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# PROCEEDINGS

OF THE

ASSOCIATION OF

# Dominion Land Surveyors

Canadian Institute of Surveying

AT ITS

## SECOND ANNUAL MEETING,

HELD AT

OTTAWA, FEBRUARY 17, 18, 19 and 20, 1885.

OTTAWA:
PRINTED BY A. S. WOODBURN, ELGIN STREET.
1885.

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# ASSOCIATION OF DOMINION LAND SURVEYORS

Organized, April 24th, 1882.

## OFFICERS FOR 1885.

| | |
|---|---|
| President | OTTO J. KLOTZ. |
| Vice-President | J. P. B. CASGRAIN. |
| Sec.-Treasurer | A. F. COTTON. |
| Executive Committee | W. OGILVIE.<br>W. CHIPMAN.<br>P. DUMAIS. |
| Auditors | J. F. SNOW.<br>E. J. RAINBOTH. |

## HONORARY MEMBERS.

| | | |
|---|---|---|
| The Surveyor General, | Prof. Macoun, | Andrew Russell, |
| Capt. E. Deville, | Dr. Bell, | E. E. Taché, |
| W. F. King, | Prof. G. Dawson, | Bolton Magrath. |
| Prof. Selwyn, | Prof. Harrington, | |

# 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 and Honorary Members.

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

3. Honorary Members shall be such persons only who are distinguished for Professional Attainments. They shall be exempt from dues.

### 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, to be elected at the annual general meeting by ballot.

## ARTICLE V.

### ELECTION OF MEMBERS.

1. Any Dominion Land Surveyor upon being proposed in writing by at least two members shall be eligible for election as a Member of this Associaton upon payment of the necessary fees.

### HONORARY MEMBERS.

2. Honorary Members must be recommended by at least two Members.

### VOTING.

3. All voting for the election of Members shall be by ballot and at a general meeting of the Association.

4. The majority of the ballots cast shall decide.

## ARTICLE VI.

### MEETINGS.

1. The Annual General Meeting shall commence on the third Tuesday in February, in Ottawa; and a General Meeting shall be held on the third Tuesday in April, in Winnipeg.

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. Five shall form a quorum at any meeting for the transaction of business.

## ARTICLE VII.

### AMENDMENTS.

1. This Constitution may be amended at any of the General Meetings by a vote of at least two-thirds of the members present at such meeting, but no amendment shall be considered unless notice in writing thereof shall have been given at the next preceding General Meeting.

2. No By-law or Rule shall be altered, or new one adopted, except at a General Meeting. Notice of such proposed change and of the meeting at which it is to be considered shall be given to the Secretary one month before such meeting, the members to be notified thereof by the Secretary.

## ARTICLE VIII.

### 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 IX.

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 X.

SUBSCRIPTIONS.

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

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

# BY-LAWS

## ORDER OF BUSINESS.

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

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

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

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

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

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

7. Every member while speaking shall address the Chair.

## DUTIES OF OFFICERS.

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

2. The presiding officer shall only have the casting vote, but 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 his receipts and disbursements, and shall perform such other duties as may from time to time be assigned him by the Executive Committee.

# SECOND ANNUAL MEETING

—OF THE—

# ASSOCIATION OF DOMINION LAND SURVEYORS

—HELD AT—

***Ottawa, February 17, 18, 19 and 20, 1885.***

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THE ASSOCIATION assembled Tuesday, February 17, at 3 P.M., at St. Andrew's Hall, in Ottawa.

OTTO J. KLOTZ, President, in the Chair.

PROGRAMME:

*Tuesday, February* 17—3 *p. m.*

Routine business.
President's Address.
Election of Officers.

7:30 *p. m.*

Notes on the different systems of Survey in the North-West Territories—by W. F. King, Inspector of Surveys.

Selection, Equipment and Management of a Survey Party—by Thomas Fawcett.

*Wednesday,* 18—10 *a. m.*

Reflections on the Accidents of Life—by Jno. A. Snow.

A new form of Field Instrument—by G. B. Abrey.

On motion the minutes of the preceding meeting were confirmed.

The following Dominion Land Surveyors were then duly elected members of the Association :—

H. Carre.
M. Deane,
H. D. Ellis,
F. L. Foster,
T. D. Greene,
J. W. Harris,
Alexander Niven,
George Ross,
S. M. Starkey,
H. H. Stephens,
J. E. Strois,
E. W. Habbell.

The President then delivered his Annual Address:

GENTLEMEN,—I congratulate the Association on its second annual meeting. It is gratifying to see that our membership has increased to seventy-two in number. The Association is still in its infancy, and will have to struggle for a few years before it is settled upon a permanent basis. The latter can only be attained and maintained by the active interest of the members.

It is customary for a president to review the progress of the society and the progress of that branch of science especially pertaining thereto during the past year. With our society it is rather a difficult subject, partly on account of its recent organization, and far more so than were we an engineering society. The real progress of our society and profession will be when the surveyor will execute his work with greater care and precision and to the best of his ability. I do not wish to insinuate that the surveyor is deliberately careless, but public sentiment and opinion regarding surveyors is so lax,—preferring a quick, cheap survey,—the basis of operation uncertain—that the surveyor from force of circumstances, has to comply with such requirements, and hence the standard of the profession is kept low.

Regarding progress in the science; this field is very limited, for our work is mostly confinnd to mathematical formulæ and instruments with which we obtain the necessary data therefor. Of the former we are amply supplied, and the same may be said of the latter, and is the limit of excellence of the latter about reached; no great discoveries or inventions are made, merely details. Were we only versed in both what has long been known, so that we could manipulate them thoroughly, our standard would certainly not be low. Furthermore, our sphere of action does not as yet reach to that extent which is practiced in other countries. This pertains to the broader view of the meaning of "surveyor."

The greatest drawback to the land surveyor in our country is that neither the Federal nor Provincial Government has made or begun to make a systematic and accurate survey of the country, at least of the more densely settled part. Sooner or later such a survey must be made, and the sooner the better; the expense of such a survey, although apparently large, would be repaid tenfold, nay hundredfold, by saving of unnecessary costs of litigation respecting boundaries, by furnishing most useful and valuable data for drainage of areas, for water basins, for preliminary surveys of projected railroads, for mineralogical development, for cadastral maps useful for purposes of assessment, and for various other matters conducing towards the welfare of the community and progress of the country. An eminent engineer states that in the State of Massachusetts alone about $20,000,000 would have been saved in its public railway expenditure had accurate topographical maps been extant. Now such maps are in course of construction.

