in Canada, passed at the Annual Meeting, held at Ottawa, March 15th and 16th, 1888.

In accordance with a resolution regarding the naming of geographical features, passed at the last annual meeting of the Association of Dominion Land Surveyors, the Executive Committee beg to submit the following remarks in reference to the important question of geographical nomenclature and orthography in Canada, and to make certain suggestions regarding the necessary action to correct many of the mistakes and inconsistencies now existing, and to prevent re-occurrence of the same in the future.

The Committee having invited the views of those gentlemen connected with the Government service, who have to do with the naming of geographical features, or the compilation of Government maps, and who are, therefore, in a position to speak intelligently on this point, submit the same as affording most valuable and reliable information in reference thereto.

SUGGESTIONS ON GEOGRAPHICAL NOMENCLATURE IN CANADA.

BY DR. G. M. DAWSON, GEOLOGICAL SURVEY.

"So far as I have been able to discover, no code of rules bear-
"ing on the introduction or use of geographical names in new or
"unmapped country has been authoritatively formulated or con-
"sistently followed. Usage in the matter has been very varied,
"and often quite manifestly very absurd and unjust, both toward
"the native races inhabiting such new countries and to the earlier
"civilized explorers, the names given by whom have too often been
"ignored in consequence of the egotism, ignorance or in some
"cases the sycophancy of later explorers or surveyors. The very
"intricacies of the question and the diversity of circumstances in
"different regions appear to have constituted the chief difficulty
"met with in laying down uniform rules, but it seems that it may
"not be impossible to formulate principles which should be appli-
"cable to the circumstances in so far as the Dominion of Canada

"is concerned. The matter is an important one from a practical "point of view alone, and the fixing of geographical names in the "first instance on published maps carries with it a considerable "responsibility.

"Dr. Egli, from a study of known geographical names, enun- "ciates the following law as the result of his investigations:—

"'Geographical onamotology, regarded as the intellectual out- "come of a people or of an epoch, represents both the stage "and direction of culture specially characteristic of that onamo- "tological family.' (*Nomina Geographica Leipsic* 1870–73, *quoted in Scottish Geog. Mag., Vol. I., p.* 425.)

"Respecting the orthography of geographical names, however, "some progress has been made, and principles have been recom- "mended which it may be well to follow. The Royal Geographi- "cal Society has adopted (in 1885) a series of rules of which the "essential points, in so far as they are applicable to the particular "question under discussion, may be summarized as follows:

(Journal Royal Geog. Society, Vol. VII, p. 535.)

"'Names which have passed into common usuage, whether "correctly rendered or otherwise, should be retained.

"'Names, such as native names, which have not been committed "to writing in characters of the Roman alphabet, to be spelt "according to sound as nearly as possible.'

"For this purpose definite values are assigned to the letters of "the alphabet, the main features of the alphabet recommended "being as follows:—'Vowels to be pronounced as in Italian, "consonants as in English. An acute accent to mark the sylla- "ble on which stress is laid in pronunciation.'

"The Geographical Society of Paris, about a year later, adopted "rules for orthography which are practically identical with the "above. The alphabets recommended by both societies are also "nearly the same with Gibb's standard alphabet published by the "Smithsonian Institution in 1863, and with that of Major J. W. "Powell (1880), the two last being, however, intended for linguis- "tic purposes. Though any one of these alphabets might be "employed with advantage, I believe that the preference should be "given to the first mentioned, as having been adopted from a "specially geographical standpoint, as being that likely to be "employed for scientific geography in the numerous and widely

"scattered regions constituting this Empire, and as being suffi-
"ciently precise for the purpose in view, while at the same time
"simple.

"In cases of conflicting names applied to the same feature, and
"for guidance in selecting those to be definitely perpetuated on
"official maps, the underlying rule must, I think, be that of prior-
"ity. This rule has always been tacitly recognized in geography,
"it has been affirmed lately by the Geological Congress, and has
"been generally acknowledged in systematic scientific nomencla-
"ture. Without entering into a statement of the obvious advan-
"tages of such a principle, I may quote the following remarks as
"embodying a late pronouncement in its favor from the *Code of*
"*Nomenclature and Check List of North American Birds* (1886).
"The passage quoted is of course intended to apply specially to
"scientific nomenclature in Natural History, but is in most points
"equally applicable to the systematic nomenclature of natural
"features. 'The general tendency at present is in favor of the
"greatest attainable fixity of names, by the most rigid adherence
"to the law of priority under all practicable circumstances, and
"by the disregard as far as possible of all rules requiring the
"rejection of names for faulty construction, for barbarity, for
"being meaningless, and even for being literally false.'

"With the facts above referred to in view, and taking also into
"account the other considerations which affect the question, I
"venture to suggest the following as principles to be observed in
"regard to the nomenclature of plans in Canada:

"1. Names of places should be adopted and perpetuated as
"they occur where first published on maps or in reports or works
"in which the places are described.

"Provided, however, that the mere incidental mention of names
"which cannot certainly be localized, or which it may be evident
"have been carelessly or casually referred to, may be rejected or
"modified.

"Exceptions to this rule may also occasionally and guardedly
"be allowed in the case of names which may have become entirely
"obsolete, owing to insufficient publication.

"2. Where well recognized English and French equivalents
"exist for the names of places, either form may be employed, but
"so far as possible that first given to any place should be retained
"in its original form; and where reports or works are translated
"from English to French, or conversely, the names of places should
"not be changed except in the case first mentioned.

"3. In respect to geographical features for which no published "names exist, the names employed by the natives of the district "should be assumed to have priority.

"Exceptions may be made to this rule where traders, settlers, "miners, etc., have applied names which have become locally "known in place of the native names. Also where the native "names are too long or too difficult of pronunciation for conve- "nient use, and where the same names have already been applied "to places in the same or neighboring districts, and are thus "likely to lead to confusion, though the duplication of names of "minor features in widely separated localities cannot in all cases "be avoided, and where they are not likely to appear together "on general maps is scarcely objectionable.

"In the case of the exceptions noted in the above paragraph, "the translations of Indian names may often be adopted with "advantage.

"4. When native names are adopted according to the above "rule, they should be taken in their entirety, and not arbitrarily "mutilated or cut down for the sake of brevity, though the general "term denoting river, lake, etc., may be dropped—e.g. *wapta* "(Stoney), *sipsi* (Cree) meaning river, *sagohequn* (Cree) meaning "lake, etc.

"5. All such native names for the first time published to be "spelt according to sound, in conformity with the alphabet recom- "mended by the Royal Geographical Society.

"6. In all cases where after due enquiry it is found necessary "to apply new names, either owing to the non-existence of "recognized names or to inability to ascertain the native names, "they should be whenever possible of a descriptive character or "have some historical or other potent connection with the district, "all trivial, meaningless or too common names being carefully "avoided.

"7. All names of places in newly explored or surveyed districts "to be approved before publication by the Surveyor General, the "Director of the Geological Survey, or head of any other Depart- "ment, under which original geographical work may be carried "out; it being understood that the head of such Department "assumes the responsibility of the nomenclature and of the ortho- "graphy of names.

EXTRACT FROM LETTER OF THE SURVEYOR GENERAL, DATED 3RD APRIL (INSTANT.)

"In reply I beg to say that this subject was already discussed "between Dr. Dawson and myself, and that I concur in the views "which he expressed and which he has, I presume, already sub- "mitted to the Association. I will merely add a few remarks.

"In the first place, I believe that the privilege of giving names "should be used as sparingly as possible. Whenever it is possible "to ascertain the name used by the inhabitants of the country or "given by former explorers, it should be preserved, unless it be "such as to create confusion, in which case it should be either "slightly altered or changed altogether.

"In the next place, I am of opinion that except in the case of "unpronouncable Indian names, translations should not be "made. This should be an absolute rule for personal names. I "might cite instances in which the non-observance of this rule "has been the cause of confusion and ludicrous mistakes.

"When a name has to be given, I think that it should be one "suggested by the natural features of the ground or surrounding "country, in preference to any other; where no peculiarity exists, "then the name of some distinguished person or remarkable occur- "rence, this to be left to the judgment of the explorer.

EXTRACT FROM LETTER OF STAFF COMMANDER BOULTON, R.N., DATED MARCH 26TH (INSTANT).

"I have the honor to submit the following:

"1. That there should be a Government Officer from whom "Surveyors could ascertain if the geographical feature they are "about to name *already possesses one.*

"2. This curator should possess a copy of every Federal and "Provincial Government map or chart, should have a good "knowledge of French and the Indian languages, so that he may "be an *authority* for the correct orthography of any names "surveyors may give or report in their maps or charts.

"3. That when Indian names are given, the syllabic system by "hyphens should be adhered to as "Ma-ni-to-wa-ning."

"4. That when native names are given, the English translations "should be bracketted in alongside of them, if there is room.

"5. When Indian names are considered to be too long for "practical use, their English equivalents should be used instead.

"I append hereto for the consideration of the Association a "system of orthography issued by the Admiralty for the guidance "of Admiralty Surveyors abroad:—

SYSTEM OF ORTHOGRAPHY.

1. All geographical names in countries which use the Roman character should be spelt as by the respective nations, or as generally recognized by Englishmen. In some cases both forms may be necessary, thus, Livorno (Leghorn).

2. Names in countries which do not use the Roman character are to be spelt after the following system, except in such cases as by long usage have become familiar to English eyes, thus Calcutta, Cutch, Celebes, Mecca, and similar words, should be written as heretofore.

3. The true sound of the word as locally pronounced will be taken as the basis of the spelling.

4. An approximation of the sound is alone aimed at. A system which would attempt to represent the more delicate inflections of sound and accent would be so complicated as only to defeat itself

5. The broad features of the system adopted are that vowels are pronounced as in Italian and consonants as in English.

6. One accent only is used, the acute, to denote the syllable on, which stress is laid. This is very important, as the sounds of many names are entirely altered by the misplacement of this "stress."

7. Every letter is pronounced. When two vowels come together each one is sounded, though the result, when spoken quickly, is sometimes scarcely to be distinguished from a single sound, as in *ai*, *au*, *ei*.

The amplification of the rules is given below:—

Letters.	Pronunciation and Remarks.	Examples.
a	*ah*, *a* as in *father*	Java, Banâna, Somâli, Bari,
e	*eh*, *e* as in *benefit*	Tel-el-Kebîr, Oléleh, Yezo, Levûka, Peru.
i	English *e*; *i* as in *ravine*; the sound of *ee* in *beet* . Thus, not *Feejee*, but	Fiji, Hindi.
o	*o* as in *mote*	Tokio.
u	long *u* as in *flute*; the sound of *oo* in *boot*. *oo* or *ou* should never be employed for this sound. Thus, not *Zooloo* or *Zoulou*, but	Zulu, Sumatra.
	All vowels are shortened in sound by doubling the following consonant.	Yarra, Tanna, Mecca, Jidda, Bonny.
	Doubling of a vowel is only necessary where there is a distinct repetition of the single sound.	Nuulûa.

Letters.	Pronunciation and Remarks.	Examples.
ai	English *i* as in *ice*	Shanghai.
au	*ow* as in *how* . Thus, not *Foochow*, but	Fuchau.
ao	is slightly different from above .	Macao.
ei	is the sound of the two Italian vowels, but is frequently slurred over, when it is scarcely to be distinguished from *ey* in the English *they*.	Beirút, Beillú.
b	English *b*.	
c	is always soft, but is so nearly the sound of *s* that it eshould b seldom used. If *Celebes* were not already recognized it would be written *Selebes*.	Celebes.
ch	is always soft as in *church* . .	Chingchin.
d	English *d*.	
f	English *f*. *ph* should not be used for the sound of *f*. . Thus, not *Haiphong*, but	Haifong, Nafa.
g	is always hard. (Soft *g* is given by *j*)	Galápagos.
h	is always pronounced when inserted.	
j	English *j*. *Dj* should never be put for this sound.	Japan, Jinchuen.
k	English *k*. It should always be put for the hard *c*. . Thus, not *Corea*, but	Korea.
kh	The Oriental guttural . . .	Khan.
gh	is another guttural, as in the Turkish	Dagh, Ghazi.
l m n	As in English.	
ng	has two separate sounds, the one hard as in the English word *finger*, the other as in *singer*. As these two sounds are rarely employed in the same locality, no attempt is made to distinguish between them.	
p	As in English.	
q	should never be employed; *qu* is given as *kw*	Kwangtung.
r s t v w x	As in English.	Sawákin.
y	is always a consonant, as in *yard*, and therefore should never be used as a terminal, *i* or *e* being substituted, Thus, not *Mikindány*, but not *Kwaly*, but	Kikuyu. Mikindáni. Kwale.
z	English *z*	Zulu.
	Accents should not generally be used, but where there is a very decided emphatic syllable or stress, which affects the sound of the word, it should be marked by an *acute* accent.	Tongatábu, Galápagos, Palâwan, Sarâwak.

EXTRACTS REFERRING TO NOMENCLATURE OF GEOGRAPHICAL FEATURES, FROM ADMIRALTY GENERAL INSTRUCTIONS FOR HYDROGRAPHICAL SURVEYORS, 1888, p. 16.

"The surveyor should therefore take every pains to ascertain the acknowledged or native names. * * * Where such acknowledged names cannot be obtained, then let the surveyor freely give as many as will answer the purpose, but he should avoid the silly repetition of popular names, which so much tends to confuse our gazetteers and to perplex our memories. *He should beware of meddling with names already established;* these which have been stamped upon places by the first discoverer are held sacred by the common consent of all nations, and when new ones must be given it would show better taste to make the name convey some idea of the form or character or productions of the place, or some characteristic of its inhabitants, than to exhaust the catalogues of public characters or private friends. The officers and crews, indeed, may have some claim to such a distinction, which, slight as it is, help to excite additional interest in a laborious exploring voyage."

EXTRACT FROM LETTER OF PROFESSOR MACOUN, GEOLOGICAL SURVEY, DATED APRIL 12TH (INSTANT.)

"My work for the last four years has been an examination into "the geographical distribution of our vegetable productions, and "this has led me to use nearly all the geographical names in the "country. As time passed, I began to see the utter confusion "that existed in the spelling of the various geographical names, "and the evident misapprehension of the origin of many of them.

"Many places in Quebec and the Northwest have become half "English and half French, as River du Loup, River de Brig, and "even Cape d'Espoir, on the Bay of Chaleurs, has become Cape "Despair; you may imagine how foolish I looked when I said to a "gentleman as we passed along it on a calm day, that it was well "named Despair, for there would be no hope for any vessel forced "upon the cliffs. The answer was: 'You are wrong regarding "the name, as it means the Cape of Hope, not the Cape Despair, "as you seem to think.'

"In conversation with the French translators at the House, I "find they are troubled over this putting an English *dress* on a "French *form*, which there is no warrant for except our loose "habit of writing what we think, and ignoring authority.

"Taking this view of the matter, I would recommend that your "Committee press upon the Surveyor General the necessity of "adopting at once some uniform method of spelling the old

"geographical names of every part of Canada, and would suggest "that he go back to the first authoritative map of the country for "the spelling. In doing this it would be very easy to make out "a complete Geographical Dictionary of the whole Dominion, and "we would have spelling and derivation in a most valuable form.

"Sooner or later, this will have to be done, and it is probable a "person could be found who would undertake the task for the love "of the work."

Very little need be added by the Committee to the remarks of the gentlemen submitted herewith, but for illustration and to show clearly the necessity for action in this matter, the following instances of erroneous naming of points and letter to the *Montreal Witness* may be of interest:

EXTRACT FROM A MEMORANDUM OF MR. R. H. HUNTER, DATED 6TH APRIL (INSTANT).

"St. Clements Point, Lake Winnipeg. On this point is situated "the small hut of a fur trader, named Jack Clements, a native of "Michigan; in consequence of his residence there during the past "few years, the point has become known to the frequenters of the "Lake as Clement's Point. Up to date, Mr. Clements has not "become canonized.

"Fort St. Frances, Rainy River District. This post of the "Hudson's Bay Company was named Fort Frances nearly sixty "years, in honor of Lady Frances Simpson, the wife of the Gov-"ernor of the H. B. Co. Although Lady Simpson was a devout "Christian and highly esteemed and beloved by all who had the "honor of her acquaintance, yet there is no record of her being "canonized.

"Lake St. Joseph, Albany River District. Although this Lake is "so named on the maps of the Department of the Interior and the "Department of Railways and Canals, the name is entirely un-"known to the residents of the district; it is known by them as "Lake Albany, and sometimes as the Big Lake Albany, in contra-"distinction to a small lake of the same name, some hundred miles "or so to the Northwest. It is true that the Lake has been known "to the French Canadian fur traders, or "coureurs de bois," as "Lac Joseph, but these traders never called it Lac St. Joseph.

"Blood River, east side of Lake Winnipeg. This should be "Bloodvein River, the former name being unknown to the resi-"dents of the vicinity. The name is given the river on account of "the red veins running or intermixed in the granite formation "through which the river runs.

"On some of the Government maps a portion of the Lake of "the Woods is improperly called Clear Water Lake, this name is "quite unknown to the residents and natives of that section; the "name has evidently been introduced by some surveyor or "draughtsman."

DUPLICATION OF NAMES, LETTER TO MONTREAL WITNESS.

"SIR,

"Your reference in a recent issue to the duplication of the names "of places raises a very important question. It seems to me that, "at least in the Northwest, the names of all important physical "features in the country, as rivers, mountains, lakes, bays, etc., "should be in the hands of the Surveyor General at Ottawa, so as "to avoid duplication. The matter, I understand, has been brought "before the attention of the Minister of the Interior, with a view of "having duplication remedied there before the country becomes "more settled, and before these duplicate names creep into hun-"dreds of deeds, books, reports, etc., when change will be exceed-"ingly difficult. Our own Northwest is not the model in respect "of duplication which you think it is. At present, we have four "Saskatchewan Rivers, including the North Branch, the South "Branch, the Little Saskatchewan at Minnedosa, and the Little "Saskatchewan, between Lakes Manitoba and Winnipeg. In the "works of Hooker, Richardson and others, it is often impossible "to ascertain whether the north or the south branch of the Sas-"katchewan is intended, and yet these two streams are 140 miles "apart. There are two large Red Deer Rivers, one flowing into "Lake Winnipegoosis, the other into the South Saskatchewan "There are two important Pembina Rivers, one in Manitoba, the "other near Edmonton, but a tributary of the River Athabaska. "There is a large Shoal Lake near Winnipeg and a smaller but "better known Shoal Lake near Birtle. Lakes and rivers named "after birds and other animals, as Swan, Heron, Pelican, Rat "Beaver, etc., are repeated in some cases several times. I have "never been able to see why the Indian names, where sufficiently "euphonious and appropriate, have not been retained. As the "surveys annually made by the Department of the Interior and "Geological Survey progress, new or little known lakes, rivers, etc., "are being constantly outlined, and, in such cases, there should be "no difficulty in giving appropriate names.

"In the older settled districts it is possible that an act of Parlia-"ment might be required to make changes.

A. T. D."

The subject is one which has no doubt received more or less attention from all persons engaged in any way in compiling maps or dealing with geographical names, and all must have noticed the many errors and inconsistencies that exist in our geographical nomenclature.

The Committee suggest the following scheme for adoption by the Government, to correct the many errors now existing and to prevent their re-occurrence :—

1. That some Officer of the Government be charged with the duty of collecting all the information necessary to enable him to compile a complete Geographical Dictionary of the Dominion, somewhat after the same style as that compiled for the Province of Quebec, by the late Surveyor General Bouchette of Quebec, published in 1832 ; and that all names as given by this Dictionary be officially confirmed, and the Dictionary thus become an authentic book of reference.

2. That it would be well that this Dictionary cover the whole Dominion, but if it be considered objectionable that the Department of Interior revise names at present existing in the older Provinces, then at least the maps of Manitoba, the Northwest Territories and British Columbia, and all sparsely settled districts generally should come under revision.

3. That special care should be taken to avoid duplication of names. Where several rivers, lakes or other natural features have the same name, and where the question of priority cannot be decided, the difficulty should be avoided by the use of synonyms in different languages—e.g., Red Deer, Elk, Wapiti, &c. ; Saskatchewan Rapid, Rolling, Swift, &c.

4. That the Surveyor General, being in the opinion of the Committee the proper person, be charged with the duty of compiling this Dictionary.

5. That all names given by explorers in new tracts of country be submitted to the Surveyor General, and after approval by him be entered in the Geographical Dictionary before being shown on any maps or plans issued by the Government.

6. That the system of nomenclature and orthography suggested by Dr. Dawson, the Surveyor General, Captain Boulton and others as herein quoted, be followed as nearly as possible, and to further this end a memorandum of instructions should be issued by the Surveyor General for the guidance of all persons conducting explorations in new or unknown districts, and who may be called upon to give names to geographical features met with by them.