I think we are the only remaining civilized nation that has not commenced such a systematic survey. Had the extreme usefulness and expediency

of such a survey not been shown and proven, there might be some plea for procrastination, but with nearly the whole civilized world for witness, there is no excuse. We can take no better example for illustration than the Ordnance Survey of Great Britain.

What use is there for the rising surveyor to acquire more knowledge in his profession than his predecessor if, when he enters upon his practice, he finds the same inaccuracies and vagueness in official plans, maps and documents,—what occasion will he have to apply his superior skill? To build a mansion upon quicksand.

The maps of our country (either as counties or as a whole) are inaccurate, for the surveys upon which these maps rest or are mostly based, were made with the old chain and compass through woods, nearly one hundred years ago. To give an idea of the reliability of maps where no survey of precision has been made we may take the wealthy State of New York. The best map of this state up to the present time is, at places, as much as two miles in error. The State Legislature has since some years appointed a Board of Commissioners of thoroughly competent men, authorizing them to have a trigonometrical and topographical survey of the state made, which is now in progress. In the most of the other states and territories similar surveys have been made or are in progress, besides the grand work of the Coast and Geodetic Survey carried on by their Federal Government. The first work necessary to be performed will be a triangulation of the country; this must precede the topographical work proper; just as in the erection of a building, a solid foundation must be laid ere a lasting superstructure can be erected. In a triangulation the public of course sees little or no use of covering the whole country with a "spider's web," yet such is absolutely necessary. It has been thought possible and practicable that if the Government laid down the framework, *i. e.* establish points throughout the country, that the detail work could and would be performed by each municipality; but this idea has proved fallacious and the attempt futile, so that it is also a settled matter that if the whole work is to be efficient it must be carried on by the Government and with a permanent and competent staff of surveyors. In the first few years of such a survey the public will receive little direct benefit ere the detail maps are published; on this account the citizens are apt to become impatient. It must be remembered, too, that moneys expended on such surveys do not bring benefits so patent as dividends of a gas company. The former must be likened to those bestowed upon the nation by our free public schools. Such a survey must be energetically carried forward so that its completion, at least of the more populous parts, may not be too much protracted, and the citizens gain the benefit thereof.

Without dilating on this subject any further or entering into any of the other branches with which the surveyor comes in contact, I would urge every surveyor to bring this subject to public notice and to keep it there until the Government begins the primary work.

The following amusing note is copied from one of Senator Cox's books. "The scientific books printed by Congress have often provoked humorous irony from the facetiously frugal mind. 'This is the queerest book inside of lids,' said Senator Fessenden. 'Take a box of common shoe blacking, and a brush, and a little white paper; smear it all over, and then take a pepper-box of white sand and sprinkle it all about, and you will have as good a book as this Exploring Expeditions.'"

Having also taken during the past season on my "Exploratory Survey to Hudson's Bay," some magnetic observations, a communication of some of the results thereof may not be uninteresting.

Magnetism is a peculiar quality possessed naturally by one kind of iron ore called "loadstone," and may be artificially produced in iron and steel (especially the latter) by certain processes, which, without altering any of their other properties, such as their weight, hardness, &c., give them certain additional properties of which the most obvious is that of attracting and in some cases repelling other bodies, but the most useful is that of "pointing" in a certain direction, when allowed to move freely. This directive power or characteristic is from the present knowledge confined to the earth; what position a straight magnet (not considering its weight) would assume in space is not known, for the cause of the earth's magnetism and the laws which govern the same are still imperfectly understood.

A straight steel magnet we term a needle.

Magnetism is distributed over the whole surface of the earth, and every where exerts its power in a greater or less degree. When a magnetic needle is suspended, and free to move, it always assumes a constant direction, but this power or force is only of direction, not of translation, herein differing from gravitation; this peculiarity may be illustrated by attaching small pieces of cork to the needle and floating it in water, it will immediately assume its north and south position but otherwise remain stationary.

We find by experience that if two needles are brought near each other that the "seeking" ends, or those pointed towards the north (in the N. hemisphere) will repel each other, but that the north end of the one will be attracted by the south end of the other, *i. e.* like poles repel and unlike attract each other, so that strictly speaking, considering the earth as a huge magnet the seeking end of a magnet in the northern hemisphere is the "south" pole. This directive property in azimuth is termed declination, formerly variation.

Furthermore we will find by observation on our freely suspended needle that in different latitudes it will not preserve its same position towards the horizon (although evenly balanced as far as its weight is concerned), this is the second part of its directive power and is called dip or inclination. On this account surveyors in changing their latitude are obliged to "balance" the needle (when doing compass work) by means of a small shifting weight, generally a brass wire wound around the needle.

There is yet a third magnetic element which is subject to variation, both from time and place, namely, the "intensity" of the force by which the needle is pulled into its peculiar position. This is found to be generally greatest near the earth's poles and diminishes therefrom, but it varies irregularly over the surface.

Concerning the history of magnetism we gather that in China more than 2,000 years B.C. the directive property of the magnetic needle was known and made use of, and through them the knowledge reached Europe, but not till about the 11th century of our era. The Norsemen were the first who made use of the loadstone in Europe. From a Chinese work in the beginning of the 12th century we learn that then the needle was suspended by a thread and the mode of determining the declination long understood. Columbus is probably the first who recorded the change of declination with a change of position. When he left Spain he had east declination, and on his voyage in lat. 28°, long. 28° he had 11° west; he necessarily crossed the agonic line, or line of "no angle," *i.e.*, where the magnetic and astronomic meridians coincide, which fact he noticed. Hence on our magnetic records and observations slowly but steadily increased. But it remained for the great Alexander Von Humboldt, in the beginning of the present century, to bring the study of magnetism to a science. It was he who first published the law that the intensity of the force increases (in general) with the magnetic latitude, supported by observations at 104 places. During his travels in the tropical regions of America, he observed the oscillations during ten minutes of the same needle at different stations, and from the number of oscillations deduced the relative magnetic force (especially Paris) using as standard or 1.0000 that on the magnetic equator in the Peruvian Andes. This method is now superseded by the superior one of determining the absolute magnetic force. Humboldt was the first to demand the establishment of magnetic stations throughout the world, and in April 1836 wrote to the Duke of Sussex, at that time President of the Royal Society, on this point, urging amongst other places the establishment of stations in Canada. In magnetic surveys which followed and the contributions to magnetism, the name of the late Major Sobine is inseparably connected.