It may be pointed out that the only branches of the Government service that are engaged in conducting Geographical explorations in unknown portions of the Dominion are the survey branch of the Department of the Interior and the Geological Survey, both of which are under the control and direction of the Hon. the Minister of the Interior; and also that all the maps or plans of Manitoba, the Northwest Territories and parts of British Columbia are prepared under his direction, it would therefore, be possible for him to take such action as would give immediate effect in a large measure to the suggestions herein contained.

Signed on behalf of the Committee,

E. J. RAINBOTH,
President.

THE YUKON RIVER AND ITS SOURCES.

FORT RELIANCE, PELLY RIVER, N.W.T., September 1st, 1887.

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

GENTLEMEN,

Your worthy Secretary, before my departure from Ottawa last spring, insisted that I should write something for the next annual meeting of the Association. To my objection that I would not be in a position to do so, and, moreover, that I would have nothing to write about, he would not listen, but imperatively demanded a paper. With this statement as my excuse, I will inflict the following upon you:

You will not expect under the circumstances a professional paper, anyway you will not get one, so I will give you what might be called a geographical paper, which though not considered strictly appropriate for the pages of our annual report, may yet be of some service to some members of the Association in their rambles through this part of our Dominion. I will presume that you are all aware that I have been sent out to make an exploratory survey of the Lewes River and the Yukon from the Coast Range, at the head of the Lewes River, down to the 141st Meridian, west of Greenwich, or the International boundary line.

I began my operations at Pyramid Island, in Chilkat Inlet, a point, the geographical position of which was determined, in 1869, by a party of the United States Coast Survey. I carried the survey across to Chilkoot Inlet, thence to Taiya Inlet, and up the same to what was called by Schwatka, in 1883, the Perrier Pass, but it had already been named by the Karuse brothers the Dejäh Pass, or, as it is spelled by the United States Coast Survey, the Taiya Pass, to correspond with the name of the inlet which leads to it. A map showing the Chilkat and Chilkoot Inlets and their affluent streams, published in 1883, at Berlin, I think, shows the pass and calls it the Dejäh, as it also calls the inlet leading to it. Moreover, it gives the height of the summit of the pass as 1200 metres of about 3700 feet. My barometer readings on it, extending over three days, make it 4100 feet. About one mile of the pass on the south side is above the timber line, and on the north about six miles. The slope on the south side is much steeper

than on the north, which accounts for most of the difference in the distances to timber line. It would be very difficult to even make a pack-trail, for the carrying of stuff by animals over this pass, owing to the steepness of its slopes near the summit and the depth of the snow, which covers it from October until August, and sometimes later. In June, when I was on it, there was as much as thirty feet of snow in some places. There is another pass just to the east of this one, which I have had examined by two of my party and reported on. I think this will be found the easiest inlet to this part of the country, should its requirements ever necessitate a resort to artificial means of improvement. It is somewhat larger than the Taiya Pass, but much lower. It is all timbered, which indicates, if we are to take the Taiya Pass as a criterion, that it is at least one thousand feet lower and probably more. There are no steep grades, consequently a railroad could be built through if required, I have called it the White Pass, after the Minister of the Interior.

There is tide water at one end of this pass and a lake at the other, which at once, without any further trouble, places us in navigable waters, by means of which we can freely move over a tract of three or four hundred miles, in which I feel confident large mineral deposits will yet be found. The waters I refer to are those of Tagish or Tahko Lake, Bennett Lake, Lake Marsh and the Lewes River down to the Cañon.

At the Cañon (Miles Cañon of Schwatka) the Lewes River narrows suddenly from two hundred yards to about thirty, with perpendicular walls of basaltic rock from sixty to eighty feet high. It is about five-eighths of a mile long, and when I saw it the current was about twelve and a half miles per hour. It is pretty rough for small boats, I might say dangerous; but large ones such as York boats, if kept from touching the sides on their way down, are safe. I ran through it with a boat thirty-one feet long, eight feet wide, and two feet deep, carrying about four tons and six men, and beyond taking a couple of barrels full of water, we met with no mishap. Our time through was a little over three minutes. Below the Cañon there are rapids for about a mile, but they are not very bad, we ran over them in our canoes with perfect safety. These are succeeded by good water for about half a mile, when we reach what is called by the miners the White Horse Rapids, from the fact that they are all white and very rough. They are about three-eights of a mile long, the upper part about two hundred yards wide, and the last fifty or sixty yards, only about thirty wide, at which

point the whole force of the rapids concentrates into one grand effort, so violent, that it confuses itself, and whirls, and eddies, and seethes back and forth at the bottom, as though desirous of making another rush over before leaving the exciting race for ever.

This rapid is pronounced dangerous by all who have seen it, and I concur in the opinion. Some have gone through it on rafts, which are much safer than boats, and one or two in boats, but they do not wish to repeat the trip.

The Cañon and these rapids are the only obstructions to navigation on the river, from the head of Bennett Lake to the mouth. Rink Rapids are nothing more than a ripple, caused by the waters of the river being dammed back by large masses of conglomerate rock standing in the channel. The river here has worn its way through a ridge of this formation, and left these masses standing. It is somewhat rough for small boats, but all run it loaded.

Of the branches of the river I will only speak of the Hootalinqua (Tes-lin-too), which from its appearance might be called the main stream and the others the branches. It joins the Lewes ninety-four miles below the Cañon. Schwatka called it the Newberry, but seemed to have given it no further attention, though it completely changes to its own the character of the river below the junction. From accounts I have got of it by Indians, it, or one of its branches, heads near the Taku Inlet; for they say it only takes four days, loaded, to pack from the head of canoe navigation on it to salt water on the Inlet, and about one day, light or unloaded. Miners who went up it this year told me it is a hundred and seventy-five miles, from its junction with the Lewes to a lake which the Indians call "Aukland Lake," an Indian name which means "the largest." Out of this lake they went up a river which they say heads near the Liard River. The lake they called a hundred and and fifty miles long, as it took four days to row a light boat from one end of it to the other, but I think these distances are imaginary to a large extent. The Indians say it takes them two days in fine weather to traverse it, and described it as being like Lake Labarge, which is only thirty-one and a half miles long, but I think they are at the other extreme. Perhaps some of you, gentlemen, may have the pleasure of determining the relative value of these statements. I would like to extend this article, but find I cannot now do it. I have written it very hurriedly and must quit it in a hurry, which I hope will incline your critical ears to leniency. Appended is a table of distances by the survey from Hames Mission on Chilkoot Inlet to Fort Reliance on the Yukon River.

Hames Mission to entrance of Taiya Inlet in miles	4.83
Head of Taiya Inlet	20.46
Head of Canoe navigation, Taiya River	26.46
Forks of Taiya River	28.78
Summit of Taiya Pass	35.47
"Landing" at Lake Lindeman	43.91
" Foot of Lake Lindeman	48.41
Head of Lake Bennett	49.01
Boundary line B. C. and N. W. T (Lat. 60)	59.20
Foot of Lake Bennett	75.21
Foot of Caribou Crossing	77.88
Foot of Tagish Lake	94.91
Head of Marsh Lake	99.93
Foot of Marsh Lake	119.33
Head of Canon	145.48
Foot of Canon	146.10
Head of White Horse Rapids	147.85
Foot of White Horse Rapids	148.25
Takaheena River	162.75
Lake Labarge	176.12
Foot of Lake Labarge	207.80
Hootalinqua River (of miners, "Newberry" of Schwatka)	240.00
Big Salmon River (of miners "d'Abbadie" of Schwatka)	274.02
Little Salmon River (of miners "Daly" of Schwatka)	310.84
Rink Rapids	371.13
Pelly River	430.58
White River	528.03
Stewart River	538.00
Fort Reliance	612.53

The boundary is probably ninety to a hundred miles down the River beyond Fort Reliance.

WM. OGILVIE.

DISCUSSION.

Dr. G. M. DAWSON said that he had much pleasure in confirming the statements, made in Mr. Ogilvie's paper, on the Lewes River. He had met Mr. Ogilvie in August, at the mouth of the Lewes, and though both parties were, owing to unforeseen difficulties, about a month later than had been intended in reaching that place, they had been so fortunate as to arrive there within a day and a half of each other. He stated that Mr. Ogilvie deserved to be complimented on the energy which he had shown in overcoming difficulties on the portage, from the Taiya River to Lake Lindeman. He had a great amount of stuff to get over the portage, and the fact that he had taken his two Peterborough canoes across the mountains from the coast was in itself one worth recording.

While agreeing with Mr. Ogilvie as to the apparently larger size of the Tes-lin-too or Hootalinqua at its junction with the Lewes, he stated that when on the way up the latter river, he had cross-sectioned both streams near their confluence, and found that the Lewes actually carried a considerably greater volume of water. The Tes-lin-too was much wider than the Lewes, but it was comparatively shoal, and the current was not nearly so swift as in the Lewes. It did not follow, however, that the drainage basin of the last-named stream was larger or its sources more remote than those of the Tes-lin-too, as the Lewes was supplied from the perennial snows of the Coast Mountains, while the Tes-lin-too unwatered a relatively dry country in the interior. Dr. Dawson then made some remarks respecting the names of places in the Yukon district, and the unwarrantable liberty which Lieut. Schwatka had taken in applying entirely new names to features which were well known and had already been named by miners. He said that while the river, which he had just referred to as the *Tes-lin-too*, was marked on the United States Coast Survey map of Alaska and adjacent regions, as the *Nas-a-thane*, it was known to the miners as the *Hootalinqua*, while Schwatka, in 1883, had named it the *Newberry* or *Tes-el-héena*. Tes-lin-too is the name by which the river is known to the Indians of the locality. Hootalinqua is ineligible as having already been applied to another river in the same district, for which this appears to have been mistaken. Nas-a-thane and Tes-el-héena are inexplicable. It is, therefore, proposed to designate the river as the Tes-lin-too or Newberry.

The above remarks on Geographical Nomenclature brought forward Dr. Bell, the Vice-President, Prof. Macoun, and Commander Boulton, who, one and all, testified to the numerous conflictions and absurdities in geographical names that were to be met with in all parts of the Dominion.

Dr. Dawson thought that it was a matter the Association might well take in hand, and that if a committee on the subject were formed, a scheme might be suggested that would, to a great extent, remedy existing evils.

J. S. Dennis then brought in resolution No. 9, naming a committee to act in the matter, which was carried. Resolutions of thanks to Mr. Ogilvie for his interesting paper, and to the Assistant Directors of the Geological Survey, and Commander Boulton, for their valuable remarks thereon, closed the debate.

THE PLACING OF PERMANENT MARKS IN THE FIELD, AS A MEANS TO PRESERVE THE INFORMATION AFFORDED BY PUBLIC SURVEYS.

In venturing to put forward any views of mine before the Association of Dominion Land Surveyors, I take leave to premise that I am fully aware they may be of very little value. There is no doubt but that I am behind in the profesional science of the day, and I have seldom an opportunity of exchanging ideas with a professional friend. Nevertheless it is possible I may remind the Association of matters at present overlooked, that are worth attending to, and if such is the case, benefit will follow, if they receive the consideration they deserve.

Few will deny that it is a great mistake not to preserve every extensive survey, whether made for railroad, exploration, or other purpose, by permanent marks in the field as well as by their maps. When I first came to the County of Pontiac, some of the station marks and pickets of the Ship Canal Survey, by Mr. Walter Shanly, were standing on the banks of the River Ottawa. That survey is now obliterated. I am satisfie d that it would be impossible to restore it. I had occasion lately to use some of the maps, to get from them a more accurate trace of the front of one or two townships than can be got from the township plans, and I found the meridian laid down as much as fifteen degrees in error, in fact, but for a plan of part of the river by Capt. Deville, on which I need scarcely say the meridian was correct, I should have been put to some inconvenience.

Engineers seldom make use of a meridian line, so they take no trouble to lay it down correctly. This was, however, a very accurate and well executed work, and if preserved, so that the lines could be retraced, would be now of great service for checking previous surveys; for no country in which a survey was ever performed required means of checking former surveys more urgently than did that on the North shore of the Ottawa, between Aylmer and Fort Coulonge; and it seems inexplicable that the opportunity offered by Mr. Shanly's survey was not taken advantage of. When township outlines, represented on the original plan as straight lines, with concessions about a mile deep, deflect from the given course as much as thirty degrees on this side and on that, the interests of the settlers in the neighborhood call loudly for verification. Lest it be supposed

that I am overstating the case, I give the notes of a township outline (reported course being due North and South) as taken from the verified plan. "(1) N. 9° W., 81 chs. (2) N. 4° E., 50 chs.; and N. 8° W., 25 chs. (3) N. 8° E., 111 chs. (4) North, 81 chains. (5) N. 15° W., 75 chs." Of course the country being heavily wooded at the time of the Ship Canal Survey, only a few points on the bank of the river could have been established,—true, but meadow and corn-field now cover vast tracts where twenty years ago the good green wood sheltered the bear and deer. Some short time since I had occasion to go to far back settlements, where I had not been for a length of time. I found it difficult to recognize the places I knew I must be passing through. Surely! thought I, that cannot be the Quyon River, or I would know where we are, yet it was; but the "where I am" of to-day is not like the "where I was" twenty years ago, when I was passing over the same ground on horseback. The surroundings are different. My horse, that should be tired, becomes restive and impatient; he is excited by four deer that intended to cross the road ahead of me, but the steed has communicated his excitement to the rider, and we score against the deer, a race won, they turn and run back now to cross, horse and rider turn also and score another victory. The deer cannot make time through the old timber works, one of them gets on a log and surveys the position, but he does not take long to decide that the time and place are unfavorable for a crossing, and then he retires with his companions to their native fastnesses. What a digression this, but may I not hope to be forgiven? How better describe the change that has taken place than to contrast the country, as I have seen it, with what it is to-day. The pine forest I was then in has past out of existence, there are not even stumps, where it was, to obstruct the plough. To "tie in" now with the point whence I made this wide departure, I shall observe that had some points been marked, and their position accurately determined by Mr. Shanly, survey lines could be run from them now, in some places, as easily as on prairie, by which other points might be fixed, and others again from these.

What kind of marks would best serve to render the survey permanent should be considered. I think I recollect having seen the marks of the Ordnance Survey in Ireland, cut on the walls of houses; a few such marks cut on rocks, and stone buildings, in the vicinity of a railroad survey, and noting the intersections of roads with its lines, should make it everlasting. It is unnecessary to say how

other points, far asunder, could be connected by means of these, hill tops for instance, that might serve as the extremities of the base of a triangle, by which a still more distant point might be determined.

As in many of the operations of trigonometric surveying, the radius of curvature of the meridian, and that of the great circle perpendicular to it, are required, I may mention that there is a Table, No. II, in Loomis' Astronomy, No. III, in Chauvenet's, from which they can be found very easily with the aid of a short auxiliary table, which I computed, and as I have never seen or heard of one of the same kind, I submit it now with deference to the Association.

I am of opinion, too, that Cadastral Surveys should be made, so as to contribute, more than they do, to the geographical knowledge of the country. The width of every township that is cadastrated should be determined by a careful traverse, made with transit and steel band, to serve as a base of operations; this would entail very little additional expense, and as we have a Dominion Land Office, to make it better serve for the Dominion, let a copy of the plan and notes of every such traverse occupy a place in its archives, or rather of so much of them as would furnish data for future operations. In a Railroad Survey this would be a trace of the lines run with courses and distances, showing the points that had been permanently marked in the field.

In conclusion, then, I would suggest that steps be immediately aken to render the public surveys of the future permanent, by enduring field marks, and in furtherance of this object, that a competent land surveyor be employed on all such surveys, whose duty it shall be to determine the astronomical courses of the lines surveyed, and to leave permanent marks in the field (the position of which shall be accurately determined) in connection with these lines.

Finally, it should not be forgotten that "Geometer," though written in English characters, is a Greek word, and is the exact equivalent of "Land Measurer;" and that Geometry, the mother of the sciences, a very embodiment of truth, takes its name from Geometer; it is none too soon then to make an effort towards removing from the Professors of this most noble science the stigma of untruthfulness that attaches to their work, owing to the grotesque surveys of the old Colonial days.

S. L. BRABAZON.

TO FIND THE RADIUS OF CURVATURE OF THE MERIDIAN AND OF THE GREAT CIRCLE PERPENDICULAR TO IT.

Let ϕ = the geographical, ϕ' = the geocentric latitude, r = the geocentric radius, a = 1 = semiaxis major, ρ = meridian rad. of curvature, N = rad. of great circle perpendicular to meridian, R'' = radius in seconds.

By the common formulas

$$\rho = \frac{1-e^2}{(1-e^2 \sin^2\varphi)^{\frac{3}{2}}} \quad (1)\ N = \frac{1}{(1-e^2\sin^2\varphi)^{\frac{1}{2}}} \quad (2)\ r = \left(\frac{\rho}{1-e^2}\right)^{\frac{1}{3}} (3)$$

$$r = \left(\frac{\cos\phi}{\cos\phi'\cos(\varphi-\varphi')}\right)^{\frac{1}{2}} \quad (4) \text{ from which can be}$$

derived $\rho = (1-e^2)\left(\frac{\cos\phi'}{\cos\varphi\cos(\varphi-\phi')}\right)^{\frac{3}{2}}$ (5)

$$= \left(\frac{(1-e^2)^{\frac{1}{3}}\sec(\phi-\phi')}{r}\right)^3 (6)$$

To compare the different methods, find ρ and N for latitude 54°. $\phi' = \phi$.

	ϕ *sin*	9·9079576	
		2	
		9·8159152	
	e^2	7·8244252	
0·0043685	$e^2 \sin^2\phi$	7·6403404	
0·9956315 =	$-e^2\sin^2\phi$, *log*	9·9980986	By Formula 2.
		3	$1-e^2\sin^2\phi$ *log* 9·9980986
		2,9·9942958	$(1-e^2\sin^2\phi)^{\frac{1}{2}}$ 9·9990493
	$(1-e^2\sin^2\phi)^{\frac{3}{2}}$	9·9971479	*ac* N 0·0009507
	ac	0·0028521	If a = equator rad. in feet
	$1-e^2$	9·9970916	$\rho \times a$ = Rad. of cur. in feet
$\frac{1-e^2}{(1-e^2\sin^2\phi)^{\frac{3}{2}}} = \rho$	*log*	9·9999437	$\rho \times \frac{R''}{a}$ = Rad. of cur. in seconds

2ND METHOD.

From Auxiliary Table for $\phi - \phi' = 10'\ 57'' = 9{\cdot}9990327$ or find N thus

r from Loomis Table XII. = 9·9990515

$\sqrt[3]{\rho}$	9·9999812	$\sqrt[3]{\rho}$	9·9999812
	3	$\sqrt[3]{1-e^2}$	9·9990305
ρ =	9·9999436	N	0·0009507
$1-e^2$	9·9970916		
	0·0028520		
N	0·0009507		

By Formula 3. $\left\{\left(\frac{\rho}{1-e^2}\right)^{\frac{1}{3}} =\right.$

$\phi - \phi' = 10'\ 57''$ is found in Loomis Table for latitude 54.° Opposite to the same $\phi - \phi'$ in the Auxiliary Table we find 9·9990327, the log. of $(1-e^2)^{\frac{1}{3}} \sec(\phi - \phi')$ a factor in formula (6).

AUXILIARY TABLE TO BE USED WITH TABLE XII. IN LOOMIS ASTRONOMY FOR FINDING RADIUS OF CURVATURE.

From Loomis.		Capt. Clarke.			Loomis values
$\phi - \phi'$	$\sqrt[3]{(1-e^2)}\ sec(\phi-\phi')$			e^2 == 0066746	$\bar{3}\cdot 8244251$
2′ 00″	9·9990306			$1-e^2$== ·9933294	$\bar{1}\cdot 9970916$
3 00	307			$(1-e^2)^{\frac{1}{3}}$	$\bar{1}\cdot 9990305$
4 00	308			R″=arc=rad. in seconds	5·3144251
4 30	9·9990309			a== equatorial rad. in feet	7·3206364
				$\frac{R''}{a}$	7·9937887
5 00	310				
5 30	311			From Manual of Surveys	
6 00	9·9990312			$(1-e^2)$	$\bar{1}\cdot 9970506$
6 30	313			$(1-e^2)^{\frac{1}{3}}$	$\bar{1}\cdot 9990168$
7 00	9·9990314			Equatorial rad. in feet	7·3206874
7 20	315				
7 40	316				
8 00	9·9990317				
8 20	318				
8 40	319				
9 00	9·9990320	9·9990183			
9 20	321	184			
9 40	322	185			
10 00	9·9990323	9·9990186			
10 15	324	187			
10 30	325	188			
10 45	326	189			
11 00	9·9990327	9·9990190			
11 15	327	191			
11 30	9·9990329	9·9990192			

Loomis gives in his Astronomy $\frac{b^2}{a^2} = 1 - e^2$ log. 9·9970916. From Clarke's values of a and b in Manual of Surveys, p. 79, we get for $\frac{b^2}{a^2}$ log 9·9970506. In the third column, there is as much of the table computed from the latter elements as will cover the ground from Essex on Lake Erie to Hudson's Straits.

Discussion.

J. S. Dennis described the method of marking corners in Manitoba and the Northwest.

E. J. Rainboth described the method of marking corners in the Province of Quebec; and G. B. Abrey described the method adopted in the Province of Ontario.

Finally Mr. Brabazon's paper was referred to a Standing Committee.

BRITISH GOVERNMENT SURVEYS.

In a geodetic sense these are the Hydrographical and the Ordnance Surveys, and I will first speak of the former, to which I belong.

The substance of the minute issued on the formation of the Hydrographic Department of the British Admirality, dates Aug. 12th, 1795, and runs as follows:—

"The great inconvenience (especially when ordered abroad) felt "by officers commanding His Majesty's ships respecting the navi- "gation, has led us to consider the best means for furnishing such "information, and preventing the difficulty and danger to which "His Majesty's ships must be exposed from defects on this head.

"On examination of charts in office, we find a mass of informa- "tion requiring digest, which might be utilized, but owing to the "want of an establishment for this duty, His Majesty's officers "are deprived of the advantages of this valuable information. We "therefore propose that a proper person be fixed upon to be "appointed Hydrographer to the Board, to be entrusted with the "care of such charts as are now in office, or may hereafter be "deposited, and to be charged with the duty of collecting and "compiling all information necessary for improving navigation, "for the guidance of the Commanders of His Majesty's ships. "The extent of such an establishment not to exceed the sum £650 "per annum, in aid of which £80 a year given to one of the clerks "of our secretary for his care of the charts above mentioned, and "£100 for care of the office papers will be applied so that the "actual expenses of the new establishment will not exceed £470 "per annum."

The proper person *fixed upon*, for Hydrographer to the Board, was a Mr. Dalrymple, not a naval officer, but a very remarkable man, who for the previous forty years had been employed in the East India Company Service, extending their trade, by means of his geographical, exploratory and nautical surveying work.

Mr. Dalrymple was an F.R.S., and ranked high among the scientific men of his day. He was strict to a degree towards those of his newly created Department, all of whom at that time received their pay weekly through him, and a portion of which was invariably stopped for absence, whether from sickness or any other

cause; the only holiday he allowed was Xmas day. After thirteen years residence in London, Mr. Dalrymple's Department was reorganized, the main result of which was the pensioning of himself. When in a letter he complains to the Admiralty for superannuating him at the early age of 75, he departs from the usual cut and dried official utterances, and in the language of one of the poets exclaims: "To be resigned if ills betide; patient if favors be denied and pleased with bounties given. This is truly wisdom's part. This is that incense of the heart, whose fragrance mounts to heaven."

Although excellent running surveys had been made by Cook, Vancouver and others, yet captain Matthew Flinders, R.N. (who did so much early work in Australia), may be said to have been the first naval surveyor employed abroad who started under the auspices of the Hydrographic Department, but record does not show that even *he* received any extra remuneration for his surveying services.

The business of the Admiralty Surveying Service is to make charts of the coasts of Great Britain, and her dependencies, and also the shores of those countries and nations, the people of which cannot undertake that work themselves, for the benefit of British trade as well as the safe navigation of the war vessels *protecting* that trade.

At the present time the Surveying branch of Her Majesty's Navy consists of 52 naval officers afloat and a staff of eleven naval officers, besides civilian draughtsmen at the H. O. in London, at a cost of about £112,000. The Admiralty Surveying Service is not conbined with the Ordnance Survey under one Bureau as is the case with the similar services in the United States; *but*, as the Ordnance Survey of Great Britain embraces the shore line as far as the high water mark, the latter and the topography at the back of it are always demanded from Southampton whenever a new Admiralty chart is made of any portion of the coast of the United Kingdom. In Admiralty surveys abroad whenever a side of a triangle can be obtained from a geodetic survey, it is always used in preference to the smaller bases measured in a hydrographical survey.

While employed at the Cape of Good Hope in 1867-70, for instance, we were able to take up bases whenever we required them from two triangulations, the one from Cape Town northwestward to the boundary of the colony measured by Sir Thomas McLean, the Cape Astronomer, to verify the arc of the

meridian measured by the French astronomer La Caille. The triangulation, over the eastern portion of the Colony, was done under the auspices of the Ordnance Survey, for the purpose of connecting the towns, farms, etc., of that the most settled portion of the colony. Both these parties made a point of carrying their triangulations down to the prominent headlands on the sea coast, with the view to a future hydrographical survey.

An abstract of the work was published, describing the character and position of the large stone cairns they left, together with the angles and sides of the triangles, and the latitudes and longtitudes of the main points, so that future local land surveyors could tie on their work to them.

In Australia, too, as far back as 1860, a portion of the Colony of Victoria was triangulated, which proved a great assistance to the naval officer carrying on the survey of that coast and under whom I was serving as a youngster.

When we cannot fall back upon these carefully calculated sides for bases, we measure our own, from one to two thousand feet long by a standard chain, the operation not occupying more than a day.

From this base a triangulation is carried out over a coast 30 or 40 miles in extent as the crow flies, which is as much as a small party on an intricate coast, like that of Georgian Bay, could manage in one season.

The latitudes and longtitudes of the two extreme points are determined astronomically and are entirely independent of the triangulation.

The astronomical bearing and distance are then calculated between them, and from the latter the scale is deduced.

As hydrographical work is dependent entirely upon the fickle elements, fixed instruments are seldom used in our service for celestial observations. These require too long a detention in one place, and on a really fine day on the water one wants to be everywhere at once but especially on outlying shoals. We content ourselves with the sextant, and artificial horizon, using equal altitudes of the sun for time, for the purpose of longitude, and circummeridian altitudes of stars, about the same altitude north and south of the Zenith, for latitude, thus cutting out very nearly any eccentricity on the sextant and error in the tabulated refraction. Three or four hours stellar observations will give us the latitude, and the same time spent in observations of the sun by day, will furnish us with the longitude, to within 100 feet

of distance, which error on the scale I am working, viz. : one inch to the nautical mile, is quite unappreciable on paper.

The principal instruments used in a hydrographical survey for detail are the theodolite, sextant, and station pointer. As the last is used only by *us*, an inspection at the close of this paper may be interesting.

The principle of its construction is based upon the 21st prop., 3rd book of Euclid, that the angles in the same segment of a circle, are equal to one another.

Two angles are taken by a sextant between a middle point and an object right and left of it: they are then laid off on the station pointer and the instrument moved about on the chart, until the bevelled edges of the legs cover the stations, between which the angles were taken, and the centre of the instrument corresponds to the intersection of the circumference of the two segments containing the observed angles. At the present time Admiralty Surveys are being carried on in China, East and West Indies, Mediterranean, Australia, both sides of Great Britain, and the St. Lawrence River below Quebec, as well as that in Georgian Bay.

Naval Surveyors together with Officers of the Indian Civil Service, have been employed for the last twenty years charting the coasts of India, at the expense and under the orders of, the Indian Government. A fair copy of the season's work is sent to the Hydrographer on the scale it is surveyed on. It is then taken in hand by the draughtsmen in the H. O., and redrawn for the engraver, on a slightly reduced scale. The object of reducing the scale being first for the purpose of supplying the navigator with as much coast on one chart as is compatible with intelligibility, the second to lessen or destroy any slight error which may have crept in in the detail.

It is arranged between the Hydrographer and the engraver (a private firm) what the price of the engraving is to be, and the latter proceeds to put it on the copper.

If he is not also a printer, the plate is transferred to a private printing firm. A dry proof is printed and sent to the H. O. for revision, after which as many copies are printed as the Admiralty chart agent may then require, the plate being kept by the printer in a fire-proof vault, to print future copies or to make corrections on.

The Admiralty chart agent, J. D. Potter, 31 Poultny, London, E.C., has the sole right of selling the Admiralty charts, and he appoints his sub-agents abroad.

The price of any chart is fixed by the Hydrographer and is printed on it, and at this price the chart can be purchased from Mr. J. D. Potter. *He* buys them of course from the Admiralty at a certain discount. The charts for Her Majesty's ships are kept corrected to date at the H. O., and supplied direct therefrom to them on their STARTING FOR a foreign station. I will now attempt to give you a brief account of the Ordnance Survey of Great Britain.

The survey is carried on in such a maner as to obtain the most accurate representation of the ground, and the details on it.

The position of well-defined points, all over the country, such as tops of hills, church steeples, etc., at considerable distance apart, are ascertained with the utmost accuracy by a primary triangulation. The necessary observations consist in measuring the angle contained between all the points or "stations" that can be seen from the observing station, and are made by means of large and very accurate theodolites. The reduction of those observations is a lengthy and tedious operation.

A base line is measured with the greatest possible accuracy, and the lengths of the sides of every triangle calculated, and thus the position of every station is fixed. A secondary net work of triangles, based on the primary triangulation, is then formed, and when the survey is to be made on a large scale, such as 25 inches to one mile, a tertiary triangulation based on the secondary is needed.

The positions of numerous points, having been thus obtained, the detailed survey can be commenced, and is generally made by taking measurements with a chain. The great distinction between the above operations as carried on by the Ordnance Survey, and as performed by individual surveyors, is that all the operations are done on the Ordnance Survey, by different persons, who, therefore, form a check upon each other.

The first base line was measured by Major General Ray on Hounslow Heath in 1784; its object being to establish a triangulation for ascertaining the difference of longitude between the observatories at Greenwich and Paris. It was measured by Ramsden's steel chain, by deal, and also glass rods, with the following results:

By chain,	27404.55 feet.
deal rods,	27404.31
glass rods,	27404.08

In 1791, this base was again measured by a chain with a result of 27404.31 feet. Since that time four other bases have been measured in various parts of Great Britain. The bases selected for the primary triangulation of Great Britain were the Loch Foyle 7.89 miles in 1827-28, and that on Salisbury Plain of 6.93 miles in 1849, both measured by Colby's compensation bars.

The primary triangulation was commenced in 1784 and completed in 1858, including the reduction of the observations. The secondary and tertiary triangulations are now approaching completion.

The survey of Scotland is complete, the cultivated districts on 25, and the Highland portions on 6 inches to the mile. The Survey of Ireland is finished on the 6 inch scale, and the county of Dublin on 25 inches to the mile.

The Survey of England and Wales is nearly complete on the 25 inch scale.

In the primary triangulation, the longest side is 111 miles. The instruments used were two 3 feet theodolites made by Ramsden, and a two feet theodolite by Troughton and Simmes. The primary triangulation is broken up into a secondary triangulation, whose sides are about 5 miles in length, and this again into the tertiary or parish triangulation of about one to 1½ mile sides. The instruments used in the two latter are 12 and 7 inch theodolites.

Each triangle of the parish triangulation on the 25 inch scale is allotted to a surveyor, and he is supplied with data to enable him to recover the trigonometrical station, but the sides of the triangle are traced for him on the ground by an observer using a 5 in. Theodolite.

He proceeds to split up the triangle into a network of lines measured by the chain, and from which offsets are taken to various points in the roads, hedges, houses, &c. He also measures the sides of the triangle, but he is ignorant of the actual lengths by calculation.

A second person lays down the lines on the plan. He sees that the lengths of the main lines as measured agree with their lengths as calculated; if the discrepancy exceed a certain amount, the line is sent back to the surveyor to be measured, This second person also lays down the subsidiary lines, and if they will not plot within a certain limit of accuracy they are also returned to the surveyor to be remeasured.

A third person plots the detail on the plan.

A fourth person makes a tracing from the detail which is given to a fifth person, who examines the work on the ground and corrects any error. This person also collects the names and investigates the spelling. He enters the names in a book, giving three authorities for each.

A sixth person draws the fair plan.

A seventh person plan-examines (*i.e.* checks) the draughtsman's work.

An eighth computes the area of each enclosure on the plan. Formerly these areas were collected into parishes and published in parish area books. The area of each field, &c., is now however printed inside the field itself on the plan.

Lastly the M. S. plan is examined in a general manner on the ground by an officer.

The plan then goes to the Levelling Division to have the levels inserted.

The offices in which these operations are carried on are scattered over the country in positions convenient to the work. All the documents are then sent to Southampton where they undergo a thorough examination. Then independently of this final examination there are eight persons who form independent checks on each other. All errors which may be made in the survey of a triangle are strictly confined to that triangle, and have no tendency to spread into the adjoining work.

As soon as the MS. plan is complete in every respect it is sent to Southampton for reproduction on various scales:—10.56 feet to a mile ($\frac{1}{500}$) for maps of towns where population is over 4000, 25.344 inches to a mile ($\frac{1}{2500}$) for parish maps, 6 inches ($\frac{1}{10560}$) for county maps.

1 inch $\frac{1}{633600}$ for map of the country.

The reductions are now made by photography (the pentagraph being given up), they are transferred to zinc, and copies printed therefrom, the dual operation being known as Photozincography. The advantage of this process is threefold. 1st. The work is more accurate, any possibility of error in reduction being eliminated. 2nd. The operation is much quicker; a plan the engraving of which took 12 years can now be produced in 2 days. 3rd. There is a great saving of expense.

During the dark days of winter, photographic printing of all descriptions is most tedious, and with large printing surfaces liable to continual failures, through non contact in the pressure frame.

To surmount this difficulty the electric light has been introduced with great effect. For this purpose an arc light of about 8000 candle power (Crompton D. Lamp) has been fitted up, and the electric current required is obtained from the dynamo that supplies the electrolytic tanks with current for electrotyping. The exposure required is about three or four times that required with ordinary sunlight.

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

NATURAL HISTORY IN CONNECTION WITH THE TOPOGRAPHICAL SURVEY.

Natural History, of late years, has been given a prominent place among the multifarious studies in our schools and colleges, and as a consequence of this, the attention of the public is being directed to our local Natural History and to the wider field of our whole Dominion. As the students of the last twenty-five years take their places in the arena of public life, they show by their promotion of Natural History subjects that what was taught them in their youth is already bearing fruit.

Ten years since, when the Geological Survey changed its name by Act of Parliament to that of the Geological and Natural History Survey, no provision was made in a monetary sense to prosecute the work of the Natural History section of the Survey, but Dr. Selwyn at once issued orders to the leaders of the various exploring parties to collect specimens in all the localities visited. In a few years afterward I was appointed Botanist and Natural History collector, and at once began to devote myself to the work, but chiefly to Botany.

The results of the last five or six years are of great value to the country and to science generally. Our Herbarium has already attained immense proportions, and we have suites of plants from nearly every part of the Dominion, and almost all our native species are represented in the Museum. In this line amateur collectors can do us little good, because what we want is in most instances what they would not see.

Ornithology has come in for its share of attention, and the appointment of a taxidermist a few years since has given an impetus to the collecting of birds, so that at present we have a large and very valuable collection of the birds of the Dominion in the Museum and one that any people might be proud of. Owing to the migrating habits of birds, nearly all our land species can be obtained by resident collectors, but there is much valuable and needful information that can be obtained by the members of the Topographical Survey better than by any other means. And this leads me to ask why ***should not they*** collect specimens as well as the members of the Geological and Natural History Survey?

While I think it would be a needless waste of time to procure

the skins of any but rare or obscure birds, I think it of the utmost importance that all unknown birds seen in any part of the North Western Territories should be shot and the wings, feet, and head taken and brought back to Ottawa. Either Mr. Whiteaves or myself could easily identify them; if the birds were shot between the middle of June and the middle of August, we would learn the nesting region of every species shot. All nests found should be taken, and notes made at the time of the materials used in their construction. The eggs can easily be preserved, and I will show how at the end of this paper. You will see thus that much can be done in ornithology, but not in the way generally supposed.

Mammals, especially the smaller ones, differ altogether in their habits from birds, and hence the difficulty of procuring skins and gaining a partial knowledge of their habits, distribution and species. In the Museum we have fine examples of nearly all the larger mammals; but in the rodents, such as mice, rats, squirrels and gophers, we are very deficient. Bats also, and moles and shrews of all kinds, should be procured. In this field much can be done by you, as many species are very local in their habits and restricted in their distribution, and what one party would get in one district would be almost entirely different from those procured in another. Of every small mammal seen, good examples should be skinned, and the skins preserved and dried in the sun. In this way they will keep perfectly for a long time, but may be packed and sent away at once by mail. See directions at the end of this paper.

Scarcely anything has been done in either collecting or studying our reptiles, such as turtles, frogs, toads, lizards, newets and snakes, and there is a wide field for good work in this section. During the summers of 1885–87, I collected all these that fell under my observation, and had no difficulty whatever in preserving them or carrying them when found. All that is necessary is a gallon of methylated proof spirits, and a few glass jars, such as household canned fruits are kept in. Place the jars in a box packed with saw dust, and have a cover which can be easily put on or taken off, and this box can go with your outfit anywhere. As the men go out to their labor let each carry a small tin box that has contained pepper or baking powder, and when he sees any frog, toad, lizard or snake let him box it, and on his return to camp let it be punctured a few times and dropped alive into the alcohol in the jars. When one jar is full another can be filled, and so on. Small mammals, such as shrews, mice, and even small striped squirrels can be preserved for a time in the same way. Should the results be turned over to

me, I would soon have the specimens determined, as I am in communication with specialists in this department, and what I could not do myself I could get done.

I shall not take space to enter into details regarding the collecting of insects, and land and fresh water shells, but it is so easily done that it requires very little knowledge to do it. Shells can be collected in small bottles, pill-boxes, or tin boxes, and when camp is reached the larger ones should be boiled for a short time, but not long enough to make the animal too soft, and it can then be picked out with a pin. All from the same locality, when dry and clean, should be put in the same box and labelled with the date and locality. Clams require more boiling, and when cleaned should have the two valves wrapped around with shoe-thread to keep them close, as when the hinge stiffens the valves cannot be closed without breaking them.

Butterflies can be easily preserved by closing their wings, and placing them singly in small envelopes and afterwards into a paper box which might contain hundreds of them. Beetles are collected by having small bottles suitable for the vest pocket, in which there is a little sawdust satuated with alcohol. At night any captures made during the day can be placed in the store bottle kept in the camp.

I have left the fish until the last, not because they are the least important, but because after botany they are the most valuable to the country in both an economic and scientific sense. It is too true that we know scarcely anything about our fish, either economically or scientifically, and in this direction anything that can be done will be of use to the Country. There is not a man in the Dominion who seems to think it necessary to study the habits and food of our fishes, and I would just ask gentlemen interested in the matter whether they take in the full significance of the fishery question when they speak only of the fish of the north-eastern coast. Throughout the whole world there is no other nation that possesses such a wealth of food fishes as Canada, and perhaps in no other portion of the world is this wealth so little appreciated. We who explore our rivers and lakes, and sail along unfrequented coasts, know something of this wealth, but who will tell us of the fish of Hudson Bay, at the mouth of the Mackenzie, and along the shores of British Columbia? It is in this connection that much valuable service can be done by every member of your Survey. Specimens of fish can be preserved in the same way as reptiles.

In conclusion, I would urge upon you the necessity of asking

the Department for the appointment of a person competent to collect all kinds of Natural History objects to be attached to every large expedition which may be fitted out for any purpose whatever in connection with the North and North-west. Had this been done when the expedition was sent to Hudson Bay, the meagre returns resulting from those expeditions would have been so enhanced, that the economic value of the information would have more than covered the outlay. In no case does either England or the United States allow a scientific expedition to be fitted out without one or more naturalists being appointed to accompany them. For years I have seen with pain the almost criminal neglect of Natural History subjects in all cases outside of our own survey, and even here we have been so cramped for funds, that I have been unable to have an assistant in my work during the whole year, and as a consequence I have been compelled to confine myself almost exclusively to botany and ornithology.

In the foregoing notes, I have tried to lay before you the status of Natural History at present in official circles, the lines in which you can assist us, and the hopes for the future. I will not detain you any longer, but hope you may use your influence both as individuals and as a body to have Natural History placed on a better footing than it is at present. It is not for me to formulate a plan, but were I requested to do so I could very easily do it and could show, how, at a very small expense, under a competent head, the whole Natural History work of the Dominion could be carried on as effectively as the Botanical section is at present.

JOHN MACOUN.

BRIEF DIRECTIONS FOR PREPARING SKINS OF SMALL MAMMALS.

FOR THE MUSEUM OF DR. C. HART MERRIAM.

Skin all mammals as soon as possible after death.