Friedrich Gauss (1777-1855) made an elaborate mathematical investigation of the problem and gave us a "general theory of terrestrial magnetism." Besides these there are other names worthy of mention, but space does not permit.

While in the magnetic force upon the earth we have the declination, inclination and intensity thereof inseparably connected, yet to the surveyor and navigator it is only the first which specially interests them. Its determination for the surveyor is quite simple. By means of his transit theodolite he takes either a solar or stellar observation for azimuth (the latter is more accurate but not so convenient to take, and for this purpose the former answers all purposes,) then comparing the determined true azimuth with the magnetic

gives the required declination,—expressed as west or plus when the north end of the needle points west of the true meridian and east or minus when in the opposite direction.—When such an observation is taken the place, year, day and hour, should be recorded as each influences the declination.

Beginning with the last we come to consider the solar—diurnal variation, which shows us a systematic movement of the needle during the 24 hours. About sunrise it is at its easterly elongation, and then follows the sun till 1 p. m., reaching its westerly elongation, when it retraces its movement. At about 10½ a. m., it passes its normal position for the 24 hours, and a second time about 8 p. m. In summer this diurnal range is greater than in winter, and also during years of maximum sun-spots greater than during minimum sun-spots. For our latitude the diurnal range is about 9 minutes of arc. Besides this movement, irregular disturbances will occur, as observed along the Nelson during the past season. I generally took with each astronomic azimuth determination a magnetic one also, for which latter several readings would be taken, naturally expecting the needle to settle at the same point, (it is better to take the reading between the vibrations,) but in several instances found over half of a degree variation in the declination. I took out the needle, examined its pivot and bearings, lest they might have been damaged, but both were in good order, I remagnetized the needle with the two long bar magnets of the dip circle, but all to no avail. The reason of such abnormal behavior, I failed to discern. Similar behavior with the dipping needles occurred. When perhaps the amplitude of vibration was fast diminishing, all of a sudden it would start off again and swing, I might almost say violently, as if some fresh magnetic current had seized it. Whether the azoic rocks amongst which I was could produce any such fluctuation does not seem probable, although their attraction was often quite evident; but this, is a constant for the same spot of observation.

It is best not to theorize upon the strength of a few isolated observations, but to keep on gathering facts, until from them, collected from all quarters of the globe, an hypothesis may be deduced, and when established become a law of nature.

The next variation is the annual, but for practical purposes it may be neglected.

Next comes the secular change of the magnetic declination. This is the most important of the various changes to which the needle is subject. Knowing the same, the surveyor is enabled to re-establish old lines, which have been obliterated, and thereby save costly litigation. Without this knowledge it would often be impossible to establish such lines correctly. In this connection it may not be out of place to state the desirability of having all maps and descriptions in deeds of land expressed in astronomical bearings which are constant, to which might be added in parenthesis, as explanatory only, the original bearing (compass) of the lot line &c. as given in the first patent

thereof. But, if in the backwoods it is found expedient to run "compass" lines the date of such survey upon which the bearings are dependent should be always given in every conveyance consequent thereto. The neglect of giving the date of magnetic bearing leads to much confusion. In my own municipality I have found four different bearings—varying several degrees—recorded for one and the same line; and all the bearings are from the same surveyor. The difficulty of giving readings to single minutes of arc with the needle, the fluctuations thereof, and the ever increasing value of land should necessitate such a change in the descriptions as above alluded to, in fact it should be compulsory by statute. This refers to the older provinces. In the North-west the needle is banished.

If year after year the magnetic azimuth of a certain line be taken it will be found to change steadily and in one direction until it has reached its maximum either to the east or to the west, when it will begin to return and move steadily in the opposite direction. This motion is not uniform but least near its eastern and western elongations.

At Toronto, during the last four years the mean has been four minutes late annually westward. The declination for August, 1884 there being 3° 57′. 25 west. There is no record of observations on this continent which comprises the whole range from eastern to western elongation, but such is found for Paris. The earliest declination there recorded is for the year 1541. From this latter record it appears that the time elapsing between the eastern and western elongations at Paris is 233 years, from which may be assumed that the magnetic pole makes a complete revolution around the actual pole in 466 years. The variation in declination between the extremes amounted to nearly 34°.

The agonic line, or line of no declination, passed in 1877 through Detroit and is steadily moving westward.

It is found that lines of equal declination——isogonic lines or magnetic meridians differ far more from the astronomic meridians than do the lines of equal inclination——isoclinic lines, from parallels of latitude.

The north and south magnetic poles are far from being diametrically opposite each other. Captain J. Ross found the former in 1831 to be near lat. 70°, N, long. 96° west, and in 1840 the latter to be at about 72° lats., and 152° long. east. Between these two poles there must be a line along which the needle turns neither to the north nor to the south, and that line is called the magnetic equator. It crossed the geographical equator in the Gulf of Guinea and eastward of New Guinea. The points of intersection are of course variable, and at present are moving westward. From these facts is seen that the magnetism of the earth is unsymmetrically distributed whether caused by the want of homogeneity in the mass of the earth is not fully known. From my observations extending from the Forks of the Saskatchewan to Hudson's Bay, about 13° in longitude, the declinations along the Saskatchewan, where there are no

rock exposures until Cedar Lake is reached, where sedimentary limestone is found, are far more uniform than those along the Nelson, the banks of which for three-quarters of its length are of igneous rocks. Along the former river in general an eastward motion gave a decrease of declination, but along the latter a similar motion produces sometimes an increase sometimes a decrease in declination, and not until we pass the igneous rocks, which are succeeded for a short distance by limestone formation and then by clay until Hudson's Bay is reached, do we find a somewhat uniform decrease in declination as we proceed eastward.