Lay the animal on its back, and make an incision along the middle of the belly from just behind the fore legs nearly to the vent. Be careful not to stretch the skin while removing it, and exercise great caution in skinning around the eyes and lips, which parts are easily cut. Skin as far down on the feet as possible, but leave in all the bones of the legs. Remove the bone from the tail by pulling it between the fingers. Take out the skull, being careful not to cut or injure it in any way, and wash out the brains; number the skull with the same number that is attached to the skin, and dry it in the shade. Never put arsenic or salt on a skull, but use powdered borax if necessary to prevent the remaining flesh from decomposing. Remove all fat from the skin, and cut off any tags of flesh that may adhere to it.

In cleaning off blood or dirt that may have soiled the hair, an old tooth brush and a liberal supply of cornmeal will be found most serviceable.

Poison all parts of the skin with dry arsenic, or better still with a mixture of powdered arsenic and alum in the proportion of four parts arsenic to one part alum, being particular to put an extra supply in the feet and tail. Put a wire in the body, letting it extend to the tip of the tail, but be careful not to stretch the tail. Use annealed iron wire of as large size as will easily fit into the tip end of the tail. In rabbits, foxes, and wildcats put wires in the hind legs also.

Stuff the skin to its natural size with cotton or tow (never use wool, feathers, or other animal substances); sew it up along the belly and place it flat on a board to dry (belly down), with the fore legs extended in front and parallel to the body, and the hind legs and tail directed backward. Attach to each skin a label, bearing the same number that is marked on the skull. On this label should be stated the length of the animal (from the tip of the nose to the end of the tail, the spine being stretched for this purpose); also the sex, date of capture (name of month should always be written in full), locality, and name of collector.

All skins should be thoroughly dry before they are packed. They should be wrapped carefully in cotton and packed in small wooden boxes. Cigar boxes do very well for the smaller species but must be strengthened by a thin piece of board across each end. They can then be sent by mail.

DISCUSSION.

J. S. DENNIS remarked that he feared that unless the collecting of Natural History specimens were made a part of the duty of surveyors, very little would be done in that direction, as they would be unwilling to spare the time from their proper duties unless specially instructed.

JOHN MCAREE agreed with Mr. Dennis, and said that unless there was a natural love of the research the time would not be given without the instructions from the Department.

PROF. MACOUN stated that he agreed with both these gentlemen, and further that he did not think surveyors should neglect their duty or make their men do so for this object, but still to bear in mind that if only one skin were collected that was rare, it was conferring a great benefit on the science. What he did mean was, that on any large party such as a Topographical party a specialist should be attached.

J. S. DENNIS explained that he did not intend to say that it would be a waste of time, but that he did not think it would amount to anything unless it were an especial part of the duty.

PROF. MACOUN replied that he *did* think it would be a waste of time for the surveyor to collect specimens, that what he wished to convey was that a specialist should be attached to the larger exploring parties.

Resolution No. 14 was then moved by Mr. DENNIS, seconded by Mr. MCAREE, and *Carried*. (See Minutes, p. 26).

Professor MACOUN, thanked the Association for passing the above resolution, and stated that any third year student, in any of the Universities, would be quite well enough posted to do the work, and would cost little or nothing as he would be glad of the trip.

Resolution No. 15 was then passed, tendering a cordial vote of thanks to Prof. Macoun for his instructive paper.

COMMANDER BOULTON said that like the surveyors, his work took up so much time that he had very little chance of making Natural History observations. One thing, however, had struck him very forcibly, and that was, that in a little while, judging by what he had seen and heard, the lakes would be fished out. He denounced the "pound net" as a very destructive method, on account of the small size of the mesh giving the smaller fish very little chance of escape.

Prof. MACOUN corroborated Commander Boulton's statements saying that our fish were being destroyed very rapidly, and no one seemed to care. To him it was terrible. The fish, he said, would soon be gone, and we would have artificial means of propagation, and the result would be that when put into strange waters they would be like a bird reared in a cage and would not know where to hide and in consequence the poor little devils would be gobbled as soon as they had to look out for themselves, as they would be partly domesticated.

Resolution No. 16 was then moved by W. F. KING, seconded by J. S. DENNIS, and *Carried*. (See Minutes, p. 26).

Professor MACOUN said that it had been suggested to him that he should send out a circular before the survey parties started for work, and this he would do.

T. D. GREEN thought that these circulars should be sent to the Surveyor General and his permission asked to have them inserted in the instruction to surveyors.

G. A. MCMARTIN suggested that the circulars should be sent to all Surveyors, not only to Government parties.

E. J. RAINBOTH, endorsed Mr. McMartin's views.

Prof. MACOUN stated that there were perhaps a dozen small animals that scientific men knew nothing at all about, and quoted a species of Marmot, of which they had a specimen at the Geological and Natural History Museum that had been obtained by a mere chance.

E. J. RAINBOTH thought the best plan would be to send a number of these circulars to the Secretary-Treasurer to distribute.

This closed the debate.

MAP MAKING.

As early as 1600 B.C., the ancients had some idea of map making, or illustrating on a plane surface the topography of the earth.

In the Turin Museum may be seen drawn on rolls of old Egyptian papyrus, works that have been recognized as a topographical map of the mining district of Nubia, shewing a road between two mountains leading to the mines. Another sheet shows the victorious return of Sethos from Asia; the Nile with its crocodiles; and Lake Tismah with fish in it.

There are many accounts of ancient wandering tribes having constructed guide maps on wooden tablets, showing routes, and the boundaries of sea and land with tolerable accuracy. Among early scientific work is recorded an observation for latitude by the arctic navigator Pytheas about 326 B.C., who made a voyage to the extreme north, for the purpose of determining the figure of the earth. A little later on Decaearchus of Messana, in Sicily, made an attempt at a projection, and drew parallels of latitude on his maps.

The next important step in the science of cartography is due to the famous astronomer and geographer, Eratosthenes (276–196 B.C.). His was the first comprehensive geography based on the sphe[illegible]f the earth, and he made the first geodetic measurement for the [illegible]se of determining the size of the earth.

To the [illegible]ent Babylonians, however, belongs the high distinction of having inaugurated map making as a science, and of placing it on a sound basis. It was they who first divided time and space, so as to admit of scientific measurement, as is the custom of today. They divided the Ecliptic into twelve signs and later on into three hundred and sixty degrees, with the circle to correspond, and in this the Babylonians greatly aided the means of determining geographical position. The Greeks also introduced this method, about 150 B.C., but little progress, however, was made in geography or map making, until Ptolemy's time—about three hundred years later on.

In Ptolemy's work we find for the first time the mathematical principle of the construction of maps, as well as of several projections of the sphere.

In detail the errors of Ptolemy are numerous, on account of defective information, and the want of astronomical observations. He, however, founded correct principles, and may be regarded as the father of cartography, and his teachings as the ideal for the guidance of the modern map maker.

From Ptolemy's time until the revival of letters in Europe, but little progress was made in the exact sciences, although commercial and military enterprise contributed somewhat to a better knowledge of the earth's surface, through rough sketches, without any pretensions to mathematical accuracy.

Astronomy and geography made little progress among the Romans and during the middle ages, consequently map making as a science fell back into what might be termed a second childhood.

The Greek Fathers continued to teach the doctrine of the sphericity of the earth, but as the knowledge of Greek died out in western Europe, correct principles gave place to fanatical teachings, wherein knowledge of geography was considered a matter of opinion only astronomy was fantastic folly, and a knowledge of distant countries was treated as learned lumber, and as this narrow conception of things on the whole was the dominant one, map making practically ceased to exist.

Isidore of Seville (A. D. 636) was the father and master of false geographical teachings, and under him the people went back to the Homeric idea of the earth being a disc surrounded by the sea.

Isidore declared that the earth had the appearance of a wheel, and consequently the name wheel maps has been given to all the maps of the earlier middle ages.

The Arabians, however, made somewhat better progress. With the aid of the works of Euclid, Archimedes, Aristotle, and Ptolemy translated into Arabic (813 to 833), they measured a degree of latitude, and determined geographic position according to the Ptolemic principle. The Arabian astronomers did not unfortunately make maps; travellers and topographers cared little about astronomy, and only made rough route maps without reference to degrees, declaring at last that mathematical division only brought confusion into geography. The Arabians made a fair beginning, but as the theoretical and practical did not blend we have as a consequence but one arabic map, on a projection which, though interesting from a historic point of view, is only an unsuccessful copy of Ptolemy.

The introduction of the mariner's compass, in Italy, during the 13th century, indicates a gratifying improvement in cartography after a long period of stagnation. The Chinese undoubtedly had the earliest and always an independent knowledge of the compass, which they divided into twenty-four parts commencing at the south. It is not improbable that they communicated their knowledge to the Arabs, and through the latter the compass was introduced into Europe; however this may be Travio Gioja of Amilfi, A.D. 1307, was, perhaps, the first European to make a mariner's compass and to teach seamen the use of that important instrument.

The Italians divided the compass into thirty-two parts or points of eleven and a quarter degrees each, they then constructed numerous maps, with the aid of this instrument, which took the name of compass maps, because they were covered with the figure of a compass.

Part of the coast and some of the islands of the Mediterranean were mapped in this way, and seamen were enabled to determine the proper course to take by the numerous radii of the compass shewn on the map.

A chart, the extensive work of Prince Henry the navigator (1394–1460), gave need for maps with latitude and longitude. It was he who first opened a road through the unexplored ocean; the pathways of the human race up to this time being by inland seas, lakes and land only. The prince was always, during his busy life, an ardent cartographer, and the finest specimen of medieval map making that has been preserved was prepared under his patronage in one of the convents of Venice.

In the 15th century we note a complete revolution in map making as a science, and Ptolemy's great work was again revived in western Europe.

The 17th and 18th centuries mark the most important era in the science of cartography, being the period of transition in which the most important discoveries in mathematics, physics and astronomy were made, and which completely revolutionized the blundering methods of earlier ages. Of chief moment was the invention of the telescope (1606); Galileo's discovery of Jupiter's moon's (1610); calculations for the determination of longitude (1616); the application of trigonometry to geodesy (1615); the French measurement of a degree; the mirror sextant (1731), and John Harrison's chronometer in 1767.

During this period, maps with many valuable corrections were

made. Traditional errors having been expunged. Later on France and Germany took the lead in the extensive publication of handsomely engraved maps, followed in England shortly after by Dowat's atlas of the world, published at the cost of the Duke of Argyle.

Up to this time map publishing was a matter of private speculation, and to France belongs the credit of successfully carrying out the first geodetic and topographical survey and complete set of maps, at the cost of the State. Other European powers soon followed, and these later maps are distinguished for their clearness and accuracy of detail. From 1750 to 1850 attention was mainly directed to the accurate delineation of the horizontal surface of the earth, it was not until 1816 that the vertical configuration of the earth's surface was represented on maps by contour lines or curves of altitude. Great Britain has been very active in geodetic surveying and the production of topographical maps since 1855, the Ordinance maps being too well known to require comment.

The largest areas that have been accurately measured are Asiatic Russia, British India, and the United States of America. The admirable charts of the Coast Survey of the United States and the practical results of the International Boundary Commission Survey, ought to be convincing evidence to Canadian statesmen of the need for a comprehensive and connected survey of the whole Dominion.

Excellent work has already been done in the Canadian Northwest and correct maps prepared therefrom, and at present there appears to be no urgent need for the contour lines of that comparitively flat and as yet but thinly populated country. The case of the older and more densely peopled Provinces is, however, very different; defective maps made largely from compass surveys, and oftimes published and re-published by unauthorized Yankee cartographical pirates, County Atlas's, and Tunison's Map of Ontario for instance, which surveyors throughout the Dominion know to be compilations of flagrant errors, and for any degree of accurate information worse than useless.

The present discussion of a geodetic survey is well timed and in able hands, and no body of scientific men are better qualified to discuss this important subject than the members of this Association, whose special training eminently fits them to undertake such an important work.

Physical geography, surveying and cartography are kindred sciences and follow in natural sequence. Geography simply de-

scribes the earth as the dwelling place of the human race; surveying adds the details of horizontal and vertical measurements, and cartography by graphic illustration gives to both representation on a plane surface. These kindred sciences are of the greatest practical importance in the civilization of the world, being as they are the embodiment and application to man of all scientific and statistical information relating to the surface of the globe. They are a safe and profitable guide to the merchant, a valuable aid to the exact sciences, and the great adjusters of all natural and artificial land marks.

J. H. BROWNLEE.

BRANDON, MAN., March 8, 1888.

THE MINING INDUSTRY OF THE PROVINCE OF BRITISH COLUMBIA—PAST AND PRESENT.

I had been asked during the past summer to write a paper for the Association on this subject, but hesitated about doing so for a time, and only definitely made up my mind towards the latter end of December. A few days after, I was called away on a survey, from which I only returned on February 3rd. I make these excuses because the subject is both interesting and important, and with such limited time at my disposal I fear I cannot do it justice. Be that as it may, I will do my best.

It is difficult to obtain reliable information, as little has been written on the subject, so I have to depend upon personal observation and what I can gather from miners, who have actually worked in the places to be mentioned later on. This of course is a good way to obtain information, but it is at the same time somewhat difficult and laborious, for such a vast fund of anecdote and information can be collected, some of which is not very reliable, for on this subject in particular most men are inclined to exaggerate a little; one, therefore, has to trim, condense, reduce to the proper dimensions, and present it in such a form that it will be interesting, reliable, and at the same time not too long. This has been my endeavor.

For convenience I shall divide into

1st. PLACER MINING.

2nd. VEIN MINING.

Under the former head I will first of all give a sort of condensed narrative of the various discoveries of gold throughout the province, with such statistics as I have been able to gather, and afterwards go into the methods of working and separating the gold from the sand and gravel in which it is found.

The first authentic discovery of gold in British Columbia was on Queen Charlotte's Island, by Indians, in the year 1851.

It was next discovered at Pend d'Oreille, by Colville men, in 1853 or 1854.

In the autumn of 1857, Indians discovered gold in the Fraser River near a place called *Necomimin*, they sent word during the winter to half-breed friends in Washington Territory, the news spread, and caused the Fraser River excitement of 1858, and it was

the first place in British Columbia where gold was found in large and paying quantities. Many experienced miners from California and elsewhere flocked into the country, and found gold in the bars of the Fraser River, from the mouth of the Harrison River, as far up as the season of 1858 would allow them to go. Among these were Boston Bar, Cornish Bar, Maria's Bar, Alexandria Bar, Hill's Bar, and many others. Hill's Bar justbelow the town of Yale may be taken as an example of one of the best. Ned McGowan (who by the way is an historical character) took $33,000 out of this bar in three months, and this bar alone is said to have yielded over one million dollars.

It is also said that the present site of the town of Yale, with the flat opposite, would yield a large amount of gold if extensively worked by hydraulic power. These early prospectors had many difficulties and hardships to overcome, the country was rough, mountainous and comparatively unexplored, and travelling by land was hard and laborious work, the waters of the Fraser river were also swift and dangerous. Experienced boatmen, however, ascended the stream; among these were Ned Gallagher and Bill Lane, both of whom are well known characters.

In the year 1859 prospectors arrived at the mouth of *Quesnelle River*, which was found to be rich, and this stopped the onward march for a time.

In the summer of 1860, Keithley Creek, which runs into Cariboo Lake, was discovered, and this marks an era of renewed activity in mining, for it was the first of the many famous streams discovered in the famous Cariboo district, which is said to have been one of the richest placer mining centres ever discovered.

In the winter of 1860–61, miners went over a bold mountain, and discovered gold in Antler Creek by digging through the snow; they kept it a secret, went down to Victoria, and tried to get a grant or lease of the stream from Governor Douglas, which was refused. The news became known and caused the rush to Cariboo. During the same year (1861), Grouse Creek, Williams Creek, Lightning Creek, Lowbee Creek, and Jack of Clubs Creeks were discovered. Five of these famous Creeks, namely, Williams, Grouse, Antler, Lightning, and Jack of Clubs Creeks head close to one another in a bold mountain.

Of these, Williams Creek and Lightning Creek were the richest.

Williams Creek was discovered by William Deitz, better known as Dutch Bill, and was named after him. He took up his claim in the cañon, supposing that all the gold would pass through there,

and that it would naturally yield well. The ground, however, was shallow, and the run of gold was through an old back channel behind the canon, and his claim did not pay very well. Other miners, Barker who gave his name to Barkerville, among them soon after also located ground. At first they worked down to a hard blue gravel or cement, which was supposed to be bed rock, they obtained comparatively little gold and the creek was at first called *Humbug Creek.*

Abbott & Co., however, to test the creek, sank a *sump* hole 4 ft. x 7ft. through this, and took out 57 ounces of gold, and the other companies soon followed their example. Black Jack and others took up ground in the old channel behind the cañon, and Barker & Co., below the cañon, they struck it rich, and Barkerville was started. Later on Cameron & Co. located deep ground about ½ mile below Barkerville, it also proved to be rich, and Cameron town was started. Previous to this the town of Richfield had been built above the cañon near the head of the Steele claim, all three towns being within 3½ miles of the creek. Starting at the upper end, and going down stream some of the principal claims were as follows:

Steele & Co., or California Co.	Lillooet Co.
Point Claim.	Forest Rose.
Abbott & Co.	Cameron & Co.
12 foot Davis.	Tinker Co.
Adams & Wilson.	Raby & Co.
Casto & Co.	Caledonia Co.
Dutch Bill.	Grizzlie Co.
Diller & Co.	Never Sweat Co.
Canadian Co.	Ballarat Co.
Welsh Co.	Prince of Wales.
Wake-up-Jake Co.	Sheep's Head Co.
Cariboo Co.	Coonskin Co.
Aurora Co.	&c., &c.

This Creek is said to have been remarkably rich, and it must indeed have been so as may be seen from the following examples.

The largest amount of gold taken out in any one day's work on Williams Creek, or indeed, in Cariboo, was on Diller & Co.'s claims, it weighed 102 lbs., during the following day he took out 100 lbs., and this with only two men drifting. Diller is said to have taken out $100,000. Nearly two miles of Creek is said to have averaged over $1,000 to the foot of pay dirt. Cariboo Cameron took out $160,000. In the Aurora claim one pan of dirt yielded 587 ounces of gold. In the Adams claim one day's

work gave 480 ounces, and gold to the value of 300 ounces per day was not uncommon. On Steele & Co.'s claims 100 feet of ground yielded $100,000 in dividends. The Point claim yielded in dividends $90,000. One hundred feet of the Wattie claim paid $85,000 in dividends. The 12 foot Davis claim, a gore between two other claims, paid in dividends $25,000.

The above examples of the yields in the different claims are the dividends actually paid, and do not by any means represent the actual yield which was much greater. As examples of the additional amounts expended for working expenses, I have been told that the pay roll on Raby & Co.'s claims for two weeks amounted to $12,000. Mr. Heron, the discoverer of the famous Heron lead on Grouse Creek, also informs me that their pay roll amounted to from $1,200 to $2,200 per week. This company took out $300,000, and for a time made from 100 to 250 ounces of gold per day.

Mr. Beatty, now well known as a successful shipping and business man, who is manager of the Canadian Pacific Railway Company's steamers on Lake Superior, and former owner of the Beatty line on the same lake, was one of the fortunate miners who made a strike at Cariboo, and so I might go on giving instances without number. I need only say that unless the claims yielded from $10,000 to $50,000 dividends to the interest of 100 feet, it was considered that they did not amount to much.

Lightning Creek ranks next to Williams Creek. I give below the names of some of the companies, with a rough estimate of their yields, including the working expenses :

Van Winkle Co	$600,000
Victoria Co	600,000
Vancouver Co	200,000
Point Claim	180,000
South Wales Co	200,000
Lightning Co	220,000
Butcher Bench	250,000
Dunbar Flat	150,000

Many other creeks yielding large amounts of gold were also worked, among these were Grouse, Antler, Lowbee, Jack of Clubs, Harvey's, Snowshoe, Mosquito, Chisholm, Davis, Last Chance, Van Winkle, &c., besides numerous gulches and ravines.

The distance from New Westminster to Cariboo by the old route was about 520 miles. Miners went by way of Harrison River to Lillooet principally by water, through a series of lakes and rivers

with portages between them. Lillooet was the headquarters for pack trains to Cariboo. During the great rush, the pack trains were inadequate to accommodate the great numbers of miners going into Cariboo, and they, therefore, had to resort to all kinds of devices, some packed on their backs, others with dogs, and still others with oxen. Ned Cannel who is well and favorably known at Kamloops bought an ox at Lillooet, trained him to pack, and this was the first pack animal to go into Williams Creek, where he was killed dressing 900 lbs. and sold for 60 cts. per lb.

Supplies, provisions, and wages were high, as might be expected, and as will be seen by the following list which may be taken as an example of the highest prices paid at any time, for they were of course much cheaper afterwards :

Flour	$1.50 per lb.
Bacon	1.50 "
Tea and Coffee	3.00 "
Sugar	1.50 "
Beef	0.60 "
Beans	0.75 "
Nails	0.75 "
Gum Boots	$30, $50 per pair.
1 spool thread	$0.50
1 needle	0.50 to $1
1 clay pipe	0.50

Wages per man per day $10 to $16.

Exorbitant freight rates were the cause. "It is not the cost of the goods," said a trader to a miner, when selling him a darning needle for a dollar, "it's not the first cost of the goods it's the freight, mine friend."

The wagon road to Cariboo was finished in 1864, and the telegraph line bought by the Provincial Government about the same time. This telegraph line is famous, for it formed part of the line built by the Western Union Telegraph Company, which was to have crossed at Behrings Straits, and which was rendered useless by the successful laying of the Atlantic Cable.

Many places of less importance than Cariboo, but which, nevertheless, yielded a larger amount of gold, were discovered about this time.

Big Bend was discovered in 1864, by French Canadians from Colville, who went up the Columbia River in boats to French Creek.

The Principal Creeks were:

French Creek,	Downie Creek,
McCullock's Creek,	Carnes Creek,
Gold Creek.	

and many of the bars on the Columbia River.

These streams paid well for about three years.

Kootenay, discovered in 1864.

Yield from 1864 to 1885, about $500,000. Some of the creeks were as follows: Wild Horse Creek, Bull River, Moyea River, Palmer's Bar, Weaver Creek, Dutch Creek and Findlay Creek.

Ominica River. This is a branch of Peace River, and was discovered in 1868. It yielded a large amount of gold, and 2000 men are said to have been working there during the excitement. This district is rich in quartz leads, but it is too far away from railroads at present to do anything with them. Vitalle Creek, Germanson Creek, Manson Creek, Lost Creek, Quartz Creek, and Silver Creeks, were some of the principal creeks.

Rock Creek, and *Similkimeen*, discovered in 1860, worked for a time paying well and then abandoned for Cariboo.

Cherry Creek discovered in 1863.

Tranquille Creek discovered in 1860.

Scotch Creek discovered in 1866.

Stikeen River discovered in 1863, worked for a time and then abandoned.

Besides these there were Louis Creek, Jamieson Creek, and in fact nearly all the creeks running into the Thompson River in the vicinity of Kamloops paid more or less.

Cassiar ranks next to Cariboo in importance. It was discovered in 1873, by Thibert, a French Canadian, and McCulloch, a Scotchman, who came from the Red River County, crossed the mountains and came up the Liard River. During 1873–4 over 4,000 men are said to have worked at *Cassiar*.

The principal creeks were:

Dease Creek,	Snow Creek,
Thibuts Creek,	Quartz Creek,
McDame's Creek,	1st North Fork of McDame's Creek.
Walker's Creek,	

All of these creeks paid well for about three years, and were then left to the Chinamen and few remaining whites.

Miners went to Cassiar by ocean steamer from Victoria to Fort

Wrangle, by river steamer from Wrangle to Glenora Landing, 150 miles up the Stikeen River, then across an 80 mile portage to *Dease Lake* where there was another steamer.

The great Cañon of the Stikeen above Glenora Landing is a remarkable sight, it is 90 miles long, has high precipitous banks, from the description, probably basalt overlying gravel and cement, and is said to be truly picturesque. Good oats, barley, hay, and vegetables can be raised at Glenora Landing.

Snowfall and climate about the same as in Manitoba.

A road or trail was cut from *Quesnelle Mouth* to Dease Lake, a distance of about 425 miles.

During the first year freight and provisions were very high, freight across the 80 mile portage was 50c. per pound, and poor pack horses cost $250 each.

I have stated before that it is hard to obtain reliable mining statistics,—many reasons may be assigned for this. It must be remembered that before the gold excitement British Columbia was thinly populated and comparatively unknown, and up to that time it had been ruled by the Hudson Bay Co. Victoria itself was small, and when during the excitement many thousands flocked into the country, it necessarily for a time caused some confusion. Besides this there was not sufficient coin in the country to pay for the vast amount of gold brought down by successful miners, many of whom went on to San Francisco to dispose of their wealth, no account could be kept of this; and, moreover, California, not British Columbia, was credited with having produced such gold. Very little information could be obtained from the Chinese miners, who are naturally secretive, and seem to decline for the mere pleasure of doing so. From these causes then it was impossible to obtain actual statistics, and numerous estimates of the yield of gold have been made, many of which are extravagant. Of these the one made by the government is the fairest and most reliable. According to it the yield in gold from 1858 to 1885 was nearly fifty millions of dollars. This represents about 2,986,270 ounces or 248,856 lbs. of gold, or it may be represented by a solid pyramid over 18 feet high, with a square base whose sides are a little over 6 feet. Of this amount Cariboo is credited with having produced thirty millions of dollars, or considerably over one half. As an instance of how successful miners were in general at Cariboo, it may be stated that in the spring of 1861, 1,200 miners crossed Beny and Adelers bridge over the Quesnelle, on their way into Cariboo, of these some 19 soon returned discouraged, the remainder

returned in the fall bringing down altogether $1,500,000 worth of dust for their season's work.

I give a tabular statement from the sessional papers of 1886, shewing the yield in each year from 1857 to 1886. You may imagine, perhaps, that placer mining in this province has ceased, in doing so you would be making a great mistake, it has certainly fallen off very much from the yields in the palmy days, but this statement shews that the province still produces annually nearly $800,000 worth of gold. Many of the places which in the olden days were scenes of great mining activity have since, are now, and will yet be worked for many a year before they are exhausted, and worked extensively and scientifically too, for mining is a progressive industry, and with improved machinery, good roads, and lower freights and wages, the miner can still obtain a fair return for his labor.

And now, before closing this part of the paper, I would like to say a few words about the indirect benefit which British Columbia as a province has derived from the discovery of gold.

The history of most countries where gold in the form of placer deposits has been the first attraction has, so to speak, been intermittent, it has its periods of great activity when all have their golden dreams, and corresponding periods of depression when these have not been realized. The trade and commerce are increased for a time, it is true, and many thousands flock into the country only to leave it again, for the prosperity is only transient.

After a time, however, this ceases, the energy and perseverance of the population are turned into new channels, and new industries spring up. So it has been with British Columbia; the discovery of gold laid the foundation of an era of permanent growth and prosperity which will be added to as years roll by. All honor then to the early prospectors and miners to whom the country owes so much, they brought with them health, strength, pluck, and a perseverance which surmounted all difficulties, and had a useful career as pioneers in the wilds of British Columbia.

TABLE.

Shewing the actually known and estimated yield of gold; the number of miners employed; and their average earnings per man, per year, from 1858 to 1885.

Year.	Amount actually known to have been exported by banks. &c.	Add ¼ more, estimate of gold carried away in private hands.	Total.	Number of miners employed.	Average yearly earnings per man.
1858	$ 390,265	$ 136,088	$ 520,353	3,000	$ 173
1859	1,211,304	403,768	1,615,072	4,000	403
1860	1,671,410	557,113	2,228,543	4,400	506
1861	1,999,589	666,529	2,666,118	4,200	634
1862	3,184,700	1,061,566	4,246,266	4,100	517
1863				4,400	482
1864	2,801,888	933,962	3,735,850	4,400	849
1865	2,618,404	872,801	3,491,205	4,294	813
1866	1,996,580	665,526	2,662,106	2,982	893
1867	1,860,651	620,217	2,480,868	3,044	814
1868	1,779,729	593,243	2,372,972	2,390	992
1869	1,331,234	443,744	1,774,978	2,369	749
1870	1,002,717	334,239	1,336,956	2,348	569
1871	1,349,580	449,860	1,799,440	2,450	734
1872	1,208,229	402,743	1,610,972	2,400	671
1873	979,312	326,437	1,305,749	2,300	567
1874	1,383,464	461,154	1,844,618	2,868	643
1875	1,856,178	618,726	2,474,904	2,024	1,222
1876	1,339,986	446,662	1,786,648	2,282	783
1877	1,206,136	402,045	1,608,182	1,960	820
1878	1,062,670	⅕ 212,534	1,275,204	1,883	677
1879	1,075,049	" 215,009	1,290,058	2,124	607
1880	844,856	" 168,971	1,013,827	1,955	518
1881	872,281	" 174,456	1,046,734	1,898	551
1882	795,071	" 159,014	954,085	1,738	548
1883	661,877	" 132,375	794,252	1,965	404
1884	613,304	" 122,861	736,165	1,858	396
1885	594,781	" 118,956	713,738	2,902	246
			$49,385,866		

METHODS OF WORKING PLACER MINES.

Before going into the methods of working placer mines, it may not be out of place to say a few words about the occurrence of gold in the sand or gravel.

The commonly accepted theory is the destruction of pre-existing vein matter. Another theory is that through the agency of organic acids and alkalies, the gold is brought into a state of solution, and reprecipitated in other localities by organic matter, in the form of nuggets. Thus gold, though soluble only to a small extent, may in a geological sense be largely distributed in this way. But it is hardly within the scope of this paper to account for the origin of the gold, it is sufficient to say that the auriferous gravel—or pay dirt, as it is called,—is found in localities where it has been deposited in a sufficiently concentrated form (to repay working) by the following agencies, *i.e.* :—

(1) The present system of water courses.

(2) Older systems following the same general direction, and in some places coinciding with the present system.

(3) Still more ancient water courses nearly at right angles to the modern streams.

(4) By the action of glaciers.

By one or by all of these agencies combined, then the gold has been distributed, but particularly so I think in this country by the action of glaciers.

According to my idea, the presence of gold in the so-called Gold Range of British Columbia owes its origin to this course, that it formed the channel so to speak of one of these immense flows of ice, carrying the auriferous *detictus* from its source in higher latitudes, and then as the ice melted it was deposited with varying richness in the localities where it has since been found. Probably also this has been further assisted, both directly by the ancient streams before the Glacial Period, and indirectly by the modern ones since. At all events then the gold has been deposited under various circumstances, and at various levels, in the old channels, in the modern streams, on benches, in gulches and ravines, and in some places almost at the summits of the mountains, often only a few feet below the surface, in other cases buried under hundreds of feet of barren soil or emptive rock, and the objective point of the placer miner is to extract this gold. Being found then under so many varying circumstances, it is impossible to lay down cast iron rules for mining, for what would suit in one locality might not work in another. The general principals are however the same,

and I will now proceed to give a short account of how the miner accomplishes his end.

Placer mining may be divided into

Shallow Placers.

Deep Placers.

Shallow placers may be divided into wet and dry diggings, being the shallow beds of permanent streams, and dry gulches and ravines carrying water only during part of the year, and where bed rock is not more than say 12 feet deep. Mining in such localities is comparatively easy.

In *deep placers*, on the other hand, the pay dirt is often deeply buried in the soil, and it is sometimes at a considerable distance from water. The miner therefore labors under many difficulties, which necessitates the use of expensive, complicated, and ingenious machinery. It may be divided into

Hydraulic Mining.

Deep placer mining by hand.

The first requisite in mining is a plentiful supply of water, and if not on the ground it must be brought there by ditches and flumes.

The principal tools and appliances are as follows:—Picks, shovels, axes, drills, crowbars, hammers, miner's pan, cradle, derrick, pumps, water wheel, wheel barrow, sluice boxes, small car, hoisting bucket, rope, nails, crescent saw, whip saw, wing dam, etc. These are all brought into service in mining in one form or another, though in any one individual case they may not all be employed. The *crowbar* is used for removing boulders and other heavy objects. If the boulders are too heavy they may be reduced in size by blasting or with hammers, or they may be removed directly with a *derrick*.

The *miner's pan* is a very useful little instrument, it is made of pierced sheet iron, is circular in form, about 14 inches diameter on the bottom, 17-18 inches diameter on the top, and 5 inches deep. It is used for separating the gold from the gravel, by a sort of circular motion in water, by which the lighter sand and gravel drops over the lower edge, while the black and gold remains behind. The black magnetic sand is then removed with a blowing pan and magnet. The pan is also used for cleaning concentrates from the cradle, or for washing gold amalgam where mercury is used. It is especially useful as a prospecting tool.

The *cradle* is of more importance as a prospecting tool, but I give a description of it. It is a wooden box about 40 inches long, 20 inches wide, and 15 to 24 inches deep. It is mounted on rockers like an ordinary cradle, has a couple of cross pieces called

riffles on the inside of the bottom to save the gold, and is slightly inclined, say, 2 to 4 inches. At the upper end on the top is the hopper, about 20 inches square, into which the gravel is thrown, the bottom of the hopper is perforated to allow the sand and gravel to pass through, this falls upon the *apron* usually made of blanket, the nap of which catches some of the gold while the riffles catch the remainder. The lower end is left open so as to allow the tailings to run away. The dirt is shovelled into the hopper, the water is added with one hand while the rocking motion is given with the other.

Sometimes where there is much stiff clay, a *puddling box* is used. It is simply a box which may be of any size, has an auger hole 4 to 6 inches from the bottom. This hole is plugged up, the clay added, and it is then thoroughly puddled with water. The latter is now run off, leaving the sand and gold in the bottom of the box, and the gold is separated with the pan.

The sluice is formed from a series of boxes made from planks 12 feet long and 1 to 2 inches thick, it is 16 to 20 inches wide and 10 to 12 inches deep for ordinary placer claims, and larger for more extensive workings. These boxes fit one into another, the whole is then supported on trestles, and set at an inclination of from 3 to 10 inches per box of 12 feet, depending upon the character of the gravel, and the available grade which the ground will allow. The boxes are provided with riffles of various form to catch the gold. The gold in this country is generally coarse, and not very much quick silver is employed, when the latter is in use amalgamated copper plates are often set.

The *Wing Dam* is a dam to turn the water from the claim. It is started at the head of the claim on either bank, runs in a slanting direction across the stream till about ½ the width of the creek is taken in, it then runs straight down stream for the remaining distance. The whole is weighted with heavy stones to prevent it being carried away, and is filled in with soil and gravel to make it water-tight. The space within the dam is then worked, and the dam is finally changed over to the other side of the stream which is worked in the same way. The *water wheel* is used for hoisting and pumping purposes. In shallow places when used for the latter purpose, it is an undershot wheel which projects over the side of the dam into the water, and runs the pump which is attached on the inner side of the dam.

To work a shallow placer in the bed of a stream then, the wing dam is first built, the sluices are then set up, as is the water wheel

and pump when the latter is required. If an open drainage ditch can be built, the wheel and pump are unnecessary. The water is then turned into the sluice and the dirt and gravel shovelled in, the latter is carried away by the water, while the gold, from its superior specific gravity, sinks to the bottom and is caught by the riffles. The sluices are cleaned at intervals to obtain the gold.

In *shallow dry digging* the process is almost precisely the same, excepting that a wing dam is unnecessary, and water must be carried to the claim by ditches and flumes.

Deep Placers are the beds of permanent streams other than above, the benches adjoining them, and the channels of the more ancient streams, which are generally very rich. It can easily be seen that this description of mining must be very much more difficult than the working of the shallow placer.

I will first take up *Hydraulic Mining*, which may be defined as being that process of extracting gold from auriferous gravel, by means of water under great pressure, discharged through pipes and nozzles against the bank. It is absolutely essential that there should be:

(1) A plentiful supply of water under great pressure.

(2) Good facilities for grade and dump, by which the immense amount of tailings may be carried away.

As a general thing the richest deposit of gold is found immediately above and penetrating for a short distance into the slate forming the bed rock of the stream. A vast amount of barren soil therefore has often to be removed to get at the pay dirt; this can be done more economically by water than by any other means, and it is on this account that water is so largely employed by the miner as an aid, by means of which the gold may be extracted with profit to himself. The miner, having found a deposit of gold, has to explore it by means of shafts, drifts, &c., so that he may learn: 1st. The depth of the bed rock. 2nd. The width of the channel and extent of the deposit. He also has to ascertain how and where he may obtain a supply of water with a good working head. His next step is to choose the nearest available grade which can be given to the tunnel and the disposal of the tailings from the mine. The tunnel is then started and run to the desired spot below the deposit, being securely timbered throughout. The size depends upon the requirements of the work, and also upon whether the line of sluices is to be single or double, and it may vary in width from 5 to 10 feet, with a height of 7 to 8 feet. The tunnel, having been run well into the deposit or channel, has to be connected with

the surface by means of a shaft, which should as a rule be vertical though inclines are also used. The direct connection of the shaft and tunnel is a work requiring great care and caution, for it is often dangerous from caves and rushes of sand, gravel and water. The line of sluices must also be laid and securely fastened, and they must be strongly built to withstand the wear and tear consequent upon running such immense quantities of boulders and gravel through them. They are furnished with riffles of various descriptions made of wood, stone, or iron. Blocks of wood, 8 to 10 inches deep, make excellent riffles, they are firmly arranged in position on the bottom, with suitable spaces of from 1 to 2 inches between them. Round stones are used in the same way, and are durable and cheap. Longitudinal riffles covered with bands of iron to prevent wear are also used, but whatever the form of riffle may be the object is the same, namely, to catch the gold and amalgam, for mercury is generally used in Hydraulic Mining. It is usual also to build a side lining for the sluice. *Grizzlies* and *undercurrents* are built at intervals. A *grizzlie* is put in a place where a drop can be given to a line of sluices, a grating of iron bars is set which carries the large boulders away, and allows the smaller material to drop through, disintegrating the clay and freeing the gold. *Undercurrents* are sluices of 15 to 20 feet wide, and 30 to 50 feet long, set at a very slight grade, and provided with riffles to catch the gold and amalgam, the sluice discharges into the undercurrent at the top, and again takes up the flow at the bottom. Some of these lines of sluices are of great length, as much as a mile or more. The water must also be conveyed to the claim by ditches or flumes, often from sources many miles distant, and sometimes also large dams require to be built to store the water for the dry season. The water is brought to the pressure box, usually situated on some neighboring hill, or high point, and from there is conveyed in wrought iron pipes to the bank where it is to be used.

The usual style of nozzle is the *Monster* and *Little Giant*; they have a ball and socket joint, enabling them to be turned in any direction. Everything being in readiness, then, the water is turned on, and washing through the shaft begins, this has to be done carefully at first to avoid rushes and caves, and a uniform slope to the mouth of the shaft must be preserved. As the washing progresses the timbering in the shaft is removed, till finally bed rock is reached when the claims may be said to be opened. As this bank recedes the tunnel or ground sluices leading to it are advanced. Immense quantities of gravel are in this way passed through the sluices, as much as 9,000 to 10,000 cubic yards per day.

The cost of washing averages about 4 cents per cubic yard, and gravel yielding 10 to 20 cents per cubic yard may be profitably worked. Water used in this way has tremendous power, will lift large boulders as if they were little pebbles, and carry everything before it. An anecdote, about one of the Hydraulic Mines in the States, illustrates this very well. They were introducing the Little Giant nozzle which has a ball and socket joint. Through some mistake this got away from the miner in charge, it began whirling around, killed 2 or 3 men, and levelled everything in the vicinity before the flow of water could be checked. Derricks run by a *Hurdy Gurdy* wheel are used to hoist boulders out of the way.

Water is also used for generating electricity for lighting purposes

I mentioned that it was necessary to obtain good dumping ground for the immense quantities of tailings. Ordinary streams would soon and actually do become choked up, and this method of mining has now become illegal in many of the Western States, because the rich farming land in the bottoms and valleys was rapidly being ruined by the rush of gravel from the mines in the hills. After a clean up, which takes place every 2 or 3 months, the gold amalgam is squeezed in canvas or buckskin bags, to rid it of the surplus quicksilver, and the remainder is retorted, cast into bags of bullion, and stamped with the companies' name.

Deep Placer mining by hand is resorted to when from various causes Hydraulic mining cannot be employed. It consists essentially in reaching the pay dirt by means of drifts and shafts, or both combined. The water is removed and kept under control by pumps, and the dirt is hoisted to the surface, where it is washed in sluices as before. In deep placer mining the miner has to overcome many difficulties. He may be troubled by water coming through porous strata, or he may strike a layer of quicksand, the timbering in the shafts and drifts must, therefore, be strongly, securely and tightly built, for the life of the miner may often depend upon it. Large water wheels also often require to be built, they are used for hoisting water, and are furnished with buckets which carries the water up, and empties it into sluices, one such wheel on Quesnelle River is 60 feet in diameter.

Sometimes also rubber hose is suspended across large rivers, to convey a supply of water to a desired point. One company in the vicinity of Clinton has an appliance of this kind crossing the Fraser River. Great ingenuity is exhibited by the miner in overcoming the many difficulties against which he has to contend, and in this country they have not been backward in this respect. As

an instance of this, it is related that a California miner came up to Cariboo with the intention of introducing new and improved machinery, which he thought would revolutionize mining in this country, but after seeing the appliances in use, he returned saying that they had never had machinery equal to it in California.