If we find from a series of observations that there is some regularity in the change of declination with change of longitude, it may be safely assumed that such declinations express the horizontal direction of the magnetic currents of the earth better than those where such regularity does not exist. Our case in point: The declination along the Nelson should lie between that of Grand Rapids and York Factory, be less than the former and more than the latter; but instead, out of 37 intermediate stations 15 have larger declinations than Grand Rapids, and one has less than York. At none of the stations was there any mass of iron ore seen nor anything special noticed to cause "local" attraction. From this it is seen that granitic, gneissoid and hornblendic rocks intersected by trap dikes exert a greater influence upon the needle than diluvium or silt deposits or sedimentary limestone. Ere this might have been asked—what is magnetism? But the echo answers "What?" Many of its effects are known, but as to its origin, or whence it emanates is still a mystery. Were the earth's magnetism dependent solely upon the magnetism inherent in certain particles of its mass, we should expect practically no change from year to year, and furthermore the concentration of this magnetism would be near the centre of the earth Now as we have changes of magnetism although our magnetic particles where such do exist remain constant or nearly so, there must be some other magnetism and this must exist in the form of currents. These are not evenly distributed over the surface of the earth nor do they continue constant in their uneven distribution of any particular time. As before remarked the magnetic energy is coincident with the sun-spot cycle; it seems probable that the source of magnetism is the sun—our origin of light and heat of which magnetism may be a form.

Returning to the record of my observations of the past season, and comparing them with those made in 1843-44 by Sir J. H. Lefroy, we find the following differences for declination:—

| | |
|---|---|
| Near Forks of Saskatchewan a decrease of | 2° 55′ |
| At Cumberland House an increase of | 0° 36′. 5 |
| " Grand Rapids, Sasketchewan, a decrease of | 2° 41′ |
| " Norway House a decrease of | 0° 36′ |
| " York Factory a decrease of | 2° 22′ |

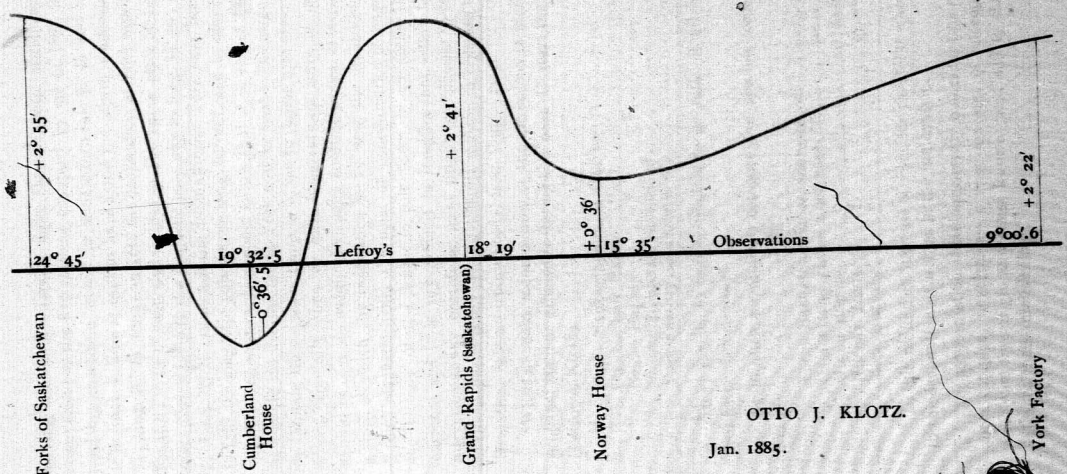
These variations are made more apparent from the accompanying figure. From this it is seen that during the last 40 years the magnetic pole has been

# EXPLORATORY SURVEY TO HUDSON'S BAY.

## VARIATION OF MAGNETIC DECLINATION

*At Stations occupied by Sir J. H. Lefroy in 1843-44, and by Otto J. Klotz in 1884.*

NOTE + indicates decrease of eastern declination.
— " increase " "




OTTO J. KLOTZ.

Jan. 1885.

moving westward. Laying down the magnetic meridians from the above observations at the five stations occupied by me in 1884, the magnetic pole resulting therefrom would be situated in lat. 68° 46′ and long. 87° west. In 1831 Capt. J. Ross is said to have found the north magnetic pole in lat. 70° 05′, long. 96° 46′ west; in 1819 the declination at York was found by Sir John Franklin to be 6° east, and in 1843 at the same place by Lefroy to be 9°00′.6 east. Now if in 1831 the magnetic pole was in long. 96° 46′, York being in lat. 57° long. 92° 26′, must not the declination at York have been west? Again if in 1831 the magnetic pole was in long. 96° 46′, and by observations since then it has moved westward, it would follow that it is west of long. 96° 46′. Now, how could the declination at York now be east? The magnetic pole, as found by Captain Ross does not appear to me to agree with observations taken elsewhere, especially when we have observations north of latitude 50°, which should be of more weight than more southerly ones. It is questionable whether a point at which the inclination is 90° and the declination indeterminate is "the" magnetic pole, the point of concentration of magnetic currents. In the vicinity of the magnetic pole there is an accumulation of magnetic currents and it is not difficult to imagine that within this area that local attraction at any particular point might be sufficient to satisy the conditions of the magnetic pole. It is a difficult matter to separate the effect caused by formations (not an isolated body) from that of magnetic currents.

When we make a comparison of the variations in inclination at the five principal stations alluded to during the past 40 years the difference is slight. (Lefroy & Klotz).

| | |
|---|---|
| Forks Saskatchewan, a decrease of..... | 12′.0′ |
| Cumberland House " " ..... | 1′.7′ |
| Grand Rapids " " ..... | 1′.6′ |
| Norway House an increase of..... | 2′.9′ |
| York Factory, a decrease of..... | 0′.3′ |

These variations bear no similarity or ratio at all to the variations of declination before stated.

Again when we similarly compare the absolute force in British units we find at

| | |
|---|---|
| Forks Saskatchewan an increase of..... | 0.052 |
| Cumberland House a decrease of..... | 0.102 |
| Grand Rapids " " ..... | 0.038 |
| Norway House " " ..... | 0.054 |
| York Factory " " ..... | 0.125 |

In this we find an increase of force for the Forks where there is a decrease in the declination as well as in the inclination.