Having thus given a retrospect of placer mining in British Columbia, and also a rough description of how such mines are worked, I will now pass on to mining proper, or *vein mining*. As an industry this is much more important than the transient prosperity produced by placer mining. It is lasting and durable, employs a large number of men, circulates a large amount of money, and extends trade and commerce; it fastens old industries and establishes new ones, and is an important factor in the general prosperity and wealth of any country. How important it is then that outside people should have some idea of our mineral wealth. As an industry in this province it is still in its infancy, and I therefore, only intend giving a short description of such localities as have been discovered within the last few years, and are supposed to be rich. These places are as follows:—Nicola Valley, Rock Creek and vicinity, Lillooet, North and South Kootenay, Cherry Creek, Cariboo, vicinity of Kamloops, Yale and Hope.

The Nicola Mines are situated on Stump Lake, about 30 miles south of Kamloops, with which place they are connected by an excellent wagon road. The mines were discovered about 5 years ago, and the Nicola Mining and Milling Company was organized to develop the claims. This company expended about $12,000, and during last season sold their property to a company of English capitalists, who so far have expended a large amount of money. They intend pushing their explorations rapidly during this season, and if the mineral increases in quantity as it now is doing, they will undoubtedly erect smelting and reducing works for which suitable land has already been secured. This company is said to have $20,000 of ore on its dumps.

Several other companies are also at work in this vicinity, among these are:

Messrs. Henderson & Patterson.
" Wright & Fletcher.
" Hepburn, Wilson & Dunsemin.
" McCullough, Jones & Deardon.
" Wilson & Turner.

These gentlemen have a large number of claims, on which a considerable amount of work has been done; and, judging from the

quantity of ore extracted, they possess valuable properties. The minerals found are silver bearing, though gold is also found; they are as follows: Galena, Grey Copper, Copper Pyrites, Carbonates, &c.

The *Rock Creek Mines* are gold bearing, and were discovered in May, 1887, they are quite close to the International Boundary, and only some 12 miles from the old placer mines on Rock Creek. The ore on the surface was free milling and showed gold visible to the naked eye, as they worked down on the deposit this gradually changed into sulphurets which, though equally rich, are more difficult to work. A working test from a quantity of ore sent to San Francisco gave returns of $62 to the ton in gold.

Several companies have been organized to work these ledges, among which are prominent business men of Victoria. The Standard Oil Company of New York is also interested. A considerable amount of work has been done during the past season, and the probability is that during the present year a move will be made to bring machinery to the ground. Mines have also been discovered on *Boundary Creek* and on the *Tulimeen River* which appear to be equally valuable.

The *Lillooet Mines* are situated on Cayoose Creek, about 15 miles from the town of Lillooet, and were discovered during the latter part of last season. The ledges are gold bearing, and some 30 claims have been located. Several companies have been organized to develop the mines, which must be rich, as very good offers for some of the claims have already been made. One offer was that a particular company should bond its property for six months for $250,000, for which a 1-7th interest was to be given. Good offers to start stamping mills have also been made. The quartz is said to show *colors* almost everywhere when crushed by hand and washed.

North Kootenay includes Illecillewaet, Big Bend, and the mines in the vicinity of Golden.

I will first take up the *Illecillewaet Mines*, which are situated in the vicinity of Illecillewaet station. The Selkirk Mining and Smelting Co. have erected sampling works, from which they have shipped some 300 tons of ore to smelting works at Omaha. The products of the mines are silver bearing ore, principally Galena and Grey Copper, the latter being exceedingly rich in silver. The average value of the ore by the carload is 70 ounces of silver to the ton and 44 per cent. of lead. This company has expended a large amount of money, and employed many men in opening their mines,

building trails, offices, mills, etc., and deserve great credit for their enterprise. They intend to build a cable road as soon as possible, so that the ore may be quickly carried from the mines to the railroad. Messrs. Corbit & Kennedy, who were the discoverers of these mines, own a number of claims, and have also organized a good company to work them, most of these ledges shew large bodies of ore, and look very promising. They intend pushing the work during the coming season as rapidly as possible.

Captain McCallam has a number of claims on Cariboo Creek in the same vicinity, which are said to be equally rich. Altogether some 225 claims have been located in this vicinity, and quite a town has been built at Illecillewaet Station.

About *Big Bend Mines* I can say very little, they are said to be rich, and produce both Galena and Gold, and I have seen some very fine specimens of the latter. There must be good indications of mineral, for several prominent members of the Canadian Pacific Railway have bought interests in one of the mines.

Mines have been discovered on the *Spellumcheen River* about 40 miles from Golden, and also on *Jubilee Mountain*, about 15 miles from the former place. The *Gold and Silver* Mining Co. have been pushing work, but met with an unfortunate accident last summer, in the shape of a destructive, fire, which burnt their mill, offices, etc., and destroyed much valuable property. This has delayed their operations, but they mean to go on again this summer. These mines produce low grade ore, but the ledges are large and will counterbalance this by the quantity of ore which can be extracted.

In *South Kootenay*, silver bearing ledges have been discovered in the vicinity of Fort Shepherd. They are situated on *Toad Mountain* and the *Pend d'Oreille River*. Assays have been obtained, going as high as 1,600 ounces of silver to the ton, and they are said to be the richest mines yet discovered in British Columbia, but this at present can only be a surmise.

Cherry Creek Mines. In this locality two ledges have been discovered, one silver bearing, the other gold bearing. The silver bearing ledge crosses Cherry Creek, just in the vicinity of the old placer mines. Assays of mineral from this mine show it to be extremely rich. I myself made one giving some 1,205 ounces of silver to the ton, and a working test from 2 tons of ore shipped to San Francisco gave 625 ounces of silver to the ton. About 12 miles from the above mines is situated the gold bearing ledge known as the McIntyre ledge, from its discoverer and principal owner. It is, I think, a good property, shews gold in several places visible to

the naked eye, and *colors* can be obtained almost any place by crushing and washing the rock. A good wagon road has been built to these mines.

The *Cariboo Quartz Ledges* have been known for many years, but the greater portion of the work has been done within the last few years. The two principal companies are the British Columbia Mining Co., on Lowbee Creek, and the Island Mountain Mining Co., on Jack of Clubs Creek.

Both companies have done a large amount of work, and the latter company has machinery on the ground, which they hope to have in running order during the coming season.

Several very promising ledges giving good assays have been discovered up the *North Thompson River*, only a short distance from *Kamloops*, and money has been raised to explore them.

In the vicinity of Yale and Hope, a number of ledges have been taken up, and a considerable amount of work done. These ledges have been examined by I. H. Collier, a mining expert from England, and his report is very favorable to them.

The province then possesses mineral deposits in many different localities, which bid fair in a few years to become very valuable. This being the case, it may very reasonably be asked how it is that so little has been done towards the development and working of these ledges.

The delays may be accounted for as follows: Previous to the completion of the Canadian Pacific Railway, the province was out of the regular line of travel, few strangers therefore visited the interior, and the miners were practically unknown to the outside world, the married men of the Province then had to bear the burden of the work, and with their legitimate business to manage they could risk, comparatively speaking, only a small amount on development of mines.

The discoverers of the mines were almost without exception poor men, and they had either to struggle along as best as they could, doing what was required by law to hold the claims, or else they had to obtain help from monied men, which is often a difficult matter when both man and mine are unknown. Miners themselves are also somewhat to blame, in many cases they are given to exaggeration, and often represent their claims as being richer than they possibly can be, and the probability is that in most cases they do this in perfect good faith. This naturally makes men of capital chary and cautious about investing money in an enterprise, where in addition to the ordinary risk there may also be deception. Might I on this

point then give a few words of advice, the discoverer sees wealth and fortune before him and is carried away by his excitement. Let him then when seeking assistance to work his mine try to give a cool, just, fair, and dispassionate statement of what he believes his property will produce, and I venture to say that the capitalist will be more impressed by his common sense, cool judgment and earnestness, than if he presented the subject in a dazzling light, which, at first, takes the fancy, but on more mature consideration must appear fanciful and unreal.

The mining laws of the Province have in one particular been somewhat defective, and when I say this, I have no intention of blaming the Government, for it is impossible to frame laws which will be perfect from the start, changes must be made when required, and they have always displayed a desire to make such changes when shewn that they were necessary. I refer to the regulation which specifies that a certain amount of work (now $100) should be done for a stated number of years on *each* claim to hold it. The result of this law was to hold the miner to do a little work on each individual claim, which practically had no effect whatever in developing the property. Now, however, this is changed, and permission may be had by a company holding claims on the same ledge to do the specified amount of work for a number of claims on a single one, which certainly shews in a much greater degree what the claims, as a whole, are worth, and is a direct encouragement for capitalist to invest.

These delays then have created doubts as to whether British Columbia will prove to be a profitable mining country or not. But these doubts are gradually and surely disappearing. With improved facilities for travelling since the completion of the Canadian Pacific Railway, many men experienced in mining affairs have visited the province, and the favorable opinion expressed by them is having a good effect, capitalists are now beginning to invest money in the mines of the country, and British Columbians may look forward with hope and encouragement to a time in the near future, when these doubts will have been wholly dispelled by the successful working and development of one or more of its mines.

In conclusion, let me say that I have as far as possible restricted this description of the mineral wealth of the province to what I believe is a plain statement of facts. Nothing I think could be more hurtful to an industry now in its infancy than a willful misrepresentation or exaggeration.

Mining affairs in this country have now arrived at that stage when

examination of its mines is courted and invited. Let us hope then that capitalists will visit the province, see its mines, and judge for themselves, and if they do this I have little fear but that their opinion will be favorable.

I trust then that my paper will have been of some little service to you as an association, and that it may be the means at least in some slight degree of directing your attention to the capabilities of British Columbia as a mining centre, which will, I think, soon be of importance to our Dominion in general. The subject is an important one, and if in more capable hands than mine, would, I feel satisfied, prove an interesting one also. The paper has assumed dimensions far beyond what I had originally intended it should, a great part of it is taken up with descriptions of mining scenes long since passed by, and it might perhaps have been better either to have suppressed this first part altogether, or to have divided the subject and taken up part in the future; but in thinking over the matter, I decided in my own mind, that this could hardly be done, for one event leads on to another from the finding of the placer mines in the olden days to the discoveries of quartz ledges in comparatively recent days. I can therefore only apologize for taking up so much of your valuable time, and could I only feel that I had presented the subject in an interesting form I would be amply rewarded for my trouble.

THOMAS DRUMMOND.

DISCUSSION.

The PRESIDENT, E. J. RAINBOTH, made some interesting remarks on Phosphate and other mining in the vicinity of Ottawa.

J. S. DENNIS corroborated Mr. Drummond's statements concerning Mining in British Columbia, and added some interesting items from his own experiences.

RELATIONS BETWEEN MASTER AND MAN ON A SURVEY PARTY.

I would like to bring before the notice of our Association a subject which is of interest to our Profession, and as I am not certain of being present at our Annual Meeting, I take this method of expressing my opinions. As the proposition which I am about to make aims at increasing the efficiency of the survey party in the field, I am sure it will receive a respectful hearing from the members of the Association.

Every surveyor knows that the amount of field work, and to a considerable extent the quality of that work, which he can accomplish in a given season, depends largely upon the personal of his party, with respect to the competency of each man to do his work, the degree of alacrity with which he does it, and the general harmony and good will existing between the chief and his subordinates. It is very desirable that at the outset, each member of the party should know what his duty is, at least what his routine duties will be throughout the campaign; and it would be of great service to the surveyor to be able to show definite authority for the orders which he is giving or the discipline which he is enforcing. As it is, at present, each survey party is, to a great extent, "a law unto itself," and while the surveyor in charge is striving his best to proceed according to the best traditions of the profession, members of his party, especially green hands, think he is acting arbitrarily or capriciously; they think he is driving them harder than there is any need for, perhaps "to get his name up" in the Department, as being a great worker, and thus they resent his attempts to make the party do its honest duty, as an attack upon their rights. Being on Government work, they think they may take it easy, and that it is all the same whether much work or little is accomplished.

I believe this state of things would be materially remedied if the traditions and unwritten laws and regulations which govern our practice were reduced in writing to a concise Code of Regulations, to be approved by the Department of the Interior, and inserted in the Manual of Dominion Land Surveys, as being applicable to the survey parties in their employment. These regulations would then be made part of the "agreement" between the surveyor and each member of his party. In this way, every one would, from the

beginning, know what he had to do and what he had to expect, and the surveyor relieved of the unpleasant task of, from time to time, promulgating laws which seemed to be supported by no authority but his own *ipse dixit.*

Contract surveyors also, when engaging men, could make these regulations part of the agreement of hiring.

I think the better way would be the appointment of a committee at the Annual Meeting now being held, who would undertake the work of preparing these regulations, and report at the Annual Meeting in 1889. It might be desirable, however, that the report should be printed and distributed to members beforehand, so that it could be intelligently discussed at the Meeting. I would be willing to act as a private member of such a committee; for chairman, we should have some one who has had a large experience in the North-west.

In order so make myself more clearly understood, and to excite some interest in the subject, I beg to submit the following scheme of regulations for the consideration of the Association, or of any Committee that may be appointed. Being a first attempt, it is necessarily crude and imperfect; it needs extending and filling up, and probably changing and correcting, but it is at least something tangible to put before the Association.

Yours very sincerely,

JOHN McAREE.

REGULATIONS FOR THE GOVERNMENT OF SURVEY PARTIES IN THE FIELD.

The Surveyor.—In issuing his orders he shall not use unbecoming language.

As he is responsible to the Government, each member of the party is responsible to him, and it is his duty to have a constant oversight of all the work that is being done; in this way he will be able to correct errors in methods of working, and make every one more proficient.

The Assistant.—The Assistant shall be diligent in learning his duties, and in acquiring a competent knowledge of every branch of his work. He shall assist his chief in all the labors of the latter, when so requested; take the responsibility of the party and of the work, in his chief's absence, uphold his authority, and in every way shew himself to be solicitous for the success of the expedition.

The Chainmen.—The rear chainman keeps the field book; if

required by the chief, he must copy out his notes in ink, in resting hours; he is responsible for the care of the chain, for the correct making and planting of posts, marking bearing trees, placing of mounds, &c., and for the correctness of his measurements.

The leading chainman is responsible for the "arrows," sometimes he will have to carry the lunch for the field party; in a timbered country he may have to carry an axe to make posts, blaze bearing trees, &c. He may be required to leave his chain and go on the line to blaze or cut it out, build mounds, &c., in moving camp he may have to carry a pack, in short, be required upon emergency to do anything required of a laborer.

The Picketman.—In clearing the line through timber, the picketman keeps up sufficient pickets at all times to show the axemen the line, and directs the operations of the latter to prevent unnecessary chopping, to see that the requisite blazing is done, and that the line is sufficiently opened out above and below. In camp, he sees that the men grind their axes, mend harnesses, &c., and that everything is got in readiness for the exact work to be undertaken; the picketman is in short the foreman of the laborers of the party.

The Laborer.—The laborer must be diligent to make himself a competent workman, so as to become expert in chopping out the line, building mounds, managing horses, &c. He is responsible that the tools or implements with which he is working are kept always in good working order.

The Cook!!—The cook must take charge of all the Commissariat supplies and furniture from the first day of the expedition to the last. He is responsible that the supplies are kept in good condition and for their economical consumption. He must be careful that the supplies in the depot, in the carts, &c., are sufficiently protected against the weather, against the ravages of animals, &c.

When they are being transported, he must see that they are properly stowed, so as to avoid loss or damage during transit. For this purpose, the men must obey his orders and carry out his instructions. In the use of the supplies he must use his best skill and judgment, must avoid waste and extravagance, and always know how long the provisions on hand will last. He must fetch and cut his own wood, and fetch his own water, unless the distance from camp is too great, or when the party is on the march.

He is chargeable with the general care of the camp, when left alone with it, and at such times must look after the horses, if possible. When lunch is to be taken out to the field by a party, he

must have it ready, so that they shall not have to wait for it. He must, if required, have breakfast ready at a stated hour without having to be called up in the morning, and he should provide himself with a time-piece.

GENERAL AND MISCELLANEOUS.

Every member of the party is responsible for the care of the property of the Government or of his chief committed to him, that it be not lost, or injured, and that it be kept always in good serviceable condition.

Only a limited amount of baggage will be conveyed for each man, and the surveyor may inspect each man's outfit to insure that he has proper and sufficient clothing, etc., for the campaign, and that no useless articles are taken.

To the assistant will be allowed lbs. baggage.
" chainman " " " "

To any other member of the party will be allowed lbs. baggage.

No one shall take firearms unless by the consent of the surveyor in charge.

Grinding of axes, spades, etc., helving of axes, etc., making new helves, etc., repairing harness, greasing cart axles, etc., marking posts, tins, etc., repairing any part of the outfit, etc., must be done during spare time and resting hours, as on rainy days, at night, etc.

The horses should be looked to every day, to prevent straying, to recover any that may be cast, mired, etc., also to ensure that they can get water. The men take this service in rotation. The only member of the party exempt being the chief and his assistant, the cook and chainman who keeps the fieldbook, except that when the cook is alone in camp, he must look after the horses as well as he can.

Every one must be ready for breakfast when it is announced, and ready for the service of the day when the meal is concluded. If going out on the line or on other work, he must have his instrument, chain, axe, spade, cart, horse, or whatever he is to use, made ready and fit for immediate service, before breakfast, and the cook must have lunch put up by the time the field party are ready to start.

On the march or when moving camp, all hands arise together in the morning, and proceed to pack up and load up, and get *en route*, working without intermission, except for eating breakfast. If horses are being used, one or two hands will be dispatched for

them, while the packing up is being done, and the baggage of these will be packed up by their comrades in their absence. The horses must be brought in in time to be ready when the camp is ready to move, even if those who fetch them have to turn out much earlier than the rest of the camp.

Each man who drives a team is responsible for the care of his horse and cart, and of the goods comprising his load. He must see that the harness is kept in repair, and that it does not gall or hurt the horse; that his cart axles are kept lubricated, that the goods composing his load are protected against the weather, and properly stored, etc., so as not to be damaged or wasted in transit. The driver of a loaded cart must not ride upon it.

After the tents are set up the horses must be taken care of, all about the carts made snug, and the out-door work generally attended to, before any one proceeds to attend to his personal comfort.

On the march the men must fetch wood and water for the cook; this is a general rule.

SUNDAYS.

Since Sundays are counted in among the days for which pay is allowed on survey parties, every member of the party is under obligation to do his share of the necessary work on that day, such as the care of the horses, taking astronomical observations, travelling in exceptional cases, and even working on the line, in extreme cases.

Hours of Labor.—With regard to this matter, it is to be borne in mind that as there is generally of necessity a good deal of lost time, from rainy weather, etc., during the time the party is under pay, this lost time should be made up by working extra hours at other times.

Advances on account while on the Survey.—Unless a special agreement has been made, an employee's wages are not due until the completion of his period of service. Any advances he may receive from the surveyor, before he is finally paid off, is an act of grace on the part of the surveyor. After serving one month, however, he may demand advances from time to time, sufficient for the actual necessities of clothing or medicine while engaged.

Small Parties.—On small parties numbering no more than five or six all told, every member of the party below the surveyor must assist in the general work, driving and taking care of the horses, fetching them in the morning, etc., loading and unloading, cutting wood, etc., etc.

JOHN McAREE.

DISCUSSION.

At the close of his paper, Mr. McAree stated that as it was the intention to appoint a Standing Committee on Land Surveying, he would be quite satisfied if the matter were referred to the same instead of appointing a special committee.

The President recognized the usefulness of Mr. McAree's remarks upon the examination of baggage, also with regard to fire-arms.

Otto J. Klotz thought that it was impossible to define any man's duties; that if a surveyor were a greenhorn, he would be humbugged anyway, rules or no rules. He did not think that any rule would make a man more serviceable than he naturally was. He did not believe in contracts, except to scare the men employed. He believed in hiring every man as a laborer.

G. B. Abrey said he also believed in hiring every man as a laborer, and did not think that rules could be made to govern their service, but that they should do anything required of them.

Dr. Bell thought there should be some such rules or record, and told an interesting anecdote illustrating the same, and bringing up the question of whether a man if discharged should have his transport to civilization supplied and paid for. Dr. Bell agreed with Mr. McAree in the matter of firearms, and also on the point that the men should work while there was work to be done. He said that example went a long way, and that the surveyor should not be too proud to do anything at all, and so set a good example. He denounced the fact of assistants being forced upon the chiefs of parties by the Government as supplying incompetent men and loosening the surveyor's control over the party.

T. D. Green said that he also had had quite an experience with Government Assistants, for though told that they could discharge them if found incompetent, still every surveyor would think twice before doing so.