The accumulation of data apparently makes the true soultion of magnetism more complex, nevertheless a vast amount of information is gained, and finally its true origin and cause known, and add to the development of the latest science—meteorology.

Of the 53 stations occupied where magnetic observations were taken, I subjoin the observations of the five principal ones, which were also occupied by Sir J. H. Lefroy in 1843-44, and whose observations I also give for comparison:—

| Stations. | Dates. | Latitude. | Longitude. | Declination. | Inclination. | Force in British Units. |
|---|---|---|---|---|---|---|
| Near Forks of Saskatchewan... | May 26, 1884. | 53° 13′ | 104° 51′ 34″ | 21° 50′ E | 78° 59′ .3 | 13.976 |
| " " " ... | Aug. 1844. | ..... | ..... | 24° 45′ | 79° 11′ .2 | 13.924 |
| " " " ... | 1859. | Henry Y. Hind. | ..... | 22° 30′ | ..... | ..... |
| Cumberland House..... | June 17, 1884. | 53° 56′ 40″ | 102° 19′ 13″ | 20° 09′ | 80° 25′ .62 | 13.991 |
| " " ..... | " " | ..... | ..... | 20° 09′ | 80° 20′ .90 | 14.092 |
| " " ..... | ..... | ..... | ..... | 19° 32′ .5 | 80° 25′ .0 | 14.143 |
| Grand Rapids (Saskatchewan) . | July 19, 1884. | 53° 08′ | 99° 27′ | 15° 38′ | 80° 24′ .87 | 14.103 |
| " " " .. | 1843-44. | ..... | ..... | 18° 19′ | 80° 26′ .5 | 14.141 |
| Norway House..... | July 23, 1884. | 53° 59′ 33″ | 98° 3′ 54″ | 14° 59′ | 81° 05′ .37 | 14.152 |
| " " ..... | " " | ..... | ..... | 14° 59′ | 81° 12′ .0 | 14.074 |
| " " ..... | Oct. 4, 1884. | ..... | ..... | 14° 59′ | 81° 18′ .0 | 14.008 |
| " " ..... | " " | ..... | ..... | 14° 59′ | 81° 15′ .8 | 14.017 |
| " " ..... | 1843-44. | ..... | ..... | 15° 35′ | 81° 10′ | 14.136, 14.098 |
| York Factory ..... | Sept. 12, 1884. | 56° 59′ 56″ | 92° 26′ | 6° 45′ | ..... | ..... |
| " " ..... | Sept. 13, 1884. | ..... | ..... | 6° 32′ | ..... | ..... |
| " " ..... | Sept. 11, 1884. | ..... | ..... | ..... | 83° 47′ .17 | 13.921 |
| " " ..... | " " | ..... | ..... | ..... | 83° 46′ .56 | 13.930 |
| " " ..... | July 1843. | ..... | ..... | 9° 00′ .6 | 83° 47′ .2 | 14.051 |

NOTE.—The darker figures (Antique) are by Lefroy. Latitudes and Longitudes as given by him.

The officers for the ensuing year were then elected:—

| | |
|---|---|
| President | Otto J. Klotz. |
| Vice-President | J. P. B. Casgrain. |
| Sec.-Treasurer | A. F. Cotton. |
| Executive Committee | Wm. Ogilvie, Willis Chipman, Paul Dumais. |
| Auditors | J. F. Snow, E. J. Rainboth. |

It was moved by J. J. Burrows, and seconded by C. E. Wolff, and

Resolved, That A. F. Cotton receive the sum of fifty dollars for his services as secretary-treasurer for the past three years, the same to be paid out of the surplus funds of the Association.

It was moved by E. Bray, and seconded by C. E. Wolff, and

Resolved, That the railroad agents be interviewed by a committee of this Association to ascertain what they will do in regard to reduced rates for surveyors and their parties over their respective roads, and that the following gentlemen be the said committee:—The President, J. F. Snow, J. J. Burrows, T. Kains, C. F. Miles, J. P. B. Casgrain, S. M. Starkey, and the Secretary.

Many of the members being unable to attend the evening session, it was resolved to dispense with the same.

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Wednesday, February 18, 10 A. M.

Otto J. Klotz, President, in the Chair.

Jno. A. Snow read a paper on "Reflections on the Accidents of Life."

Whereupon W. F. King, Inspector of Surveys, read the following paper on

## NOTES ON THE DIFFERENT SYSTEMS OF SURVEY IN MANITOBA AND THE NORTH-WEST TERRITORIES.

History tells us that man, in his primitive state, subsisted by hunting wild animals and fishing, and on the natural products of the earth.

Afterwards, as population increased, game and wild fruits became scarce, and he found it necessary to domesticate certain animals such as sheep and other cattle, so that by keeping them within his reach and protecting them from the ravages of beasts of prey, he might always be assured of his sustenance. He was still a nomad, as he was obliged continually to drive his herds to where the best pasturage and water could be obtained.

As population increased, and flocks and herds multiplied, it became necessary for each cattle owner to restrict himself to a particular holding, where he would not interfere with his neighbors. These holdings, no doubt, were governed in the first place by natural boundaries such as creeks, rivers, mountains, and so forth. In support of this contention, I may refer you to Chapter 15 of the Book of Joshua, in which the boundaries of the lot of Judah are very particularly described, showing that this was the system practised by the Israelites at a time when they seem to have made some advance in civilization. The holdings being thus restricted in area, the pressure of dry seasons, in diminishing the pasturage and therefore hindering

the natural increase of the flocks, upon which the inhabitants depended for their food, would be severely felt. This drove them to tilling the ground as a supplementary means of subsistence.

It does not appear, however, that agriculture was carried on to any great extent among Eastern nations at the dawn of history, except in countries such as Egypt, where the fertile belt on each side of the Nile at once attracted and supported a large population who lived by husbandry. We read in the book of Genesis, that during a season of famine, Jacob sent his sons to Egypt to buy corn, showing that even at that early date Egypt must have been an agricultural country.

A large agricultural population crowded into a small space, required the sub-division of the country into small holdings, which had to be determined by means of lines instead of natural boundaries.

The science of geometry, which is the foundation of all surveying, is said to have taken its inception here, where every year landmarks swept away by the inundations of the Nile had to be re-established. Among the foremost ranks of mathematics is placed by common consent, Euclid, of Alexandria, who first placed geometry upon the footing of a logical science, and whose elements of geometry are used in schools to the present day with very little alteration in the order of the propositions.