J. S. Dennis agreed with Mr. McAree in some respects, in others, not. He agreed with Mr. Klotz and Mr. Abrey that every man should be prepared to do anything he was told. He thought, however, that some such suggestion as Mr. McAree had put forward might be carried out. With regard to payment of men referred to by Dr. Bell, he thought the legal aspect of the case as understood, required you to return the man to the place he was taken from, and that it was the custom of the Department of the Interior to do so. He agreed with Mr. McAree about not having more baggage than absolutely necessary, and if some certain quantity were the rule it

would strengthen the Surveyor's hands in managing his men. As to firearms, he agreed altogether with Mr. McAree. He doubted if it could be embodied in the Manual of Survey, but thought it might be used to advantage if a memorandum were issued by the Association.

G. B. ABREY told an incident of discharging men in the North-West, and of being summoned before Stipendary Magistrate Richardson for wrongfully discharging them, on the ground that they had been engaged for the season. He was compelled by the magistrate to give them an extra month's pay.

Resolution No. 25 referred the subject of Mr. McAree's paper to the Standing Committee on Land Surveying, to be reported upon at the next Annual Meeting.

MR. MCAREE signified his satisfaction at this course.

METHODS OF DETERMINING GEOGRAPHICAL POSITIONS.

The title I have chosen covers a very wide extent, too wide, in fact, to be fully treated in a short paper,—a volume, or many volumes, would be filled before the subject was exhausted. It includes the whole science of geodesy as well as astronomy, the description of the instruments used in measuring angles, the practical methods of observing the angles of a triangulation, the measurement of base lines by means of the fine modern appliances, measurements by chain, surveying and astronomical instruments of all kinds and their use, the determination of the general figure of the earth and its local irregularities with all the mathematical processes and physical investigations connected therewith, all these are involved in a full treatment of the subject.

In the present paper, however, I intend to confine myself to a few brief notes upon some of the methods, by which the latitudes and longitudes of places may be found with sufficient accuracy for the purpose of ordinary map making.

A glance at the map of Canada shows how little is accurately known of the geography of the vast interior. Main routes of travel appear merely in skeleton form, roughly sketched in, miles perhaps out of their proper position; while off these routes nothing is known, the map is a blank.

It would be well that all travellers, whether on business or pleasure, should endeavor to obtain as much accurate information as possible of the geography of the country traversed. My object in writing this is to mention a few of the more convenient methods by which, with little trouble, with the help of simple instruments, such information may be procured.

The necessary instruments are a good watch and a surveyor's transit theodolite, having a vertical arc. For the latter a sextant

or reflecting circle with an artificial horizon may be substituted, and is preferable on account of its greater accuracy, portability, and rapidity and convenience in using. Those, however, who have to carry an angular instrument for other purposes will use it for their observations in preference to carrying an additional instrument. With the theodolite the reading of the two verniers in each case cuts out, in the mean, the eccentricity of the verniers. With the sextant of the ordinary pattern, having but one vernier, this is not the case. It is, therefore, necessary to test the sextant by reading angles measured also by other means, so that the actual error of each part of the arc may be tabulated and applied as a correction to angles read with the vernier. Uncertainty that the eccentricity remains constant affords the chief objection to thef sextant. A variation will occur at every reading from the drag o the vernier, the action of the tangent screw, etc., unless the fitting of the centre is very good.

The reflecting circle having two verniers avoids this cause of error. The reading of the two verniers moreover, cutting out accidental error of the reading, makes it possible to get results equally as good as given by the large nautical sextant, with a much smaller and, therefore, more compact circle.

A high power telescope is advisable on a good reflecting circle. Most reflecting instruments are not furnished by the makers with telescopes of sufficient power.

Both the reflecting instruments and the transit theodolite are subject to index error. In the former this is readily found by observation of the coincidence of images at the zero point. With the theodolite it can be found by a second observation of the altitude of the object in the reversed position of the telescope; but this in the case of an object which is observed at its highest altitude may lead to error by reason of the object having passed its highest point, and being at a lower altitude at the time of the second observation. It may also be found by readings in the two positions of the altitude of a terrestrial object.

The latitude of a place may be very readily found. The simplest method is that by meridian altitude of the sun or a star. The observation is made by following the object until its highest altitude is reached, when the angle read gives the meridian altitude.

Observation of the altitude of the pole star at a known time is a good method. Stellar observations give better results than those on the sun, on account of the better definition of the object given by the telescope.

When the latitude is required with greater accuracy, a number of observations of the sun or a star may be taken near the meridian, noting the time of each observation. The observations are then reduced by the method of "circum-meridian altitudes." A really accurate result can only be got by star observations, taking complete altitude observations on two stars,— one north of the zenith and the other south, the two stars having as nearly as possible the same altitude. The mean of the results cuts out errors in refraction as well as constant instrumental errors, such as the eccentricity, also periodic error of graduation.

Observations on the sun should be taken on each limb of the sun in succession to eliminate enlargement of the sun's apparent diameter or indistinctness, arising from low optical power of the telescope.

The method of circum-meridian altitudes for latitude, as well as that by altitude of the pole star at any time requires a knowledge of the time, which, therefore, must be found by observation. Observations for time must also be taken, whenever the longitude is desired, by astronomical observations. We, therefore, pass to some methods of determining it.

The simplest method is by altitudes of the sun or a star. The object should be as near the prime vertical as possible, without being near enough to the horizon to introduce unknown or variable refraction. When possible two stars should be observed east and west of the meridian, for reasons similar to those given above for the use of north and south stars for latitude.

Equal altitudes of the sun before and after noon, or before and after midnight, is an excellent method with the sextant. Equal altitudes of stars is too difficult an observation to be recommended at least with the sextant.

For latitude observations it is not necessary to know the time very closely, but in longitude determinations the error in the time appears directly, so that all possible care should be taken to secure accuracy in the observations.

From an observed altitude the time may be calculated by the usual spherical formula for the sine of half the hour angle in terms of the sides of the triangle, but the work may be shortened by using, with subtraction logarithms, the formula

$$\cos t = \frac{\sin h - \sin \phi \sin \delta}{\cos \phi \cos \delta}$$

where t is the hour angle, h the altitude, ϕ the latitude and δ the declination.

I may here remark that as far as the sun is concerned, an almanac may be dispensed with by using a table given at the end of Bremiker's Logarithm Tables, a book which is in the possession of a good many Dominion Land Surveyors. This table gives, by a simple interpolation, the sun's declination and semi-diameter, and the equation of time, for any day of any year.

Similar tables might, perhaps, be constructed to give the right ascensions and declinations of fixed stars with sufficient accuracy for most purposes, since the principal terms of the corrections for precision, mutation and aberration by which the mean places of stars at any epoch are reduced to apparent places at a given date, either vary directly as the time, or have a yearly period, or have a nineteen year period. Hence tables might be constructed, giving for some epoch the mean places of the principal stars, and the corrections to be applied for certain years and certain days of the year. There would be two or three interpolations however, and so the almanac would be preferred.

With the transit theodolite, time may be observed by meridian transits, but unless great accuracy is wished for, this method will be found less convenient than the method of altitudes, on account of the longer time which the observation usually takes. A similar objection will apply to transits over the prime vertical for latitude, which is a very accurate method and one which can be used when there is no vertical circle, or only a very small one, on the instrument. Nothing is gained by it in accuracy, unless the striding level is sufficiently sensitive to give a reading less than the reading of the vertical circle. Needing some calculation to prepare for the observation, and necessitating a long after calculation to give the results, this method can hardly be considered suitable for a rapid survey. The time, moreover, must be known very accurately.

If the watch can be relied upon to keep a steady rate, the local time, given by observations, gives by comparison with the watch-time of the reference meridian the difference of longitude from it. Time pieces usually have a different rate during travelling from what they have when stationary, the difference being frequently very considerable. Hence care must be taken to properly determine the travelling rate, by observing twice at the same place before and after the journey. If during the trip a stay is made for several days at one place, the watch then remaining at rest, it is

well to observe at the place as soon after arrival and as soon before leaving as possible, so that the stationary rate so found may be separated from the travelling rate.

With care, very good longitudes may be got by this method. Two or more watches, however, should be carried if the best results are wished for, as the rate is liable to irregularities from changes of temperature, jolting during transport, etc.

There are several methods of determining longitude by lunar observations.

1. The method of lunar distances with the sextant. This method is subject to the principal defect that the low magnifying power of the sextant telescope gives an imperfect definition of the moon's limb, making the moon appear larger than it is. This error is eliminated by taking the mean of a number of observations before and after full moon. This necessitates a stay of several days at a place. The calculation to obtain the longitude from the observations is long. It is difficult to get a result true within some miles by this method.

2. The method by moon culminations, or transits of the moon over the meridian. This method is much more accurate than lunar distances, and is the best method usually available, as well as the simplest. Observations on both sides of the full moon are necessary in this method also for the best results.

3. The method by occultations of fixed stars by the moon. This observation consists in noting the time at which the star disappears under the moon's limb, and again when it reappears. The observations can be made with great precision. Unfortunately occultations of stars of sufficient brightness to be observed with an ordinary telescope occur but seldom, and an intricate calculation is necessary to obtain the approximate time of occurrence for the purpose of preparing for the observation. The method is well worth trying however, should a star of the third or fourth magnitude be occulted. Fifth and sixth magnitude stars will be found rather small for ordinary telescopes. I hope to give, at some future time, a method by which the calculation for prediction can be shortened and simplified.

Eclipses of the sun and moon may be used for longitude, but accurate results cannot be got from them.

Eclipses, occultations, and transits of Jupiter's satellites may also be employed, but this method also is not capable of much precision.

Another method is the comparison of time at two places not

very far apart by visible signals, such as the bursting of a meteor, flashes of gunpowder, etc.

Where the electric telegraph is available, it furnishes the most accurate method known for comparison of the local times at two places to give their difference of longitude. The various refinements used in connection with this method when the highest precision is aimed at, such as the sending of signals in opposite directions, equalization of resistances, etc., may be dispensed with, and a result obtained from the receipt of a simple hand signal made at the further station which will be more accurate than any of the other methods can be made without very long continued observations.

This method is particularly applicable along the C.P.R. main line in Ontario, where the country has not been surveyed, and maps, even of the country along the railway line, are not reliable. The time is telegraphed from Montreal to each station every day. On the whole it appears that the methods most within the means of travellers are the simple methods of latitude by meridian or circum-meridian altitudes, or altitudes of the pole star, and longitude by the carrying of watch time from some known place. Lunar observations to be taken when remaining some time at a place.

Longitudes may be very well laid down by means of even the roughest kind of track survey when it is properly checked by latitude observations. The plan adopted by myself in several rapid track surveys was to stop at noon, wherever I might be, and observe the meridian altitude of the sun with the reflecting circle and artificial horizon, the whole observation, with the unpacking and repacking of the instruments, occupying less than ten minutes. Then at night two or three altitudes of Polaris and the same of a star on the meridian south of the zenith gave a good latitude, while stars east and west gave the watch correction. By means of the latitudes and longitudes thus obtained, the roughly observed intermediate bearings and distances were checked in, affording a very good sketch of the route. The intermediate courses may be put in either by pacing, odometer, estimation of speed of travel, micrometer measurement, or any method which the character of the country and the quickness of travel renders available.

W. F. KING.

ELECTRICAL APPARATUS IN THE DETERMINATION OF LONGITUDE.

Of the various methods for determining longitude, that by means of the electric telegraph is pre-eminently the most accurate.

In nearly all the other methods, the moon is the chief factor, and of all celestial bodies the moon is the most difficult for investigation.

Hence, whenever a longitude determination is to be made of a place which is connected by wire with some known point, the telegraphic method is always used.

The principle involved is simple. One observer is stationed at each of the two places, where, by means of a transit instrument placed in the meridian, he observes the transit of north and south stars from which he deducts his chronometer correction, that is the local sidereal time.

By means of the electric telegraph the time of each chronometer for an absolute moment is obtained, and this combined with the chronometer correction of each gives the difference in time between the two places, which is equivalent to the difference in longitude.

Were the instrument placed exactly in the meridian, its axis level and no collimation error, then the difference between the apparent right ascension of the star and its time of transit, as noted by the chronometer, would be the chronometer correction; but as these conditions can never be fulfilled, it is necessary to determine the instrumental errors.

In preparing the programme of stars for the past three years for the longitude work, I have adopted the following scheme: Each programme consists of twenty stars, in four sets of five stars each Each set has one polar and four time stars,—the former for the determination of azimuth and collimation errors, the latter for the chronometer correction. The instrument occupies the four positions,—clamp east, clamp west, clamp west and clamp east.

Between the second and third sets is an interval of about an hour, during which time each observer places his chronometer into the circuit of the telegraph line, whereby each chronometer records at both stations, and thus the time shown by each at an absolute moment is found.

The same stars were always observed at each station to eliminate error of star places. The positions were obtained from the Berliner Astronomisches Jahrbuch.

In the reduction of the transit observations another correction has to be applied; it is that of rate.

In our assumed ideal case of a perfectly adjusted instrument, although each star transit would give the chronometer correction, the corrections deduced from different stars would not be equal to each other on account of the rate of the chronometer, each correction being only true for the instant of transit of that star from which it was deduced, so that in practise, when simultaneously reducing a number of transits to some common time, generally that of the exchange of telegraphic signals, a correction for rate must be applied to each star. If the chronometer is losing the sign of the rate correction before signals will be negative, and after signals positive, vice versa, if gaining.

This question of rate, I consider the most difficult problem in the field work of longitude determinations. Chronometers have more idiosyncrasies than any other astronomical instrument. The great desideratum in such a time-piece is that it have a uniform rate, be it gaining or losing.

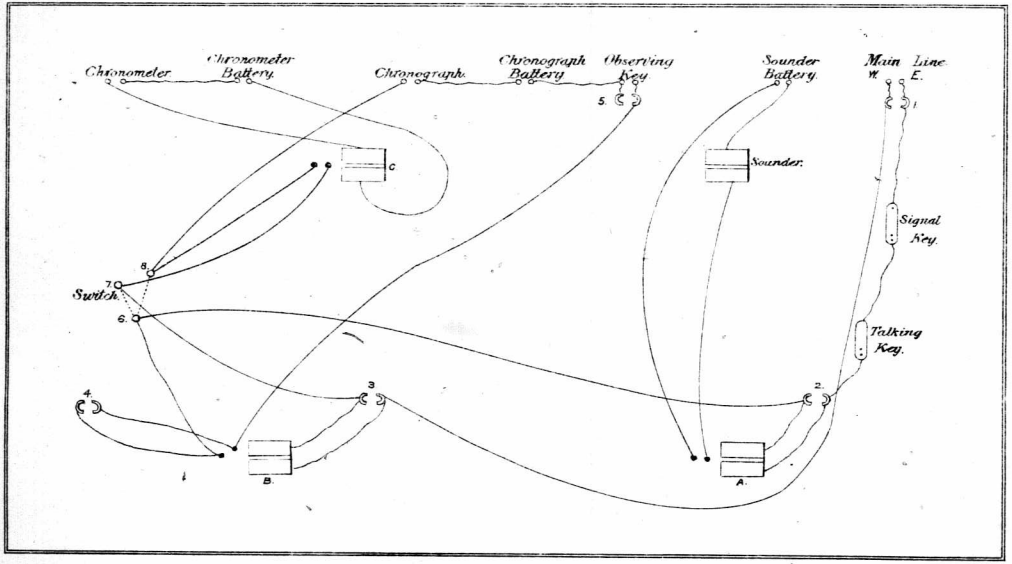
By experiment it has been found that rate varies as the square of the temperature; or, to state it more definitely, there is a certain temperature, called the temperature of compensation, at which a chronometer has its fastest running, for any other temperature the rate is found by multiplying the temperature constant (which must be determined for each chronometer) by the square of the difference of temperature, and adding this quantity to the former rate. Expressing it in a formula we have

$$r' = r + z\,(\theta - \theta')^2$$

in which θ is the temperature at compensation, r the rate at θ°, and z the temperature constant.

Reverting to the reduction of the transits, after applying the corrections for rate and inclination of axis, there still remain the three unknowns: the azimuth and collimation errors and the chronometer correction.

From experience, I have been led to assume that the azimuth and collimation remain constant during the interval of sets one and two, and similarly for sets three and four, so that in computing one night's work we have two groups, each of ten condition equations, from which the three normal equations are formed and the three unknowns found.


Chronometer.
Chronometer Battery.
Chronograph.
Chronograph Battery.
Observing Key.
Sounder Battery.
Main Line
W.
E.
5.
C.
Sounder.
Signal Key.
8.
7.
Switch.
6.
Talking Key.
4.
3.
2.
1.
B.
A.

It would be more satisfactory to determine the collimation independent of the transit observations, so that there would remain only the two unknowns: azimuth and chronometer correction.

In a fixed observatory this can easily be done by means of collimators, but in the field we are dependent upon circumpolar stars, noting the time of transit over half of the threads, then reversing and again noting the time over the same threads.

It frequently happens in the field that no suitable polar star is available just before or after the regular transit observations, and hence the collimation is not obtained independently. Even if it were obtained, it is questionable, from the unreliability of its constancy, whether its application would give a more accurate value of δr than when it is treated as an unknown in the condition equations.

I may cite a peculiar case of change of collimation. During the past season I was observing at Port Arthur, in July, the collimation varied between $-^s.06$ and $-^s.10$. Then followed an interval of about a month, during which time no observations were taken; resuming work in the latter part of August, the observations gave the collimation as varying between $+^s.33$ and $+^s.37$. The instrument had remained mounted during the interval, and there was no looseness of screws carrying the diaphragm. The only known change of conditions was a lowering of the temperature of the air.

Having given a cursory review of the observations themselves, we now turn to the subject of this paper, "Electrical Apparatus in Longitude Work," and I will confine myself to that used by Mr. W. F. King and myself, each of us being provided with similar apparatus.

Wherever we observe the telegraph line is cut and brought into the observatory, where it is attached to the apparatus, of which the accompanying is a plan. (See Figure.)

A Talking relay

B Signal relay

each of 204·7 ohms resistance at 65° F.

C Pony relay for chronometer

1, 2, 3, 4, 5 are cut outs, with the necessary plugs.

The whole apparatus is neatly arranged on a mahogany board.

One gravity cell is used for the chronometer and one for the sounder, and two Laclanché cells for the chronograph, the gravity battery being found rather weak for the chronograph. As the two forms of battery are in circuit for some minutes only, no drawback

results from their combined use, which otherwise would not be the case, polarization taking place.

The talking relay and its accompanying sounder could be dispensed with and the signal relay used instead, the sound being taken from the working of the armature thereon. The latter relay has split cores, whereby its quickness of action is increased, the electric current being more rapidly discharged.

The signal key differs from the ordinary talking key in that the anvil is placed at the back, so that when the key is depressed the circuit is broken instead of made as ordinarily.

Neither a galvanometer nor a rheostat was put into the circuit, the non-application of either being found to be unessential.

The chronograph used was the standard register of the Western Union Telegraph Company, and served its purpose well. It unreels about an inch per second, but this quantity can be increased or decreased by means of the governor in the mechanism. Its only disadvantage compared with the chronograph of observatories is that each record is on a separate tape, many accumulating during a night's work, whereas on the other the records are on one sheet. Its electro-magnet has a resistance of about 4 ohms.

The special appliance to the chronometer to make it serviceable for telegraphic work is that the second hand, which makes one revolution a minute, is attached to a wheel having twenty-nine teeth, the thirtieth tooth having been filed away, the vacant space causing the omission of the tick, which would otherwise mark the fifty-eighth second of the minute. By this means the beginning of the minute is identified. The remaining teeth act upon a delicate jewelled spring, which breaks an electric circuit at the passage of each tooth, that is every two seconds, the break being shown on the chronograph by breaks in the line of depression made by the style, which is attached to the armature, upon the tape.

When the apparatus is not required for work, a plug is inserted at 1 which then short-circuits the main line at 1.

When used for speaking only, plugs 1 and 2 are taken out and 3, 4 and 5 are left in. The current then passes through signal and talking keys, through relay A, which works the sounder, to switch through 6 7 and back through plug 3, without passing through relay B and out into the main line.

The circuit of the chronometer and its battery always remains the same, not being affected by any other current under the various conditions in which the apparatus may be used.

For speaking and at the same time to record the beats of the

chronometer (each chronometer on its own chronograph only as when recording observations), that is not sending nor receiving beats over main line, the arrangement remains as above described. In this case the local circuit of the chronograph passes from the battery through the chronograph to 8, thence to one of the points of chronometer relay C which breaks the current to 7 across switch through 6 to one of the points of relay B (there being no current through this relay, its points are apart), thence through plug of cut out 4 to other point of relay B, thence through observing key or plug of cut out 5, completing the circuit at the battery, whence it began.

When plugs 1, 3 and 4 are taken out and switch is in position 6 7, then the apparatus can only receive signals over main line, but cannot send any. This arrangement is sometimes necessary when alternately arbitrary signals are given in case the beats of the two chronometers are co-incident or so nearly so that their breaks cannot be identified in the chronograph.