The Pyramids no doubt were used as points of reference in these surveys, and it is probable that the Great Pyramid, in which there is a passage pointing to the Pole Star, was so constructed under the orders of the monarch by skilled astronomers for the purpose of establishing a meridian of reference to be used by surveyors who, in that day of primitive instruments, had not the means of readily and frequently observing the stars.

It would be impossible for me in such a short paper as this to trace the history of our profession from that time to the present day, or to enter into the different systems of survey which have been practised according to the varying needs of different countries. What I wish more particularly to direct your attention to is the systems of survey which we have adopted in our Provinces, and more particularly in the vast extent of country which we have been called upon of late to survey in the North-West.

It was impossible in Ontario, Quebec, and the Maritime Provinces, which were wooded countries, and where the first settlers selected their locations along the banks of large rivers or lakes, to have any one system of survey for the whole country, and the exigencies of each case had to be met by surveys which would cover the wants of the people. For this reason there has never been any uniform system in these Provinces. But where surveys were to be made in a large extent of territory, and the opportunity was had of surveying it ahead of settlement, it became the duty of the Government to select such a comprehensive survey system as would obviate all the difficulties arising from irregular systems.

For the sake of greater simplicity in making the surveys, it is necessary that all boundaries of lots shall be straight lines; that is, parts of great circles of the earth, and as the lots are intended for farms, they should be as nearly as possible square, the square of all four-sided figures containing the greatest area of land for the length of fencing required, and any other angles than right angles causing inconvenient corners.

Now the curved form of the earth prevents our making all the lots in an extensive system exactly square, and we have therefore to resort to an approximation to the square, which may be done in several ways. In this respect a system of survey may be likened to the projection of a map. While it is impossible to represent any portion of the earth's surface on the plane surface of a piece of paper exactly in all respects, as to its area, the directions and curvatures of its lines, and so on, it is conversely equally impossible to

lay down on the earth's surface any system of rectangular conterminous lots as projected on a plan, without overlapping or distortion.

But as in choosing a projection for a map, we are guided by what we want to show most correctly, whether it is the areas, or the directions or the curvatures of the lines, or the distances between points, so in selecting our system we must first decide in what respects we require the most accurate accordance between our lines upon the earth's surface and the squares laid down on the plan.

The requisites of a good system of survey are these:—

(1.) Every line must be straight, *i.e.*, lying on a great circle of the sphere, and must be continued straight as far as possible. This is necessary to facilitate both the first survey and the picking up of the line again when grown up with brush, or when the monuments have been destroyed.

(2.) Areas must be as nearly as possible equal and similar in form, in order to simplify descriptions as by townships and ranges.

(3.) Independence of the surveys of different parts of the country, so that any accidental error may be cut out and not carried throughout the system.

(4.) The directions of analogous lines in two townships or two sections must be alike, both to simplify the observations and calculations needed in surveying, and to make it possible to readily re-establish obliterated survey lines.

(5.) Directions of all lines must be referred to the astronomic meridian.

Our North-West survey system fulfils very fairly all these conditions. To show its advantages, I shall compare with two other systems which might have been adopted.

First—Suppose equal distances of six miles each laid off along a central meridian, and let transit lines be run from these points at right angles to this meridian, and continued indefinitely. Measure off six mile lengths along these and join the points so obtained. Here the townships are of equal area and of similar form, but only for a short distance from the central meridian. The effects of errors of measurement along the base lines would not be eliminated, but would affect the form of all the townships and the bearings of the exterior outlines, as far west as the system extended. Even if all the surveys were correct, each range line, and each part of a base line would have a different bearing, which fact of itself would make the survey work very complicated.

This system of survey may be compared to the projection ordinarily used for small maps, where the meridians are all parallel to one another, and the circles of latitude are represented by parallel straight lines at right angles to the former. As for larger maps, we use the simple conic projection, so as an improvement on the last system we pass naturally to the following:

Let a base line be established along a parallel of latitude central to the country to be surveyed, using chords of the latitude circle six miles in length, and let the meridians through the corners be the east and west boundaries of townships. Let these meridians be posted for township corners at every six miles. Here all the conditions would be fairly well satisfied, except that the township areas would increase considerably to the south and decrease to the north. Also, while theoretically the north and south outlines would in all cases be chords of latitude circles, yet the accumulation of ordinary errors of measurement along the meridians would soon make this untrue, and any chainage error on the base line would operate on the whole range of townships north and south of it. Further, the survey of a large extent of country at once would be difficult, and outlying regions would have to wait for surveys until the whole country between them and the central parallel had been outlined.

The defects of this latter system are at once remedied by passing, as we may say, from the simple conic projection to the polyconic, *i.e.*, by employing, instead of one, a number of base lines. The convergence and divergence of

the meridians run from the successive bases can thus be allowed to fall, together with the errors of the survey, on lines midway between the bases, or correction lines.

We thus arrive at our own system of survey. In this the extreme differences of area in the sections are practically insignificant. An error in measuring a base line only affects the width of two townships on each side of it. An error of chainage on a meridian outline affects only two townships directly, and two more, or four at most, indirectly, and all these errors are rendered unimportant by the manner in which the sub-division of townships is done. Several base lines can be surveyed at the same time, as was done in the North-West in the years 1882 and 1883, so as to render a very large tract available for immediate sub-division. When greater speed is necessary base lines can even be surveyed backwards from one principal meridian to the next one east of it, the result being a, perhaps, considerable closing error, which yet affects the width of only four townships in one range. The eastern and western boundaries of townships being all true meridians, and the north and south boundaries having all very nearly the same bearing, almost due east and west, the finding or re-establishment of an old line is a very simple matter.

The most apparent defect in this system is the rapid increase of jogs on correction lines, which, in thirty ranges west of the initial meridians, amount to nearly a mile and a half. This makes the ranges appear irregular, while, where these large jogs occur, the curvature of the earth affects considerably the width of the roads.

In order to stop at once both the increase of jogs, and the accumulation of chainage and other errors on the base lines, the device of new initial meridians, from which the surveys might be started afresh, was resorted to.