Finally when it is desired to send and receive simultaneously chronometer beats the switch is placed over 6 8, plugs 3 and 4 taken out and plug 2 put in (this is to cut off relay A and the sounder). Now the main line current passes from E through the signal and talking keys to 6 through 8 over the point of chronometer, relay C which here breaks the main line circuit to 7, thence through relay B which breaks the local chronograph circuit at points of relay B, thereby recording main line break, and finally out by W. (It is customary to speak of the electric current as entering by one wire and going out by another, similar to water running through a pipe; that is only relatively so, as there are continuously two currents the + and — flowing or passing in opposite directions towards the terminals of the line and there discharging into the earth). In this case the local chronograph circuit is shortened, the wires from cut out 4 to points of relay B, and those from 7 and 8 to points of relay C being cut out.

It sometimes happens that the beats of the two chronometers are co-incident or so nearly so that it is impossible to identify them on the chronographs, when such is the case another method than that last described must be adopted.

It consists in each observer sending alternately arbitrary signals. To do this the switch bar must be placed in position 6 7, so that the main line current is not broken by the chronometers, the arbitrary break being made with the signal key; otherwise the arrangement is as described last.

The arbitrary signals will then be recorded on each chronograph, which have their own chronometer beats recorded also.

The following equations will illustrate the method of arriving at the quantity sought:

1° O sending signals.

Set O = the distance (in time) of arbitrary signal from preceding second break of O chronometer on O chronograph.

$W+\mu$ = the distance (in time) of arbitrary signal from preceding second break of W chronometer, on W chronograph.

μ being the time of transmission of electric fluid from one station to the other.

2° W sending signals
then similarly as above

W' = distance on W chronograph.

$O'+\mu =$ " O "

Set a = difference (fraction of a second, the minutes and seconds being known) between the two chronometers.

then $O = W - \mu + a$

$W' = O' - \mu - a$

hence $a = \frac{(O'+O)-(W'+W)}{2}$

which gives the quantity sought.

The chronometer beating half sounds breaks circuit every four beats, that it is every two seconds, but omitting the fifty-eighth second, whereby the minute is identified on the chronograph record as previously explained.

The break-circuit is preferable to the make-circuit, especially on account of the greater potential of the current at opening than at closing; in the former the induced or extra current is in the same direction as the primary, thereby increasing its strength, whereas in the latter it is in the opposite direction, so that the primary does not obtain its maximum strength until after the lapse of a short interval of time.

This phenomena is distinctly shown on the chronograph, which is of the tape-register type. The end marking the break is sharp and distinct, that showing the make is far less so, but the line immediately increases in distinctness. The scaling of the tape is reduced to the one hundredth of a second.

In the following table are given the differences between the chonograph records when both chronometers are registering simultaneously at each station. This difference equals twice the time of transmission of the electric current. The time of induced current is eliminated.

If x = absolute distance between the two chronometer beats O and W.

$c_o\ b_o\ r_o$ = time of demagnatization of cores within coils of chronometer, signal and chronograph relays respectively of O instruments. Similar designations for W instruments.

μ = time of transmission of current, then on O chronograph we have

O_o to $W_o = x - c_o - b_o - r_o + \mu + c_w + b_o + r_o = x - c_o + c_w + \mu$.

On W chronograph.

O_w to $W_w = x - c_o - b_w - r_w - \mu + c_w + b_w + r_w = x - c_o + c_w - \mu$ hence

O to $W = x - (c_o - c_w)$.

The two pony relays being similar, the quantity $c_o - c_w$ is extremely small and may be neglected.

Subtracting the two equations gives us twice the time of transmission, as equal to the difference between the linear measures (expressed in time) between the breaks of the two chronometers as shown on the two chronographs.

That the time of transmission between two stations varies is shown by the following results, and this difference must be mostly due to changes in the electrostatic condition of the atmosphere, (including thermometric and hygrometric), as the electro motive force, the wire, the apparatus and its adjustments remain constant or nearly so during the observations at a station.

In exchanging chronometer beats, the chronographs were allowed to record for a minute at a time, so that thirty measures of the quantity sought were obtained. The mean of these was always taken, and to allow for differential rate of the two chronometers, the mean was accepted as the absolute value at the half minute of the time of recording.

Date.	Stations.	Distance.	Difference.	Mean.	Deduced Velocity.
1885.		Miles.	s.		Miles.
June 14	Seattle, Victoria.....	317	.180	.209	3030
" 15			.238		
" 19	Seattle, Kamloops.....	427	.194	.155	5510
" 21			.142		
" 22			.146		
" 24			.152		
" 26			.140		
August 11	Port Moody, Kamloops....	239	.068	.067	7140
" 12			.066		
1886.					
August 15	Kamloops, Revelstoke.....	129	.030	.023	11220
" 16			.020		
" 17			.019		
Sept'ber 7	Kamloops, Field.....	258	.047	.040	12900
" 10			.056		
" 11			.032		
" 12			.027		
October 2	Kamloops, Calgary.....	391	.063	.061	12820
" 3			.046		
" 10			.074		
" 31	Kamloops, Winnipeg.....	1230	.262	.257	9580
Nov'ber 9			.231		
" 10			.256		
" 12			.255		
" 14			.282		
1887.					
July 1	Winnipeg, Wapella.....	235	.069	.063	7460
" 2			.080		
" 3			.051		
" 5			.053		
" 22	Winnipeg, Port Arthur....	430	.075	.073	11700
" 26			.083		
" 27			.066		
" 30			.070		
Sept'ber 30	Winnipeg, Kalmar.....	110	.024	.024	9200
October 3			.026		
" 4			.024		
" 5			.022		

The most of the differences given above are the mean of a number obtained each night.

It will be seen that besides the fluctuations in the velocity between two stations, there is the more apparent one for different distances, where difference of insulation, wire and climate come into play.

In the above results, the wire of the telegraph line was nearly all of No. 9 guage, although on the Pacific Coast end some No. 6 was used, where there were also 90 miles provided with porcelain insulators, otherwise glass ones support the wire. The Canadian

Pacific has now a No. 6 wire with porcelain insulators across the continent, but that line was generally too busy to be utilized for our work.

It may be remarked that in the summer of 1885, when working from Seattle, there were continuous bush fires interfering with the working of the line, the heated wires decreasing the current, and probably the velocity.

The mean of the above results leaving out the cable line (27½ knots), between Seattle and Victoria, gives 9700 miles as the velocity per second of the electric current. This must be understood as the average velocity on telegraph lines of No. 9 wire.

OTTO J. KLOTZ.

DISCUSSION.

After Mr. Klotz had read his paper, the members present gathered around the table, where he and Mr. King had set up the apparatus, batteries and the two chronometers, everything operating as in longitude work.

Numerous questions were asked, and everything was fully explained, so that the members were highly pleased with the practical illustration.

RANCHING AND IRRIGATING IN BRITISH COLUMBIA.

British Columbia, as a Province of the Dominion of Canada, has received more than a passing attention.

The place has been known by hearsay for years, and its fine climate, fertile soil, luxuriant pastures, massive timber, delicious fruit, enormous mineral wealth and unlimited fisheries, to which may be added its picturesque mountain scenery, have given it a reputation exceeding that of any other Province in the Dominion of Canada.

While glowing pictures may be painted of almost any country, and correctly so, it does not follow as a consequence, that wealth and the means of living luxuriously will be at once offered to persons who find themselves in these countries without wealth to commence with.

During the last two seasons, while engaged in surveys in the Kamloops District, which is supposed to be second to none in the Province of British Columbia, I had the opportunity of becoming acquainted with quite a number of the early settlers and their methods of life.

As the level tracts of land, when compared with the mountains, form but a small percentage of the whole, the greater portion of the country will always be used for pasture land, and hence the adaptability of this part of the Province to the raising of cattle and horses. Some twelve years ago when there were only a few settlers in this locality, those who were lucky enough to possess a small band of cattle and horses are to-day among the wealthy of the country.

At that time, before the pasture had been eaten down, all the early settlers had to do was to "round up" their stock once a year and brand them.

"Rounding up" is generally accomplished in this way: The stockmen with their assistants start out on a branding expedition in the summer, several parties frequently joining forces, and when they come across a band of cattle they are driven into the nearest coral and the calves branded with the registered brand of their respective owners.

To facilitate enclosing the animals, points are selected generally

where the natural configuration of the country will be favorable for bringing them together. I have found myself following an open ridge, or valley in the woods, until at a distance on each side I could see either an artificial or natural barrier, and the space would become narrower until they come together at the entrance to the coral which is a high wooden enclosure generally, built in two parts with a narrow passage between the two.

By means of bars which can be manipulated from the outside of the fences, the animals can be let into the narrow passage and through into the inner department at pleasure. The animals are detained in this passage, into which they are driven singly, and branded and then allowed to pass into the other department. Sometimes it becomes necessary for a man to go on foot into the coral and then he has to look out for squalls, for while the cattle seldom turn on a man when mounted, yet if corned closely they will sometimes rush at a herdsman on foot, and woe betide him if he be not active.

This operation of "rounding up" and branding is carried on more or less during the latter part of Summer and in early Fall. Those stockmen who have but a few head and can manage to collect them themselves with one or two assistants will not be engaged more than two or three days, as they don't need to join the larger parties. The people usually make themselves at home wherever night overtakes them while engaged in this work, that is, they stay at the ranch of the nearest interested party.

Ten or twelve years ago this "rounding up" and branding was all that the stock-owner had to do, and as a result we find a number of wealthy stock-owners who are now able to purchase from the Government the pasture lands which they have been using free.

There are not the same facilities for becoming wealthy now that there were years ago, the pastures having become exhausted through over-stocking as wealth increased and stock became more numerous. The hills where grass used to be knee deep all the year around became bare, and in the Fall when growth ceased it became evident that feed would have to be procured for winter use.

This gave rise to great competition, and the ranchmen began to explore the mountains for meadow lands which are sometimes found far in the timber on the mountains. The grass is cut and the hay put up in stacks. Usually sheds facing the South are built as a shelter from the cold winds which generally come from the North and Northwest. A small shanty is put up for the

accommodation of the party or parties appointed to feed the cattle, and all is in readiness for the winter which generally begins in December and becomes severe about Christmas.

The animals are gathered in from all parts, and you will often find your neighbor's cattle along with your own, and some of yours will probably have been driven in with the cattle of a neighbor some twenty or even fifty miles away. In this case you will notify the man whose cattle you have that you have so many head with his brand, and it is an understood matter that rather than come after the cattle in winter time he will compensate you for wintering them, and you will do the same for the cattle you have failed to get home.

In some seasons the cattle get much scattered and it occupies a large share of the winter in tracing them all up, by no means a pleasant task. In the summer time riding around on horseback seeing after the stock is an enjoyable exercise, when the heat is not too intense; but in winter, when the thermometer is ten degrees below zero, and a keen wind blowing, it is an unpleasant task.

In reference to raising horses the labor is not so great, as they are shifted from place to place more easily and stand the winters better. They, too, have to be "rounded up" occasionally, in order to brand the colts and to "break in," to lead or ride, or to harness, as may be required. Experienced men are usually entrusted with this task.

The horses are hardy and surefooted, being able to climb almost anywhere a man can go. From the foregoing notes it will be seen that wealth in the Pacific Province is not secured without a good deal of unpleasant work. In Kamloops and kindred towns the people are only beginning to enjoy the comforts and luxuries, derivable only through companionship and co-operative administration to each other's enjoyment, such as people enjoy to a large degree in the older provinces.

The foregoing is a rough outline of life in British Columbia. One element which has been introduced in the Kamloops District within the last few years, and which has a favorable influence on the morals and finer sentiments, is that of ladies. In the town of Kamloops four years ago there were only some two or three white ladies; now the Town compares favorably with any other of our Eastern towns in this respect, so that in any of the public entertainments or places of worship the fair sex are quite fairly represented. But since I propose to state something on the subject of irrigation, I must drop this phase of life in British Columbia.

So far I have only mentioned the country in its connection with stock-raising and the methods pursued with regard to that enterprise. I will now notice its agricultural resources. To the uninitiated who land in the country in the latter part of summer, when vegetation has become more or less dried up, the country would appear absolutely useless for agricultural purposes. The soil has a light sandy appearance in many places, but upon closer examination it will often be found rich in the mineral elements which are utilized in the growth of crops. While in British Columbia I have had to change my opinion previously formed in regard to soils. I have seen abundant crops of grain, grass and roots growing on land which, previous to my experience in this line in British Columbia, I would have pronounced a barren sand and incapable of producing a crop; and this with no fertilizer except being irrigated with an abundant supply of water. I may here add that it is my firm conviction that every acre of land in our Great North-West can be made to produce magnificent crops; but in order to accomplish this, those parts lying between Regina and the Rocky Mountains will have to be supplied with water with which to irrigate the soil when necessary. The practice of irrigating the soil in our country has not received the attention which it deserves. Although in Ontario, we have as a usual thing natural irrigation sufficient to produce a fairly good crop, yet there is scarcely a season when the same could not be increased about one-third if a certain amount of artificial irrigation could be managed. And then, every few years, there comes a dry season in which there is only about one-third of a crop, and this in localities where irrigation could be accomplished at a reasonable outlay, and would be readily undertaken were the practice properly understood. Irrigation, although not much understood in this part of Canada, was practised by the Egyptians, Arabians, Assyrians, Babylonians and Chinese. One valley in Arabia was watered from a vast reservoir made by a dam two miles long and one hundred and twenty feet high, built of enormous blocks of hewn stone, and which stood and restrained the current of a large stream, having seventy tributaries, for some two thousand years. France, Spain and Italy pay great attention to irrigation. The Romans during several centuries constructed expensive works which are still in use. In some parts of these countries all the water in the Lakes and rivers is claimed by the Government, and the people are charged a rental for the water, according to the quantity required during the season, the Government constructing

and maintaining the irrigation works. On the American Continent the ancient inhabitants of Peru were found by their conquerors in the use of the most costly works, constructed for the irrigating of their lands. Prescott says, "canals and aqueducts were seen crossing the low lands in all directions and spreading over the whole country like a vast network, diffusing fertility and beauty around them." The Aztecs of Mexico also made use of similar means to counteract the natural dryness of their atmosphere. When the Mormons first settled in Utah in 1846, that Territory was a waste of barren land and sage brush. In 1868, twenty-two years later, there were ninety-three thousand eight hundred acres under irrigation at an expense of $250,000, and since then the area has been very much increased, so that we have a case here in which the desert has been made "to blossom as the rose," by the simple art of irrigation. In Colorado extensive canals and other improvements have been constructed at a large cost, and over a million acres thus brought under cultivation. In that State the water is controlled by joint stock companies, and delivered to the farmers at a cost of from a dollar to two dollars per square inch equal to about a dollar per acre, the cost of distribution over the land itself being about one half dollar per acre. A fall of three feet per mile will give a velocity of about three miles per hour, and one square inch having this velocity is considered sufficient for each acre under cultivation. In any country if the cross section of the stream, which may be used to irrigate the land, be determined, the number of inches may be taken as a practical measure of the number of acres, which can be irrigated if all the the water should be used for that purpose. For example, a stream of 100 feet wide and 5 feet deep would water 72,000 acres or 720 farms of 100 acres each. A farmer with 100 acres of land under cultivation secures 100 inches of water at this velocity, and he can with it water his whole crop in ten or twelve days. Wheat usually requires to be watered two or three times during the season, late crops needing it much oftener. In California the system of irrigation is carried on in very much the same way as in British Columbia, each farmer constructing his own ditches which are often rude affairs, but nevertheless they succeed in bringing the water, in some cases, ten miles. There are a few companies which supply water on the same system as in Colorado, while numerous farms, gardens and orchards are irrigated by small ditches and wells. Many complications have arisen in California over this water question, regarding individual and prior rights, and it bids

fair to become the cause of a great deal of litigation in our own Province of British Columbia. In that Province at present but a small proportion of the land which might be utilized in this way is brought under cultivation. In not a few cases persons who are in possession of irrigable lands through which streams pass have already had registered to their credit more water than is found running in the streams after the flood once passes away in the Spring. The only remedy which I can see would be to construct dams and form reservoirs at the sources of these streams, or in some other suitable place, and retain all the water which accumulates from melting snows. In British Columbia the valleys are surrounded by mountains to such an extent, that there would be a supply of water from the snow melted from off them quite sufficient to irrigate all the land that could be brought under cultivation, were it only preserved in reservoirs for summer use. This, however, would require considerable capital. One of the difficulties with which any company would have to contend, in adopting a system of irrigation for British Columbia, would be settling with owners of private rights. People who own rights of this kind are generally disposed to take every advantage afforded by such rights. A person would naturally think, that if those who possess registered rights in certain streams had their usual supply delivered at their farms free of cost by a company, that this would more than compensate them for the right, but such is not the case. Their present possession of the water secures them from competition, which would be the result of other settlements near them, and this is by no means a small consideration to those who own from five hundred to twenty-five hundred head of stock, for which they are naturally anxious to have as wide a pasture range as possible over the Government lands. There are men to-day on the lookout to secure all the water privileges possible, expecting that if they can secure the water they will have the use of large tracts of land unmolested. These men are awake to their own interests. You will find that the people of the Western Province are not slow in looking after their own interests in these as well as other respects. They, as a rule, don't understand that it would be an advantage to the country if it were more densely populated. Business men and manufacturers are alive to this question, but ranchmen don't want to see any alteration in this respect. They are quite satisfied to let matters remain as they are and would discourage any effort which might be made to settle the country or improve it by bringing a larger area under cultivation, except as a means of increasing their

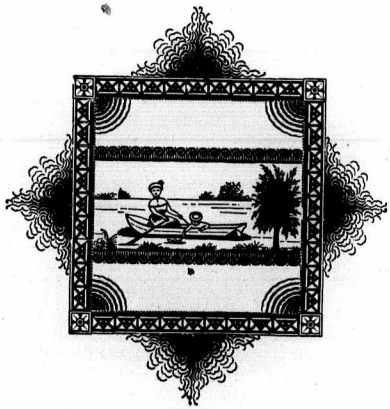
winter supply of hay and feed for winter use. In computing the measure of water supply by inches, there are several standards by which this quantity is determined. That generally understood in California is the miner's inch, an arbitrary measurement established many years ago by the miners in accordance with laws which they adopted. It is a quantity of water which is discharged from an opening one inch square through a two inch plank with a pressure of six inches above the opening. Another standard known as the Smartville inch is measured by a four inch orifice under a pressure of seven inches above the upper edge of the opening. An opening four inches wide and two hundred and fifty inches long, with the seven inch pressure above the top of the orifice, discharges 1000 Smartville inches. Each square inch of the opening discharges 1.76 cubic feet per minute, which is nearly the same as the discharge through a two inch orifice in a plank with a pressure of nine inches above the centre of the opening, and which is equal to 1.78 cubic feet per minute. The inch of the Park Canal Company in California discharges 1.39 cubic feet per minute.

In elevations where the pressure of the atmosphere is much less than at or near sea level, we can understand that through an orifice of a given size the discharge would be considerably less than would pass through an orifice of similar size at a lower altitude where the atmospheric pressure would be greater; so that the only correct rule to be adopted in measuring water supply would be let an inch, or whatever is adopted as the unit of measurement, mean a certain definite quantity of water discharged in a certain time. Whether 1.76, 1.78 or 1.36 cubic feet per minute, let the inch be determined in this way, which is the most simple method as well as the most accurate. The cross section of a stream may be determined in square feet or fractions thereof, the velocity of the stream in feet per minute by means of floats, and then if A= area of cross section in feet, V= velocity of steam in feet per minute, then the capacity of a ditch or stream in inches will equal $\frac{A+V}{1.76}$.

But the field is a large one, embracing the construction of ditches and canals with the various methods adapted for conveying water, also the different devices in use for raising it from streams and wells beneath the surface to be irrigated. Then there is the preparation of the surface and means of distributing the water over the entire area of the same, requiring careful attention when the land to be watered is to any extent hilly. Irrigating in itself after the water has been procured is

quite an art, and is understood pretty well by many of the Chinamen, who are found at nearly every ranch. Very likely many of these Chinamen learned the art in their native country, and as a rule they take naturally to that kind of work. But my paper is already too long, and I fear will not be sufficiently interesting to be appreciated. The subject is an important one, and I trust it will receive attention from some member who is better qualified to do it justice than I am.

THOMAS FAWCETT.



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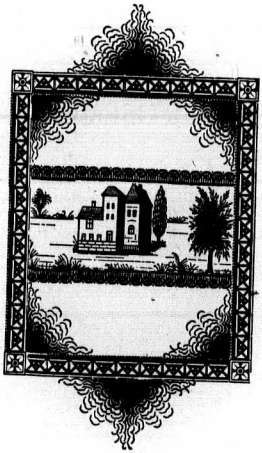

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