The second initial meridian was established in 1875 by the operations of the Special Survey by a triangulation, for a description of which I beg to refer you to the Surveyor-General's Report for 1883. The other initial meridians were established in the following years, by ordinary chain measurements along certain of the bases.

These meridians were intended to lie on even degrees of longitude from Greenwich, four degrees apart. This was to facilitate the calculation ahead of survey of the widths of the broken ranges adjoining them. As the longitude, however, of those after the second meridian depends each upon the chainage of one line only, it was to be feared that their errors of position would be very large. It has been found, however, that in general they are very near their intended position as far as that can be proved by the subsequent chainage of many base lines. These chainages, howerer, may all have large constant errors in the same direction. There is, unfortunately, no astronomical check which can be applied to the longitudes except by means of the electric telegraph. At the time the principal meridians were established, the telegraph line which then extended as far as Edmonton, was in a very bad condition, and although attempts were made on three occasions to obtain longitude determinations by this means, they all failed. It is to be hoped that another attempt will be soon made, as there are now two good telegraph lines across the North-West.

I may remark here, that in laying down these meridians allowance was always made in the broken section adjoining them for the discrepancy between survey and true longitudes caused by the elevation of the base line above the sea level. This correction amounts to between sixty and seventy links for each one thousand feet of altitude, and the broken section adjoining a meridian on any base line should therefore be found longer than theory gives it by from one to two chains.

A check on the north and south errors was obtained by astronomical observations for latitude. A point was thus fixed on each meridian, from which the chainage was commenced, and two or more check points were also

established on each meridian in order to cut out the accumulated errors of the chain. Unfortunately, astronomical observations, whether for latitude or longitude, are affected, sometimes very greatly by the attraction of masses of hills, etc., on the levels of the instrument.

On the survey of the International Boundary, where a great number of stations were carefully observed, these station errors, as they are called, were found in many cases to be as much as 100 feet and upwards. In one case the error was even as large as eleven chains, but this was an exception, caused by the attraction of a very high hill, one of the Three Buttes, to which the station was in close proximity.

If it were possible always to select a place for observation away from any high hills or deep valleys, I think that in a country like the North-West, where the geological formations are generally regular, these errors might be confined to reasonable limits, but it must be remembered that if hills or valleys affect the result, so also must underground cavities or parts of the earth of greater density than the surrounding areas.

For this reason it is well to confine corrections made from these determinations to the initial meridians, and not to employ them to check base lines, as has been done in one or two instances, between the principal meridians. This is objectionable as introducing an irregularity into the azimuth of the base line, and perhaps a greater error than before existed.

Had not the necessities of settlement in the far west made it imperative to push forward the surveys of principal meridians so far ahead of the base lines, these astronomical checks might well have been dispensed with, for the surveyor of a new principal meridian, if he had had several base lines already established to tie to, could have compared his chainage at each one, and would have at once noted and corrected any large discrepancy. With the present perfection of instruments, base lines can be surveyed as far as regards their azimuth, with greater accuracy than can with certainty be obtained by the best latitude observations.

The International Boundary or 49th parallel, which forms the first base of our system, was surveyed in the years 1872 to 1874 by a Joint Commission appointed by the British and American Governments. There were two methods of surveying this line from which choice could be made. One was to establish one point on that parallel, say at Red River, and to run a series of transit lines west therefrom, similar to the surveys of base lines, and to measure offsets to the true parallel at convenient distances. The other way was to locate astronomically a number of points on the parallel and to run transit lines between, measuring offsets as before. This plan was adopted because it enabled several parties to work at once instead of only one, and the survey could therefore be more rapidly as well as economically carried on. This method was also considered to be more in accordance with the treaty by which this line was named as the boundary, as will be explained below.

The points for astronomical determination were taken about twenty miles apart. These, by reason of the extreme dryness of the seasons, were located in or near the valleys of large streams, the choice of level country for stations being generally impracticable from scarcity of water. The station errors, therefore, as mentioned above, were frequently very large. The transit line from one station might meet the meridian of the next one or two hundred feet too far north or south. The transit line, and the parallel depending by calculated offsets upon it, had therefore to be swung into position, the error being distributed evenly throughout the twenty miles. This makes the angles of deflection along the boundary line very irregular. The monuments over the greater part of the line are about three miles apart. The deflection angle therefore, is in general about three minutes, the line curving regularly to the north, but when one of the astronomical stations is reached the observer will be surprised to find a sudden and often large change in the angle. It may be

increased to as much as fifteen minutes or more, or perhaps the line makes a sudden turn to the south instead of north. After the station is passed the deflection continues regular as before.

A proposal was made that when all the forty-one stations had been determined, and their relative station errors found by the survey, a mean parallel should be adopted, such that the sum of the errors on one side of this mean line should balance the sum of the errors on the other. Such a parallel would have been a true latitude circle and a small circle of the sphere, but not necessarily in latitude 49° at any one place. This proposal was rejected for the reason that the boundary was by treaty to be the 49th parallel of astronomical latitude, and therefore ought to depend on the astronomical observations. Now taking two stations twenty miles apart, one of them may have hills to the north, and the other hills to the south. There will therefore be station error between them. Now it is natural to suppose that along the line joining them the attraction of one range of hills will diminish and that of the other increase in proportion to the distance on the line, so that the probabilities are in favor of an observer at any intermediate point of the oblique parallel laid down by the boundary survey finding himself in true astronomical latitude 49°

For these reasons the boundary line is nearly valueless as a base line. It should have been made a correction line. However, at the time our system of survey was framed this line had not been established, and it could not be predicted in what manner the survey would be made.

Since the inception of surveys in the North-West, three systems of survey have been in force. The differences between them are, however, very slight.

In what is known as the first or old system, the base and correction lines were established in a manner very similar to those of the present system, but the subdivision of townships was made on a system of squares based on the eastern outline of the township, the resulting irregularities of area being thrown into the western tier of quarter sections.

In the second system, adopted in 1880, the east and west boundaries of sections were made meridians to conform to the directions of the boundaries of townships, while the third system agreed with the second as to the manner of subdividing the townships, but differed from it in reducing the number of roads and decreasing their width to one chain, while in the first and second systems the roads were one chain and a half wide and surrounded every section. Another important difference was the method of surveying the standard lines. In the first as in the third system, the base lines were surveyed as standard, while the correction line served, as its name implies, for the reception and correction of all errors. But in the second system the correction lines were run by the block surveyors instead of the base lines. This method defeated the main object of correction lines. The exterior meridians of the blocks, which by theory are straight lines from correction line to correction line, had to be deflected in the quarter sections closing on the correction lines to allow for differences of measurement along these latter, while the base lines being run through the centres of the blocks by the surveyors of township outlines, had to be also deflected in closing on the exteriors, and the last quarter sections had also to be made of irregular width.

No comprehensive system of rules was ever laid down to guide surveyors as to where or how these discrepancies were to be allowed for, and the system was, after one year's trial, abandoned altogether on the adoption of the better planned methods of the third system.

Some difficulties arose in connecting the surveys of the third system with those of the second which had been previously established. A notable error arose in this way. The new system was three chains narrower in each range than the old. The first section on a new base line west of the old system has therefore to be made narrower than the theoretical eighty chains. In order to obtain the width of this section, the usual plan adopted was to subtract from

eighty chains three times the number of ranges of the old system. This gave an erroneous result, as allowance was not made for the divergence of the meridians. Suppose, for example, the eleventh base was to be surveyed west from the line between ranges sixteen and seventeen of the old system. Here the new base being forty townships north of the 49th parallel is forty times six chains, or three miles south of the old eleventh base. The divergence of the sides of one township in three miles is about forty links, and therefore this divergence in sixteen ranges will amount to sixteen times forty or six hundred and forty links. The width of the first section in range 17 of the new system therefore, instead of being, as appears at first sight, 80 chs. — 3×16 chs. = 32 chs., in reality should be 32 chs. — 6.40 chs. = 25.60 chs., and a surveyor who had not allowed for this would find, at his first closing, a correction line with a correct base line of the new system, an error in the jog of 6.40 chains. For computing this correction accurately, the best plan is to take from table 2 of the Manual the number of seconds of longitude in one range according to the new system for the base in question. A similar quantity for the base line of the old system will be found in a table published in the Surveyor-General's Report for 1879. The difference of these longitudes is to be multiplied by the number of ranges. This result in seconds, multiplied by the length of one second of parallel in chains at the latitude of the new base line (the logarithm of which is given in table 2 of the Manual, under the heading of Log. P. Sin. I) gives the number of chains in the required correction.

Another difficulty which occurred was in properly surveying the broken townships or narrow ranges adjoining the old system. However, as this is covered by the instructions in the Manual and is now well understood by all surveyors, I need not dwell upon it.

In all these systems of survey, the establishment of the correction line has been the most intricate part, and many difficult cases have arisen. Instances are not wanting where a large error in chainage on one of the meridian outlines has thrown the correction line so far out of position that the sub-divider in running the correction line has found his line of posts on the north side of the road actually crossing the line of posts on the south side. In a case like this, the only remedy which can properly be applied is the entire re-survey of the outlines.

A similar difficulty often occurs in the broken range adjoining a principal meridian. The jog on the correction line at the eastern boundary of this last range being very large (about a mile and a half) if the posts on the meridian are some chains too far north compared with the base lines, the surveyor who establishes the correction line according to the instructions contained in the Manual of Survey, by joining the post on the meridian south of the road with the other southern post may find that his line actually passes north of the post planted by the outliner as the south-eastern corner of the township north of the correction line, or if the error is not so serious, yet the width of the road is greatly decreased. Or, on the other hand, if the error on the meridian is to the south instead of the north, he may find his road several chains wide opposite the western end of the jog. This case is not governed by the instructions given in the Manual, although it occurs to a greater or less extent at every correction line where it adjoins a principal meridian. It has been ruled, however, that the proper procedure in such a case is to establish a temporary corner one chain south of the outliner's iron post at the western end of the jog, and to connect this point by straight lines with north-eastern and north-western corners of the township south of the correction line, so as to make the road the proper width throughout, although the northern boundary of the southern township will be made crooked.

Again, where there is one more range line run from the southern base than there is from the north, a turning point may be established one chain north of the bar at its northern extremity, making in this case the southern

boundary of the northern township crooked. These methods should not however be resorted to, unless the error seriously increases or decreases the width of the road. Perhaps fifty links of increase or decrease would not be too great a limit.

Some minor difficulties in the interpretation of the Manual have arisen, but is not necessary to refer to them here, as they are merely matters of detail, and not material to the principles of the system.

In this brief paper I have endeavored to examine into the advantages, and also the defects of our system of survey, and I have tried to show that the system is as good a one as could have been devised. Now that the surveys have been extended over such a wide extent of country, comprising almost all the prairie regions of the North-West, we can look at them as a whole, and consider whether a system, so perfect in principle, has given in practice correspondingly good results. I think the verdict of an impartial observer would be that this has been the case, and that the surveys of the North-West as regards accuracy, economy, and the rapidity of their execution, can compare favoraby with those of any other country in the world.

The next paper read was by G. B. Abrey, on "A new form of Field Instrument." Two solar instruments of his design were exhibited in connection therewith.

## A NEW FORM OF FIELD INSTRUMENT.

Some years ago I had a transit made at Philadelphia to order, of somewhat special and elaborate design with horizontal circle reading to 10″ of arc, &c. This instrument had attached to the lower plate a solar which was capable of a good degree of precision in adjustment and use, but from its exposed position extending on one side of the main instrument, was liable to get out of adjustment as well as—from the same cause—preventing good adjustment of the main instrument. I detached this solar and had one of my own design constructed and placed on the top of the telescope. The principle of this last one was good, but was on rather small a scale, and it also threw the instrument out of symmetry too much for precise adjustment, and therefore I removed it also and had another one similar in principle but symmetrically mounted and on a larger scale, made during last summer. This is the instrument you see here and the one I desire now particularly to describe. You will observe that it is not an attachment to a transit, but is a part of the transit instrument capable of all the precision and convenience of the best transit theodolite, and when set equatorially, will do all the work of an equatorial instrument of equal power and dimensions. It consists of plates, tangent screws, standards &c., same as other transits of its class. The new feature for your attention being the telescope, its method of mounting and its attachments.

First the telescope is mounted in Y bearings on the standards. The cross axis may be reversed in these Ys end for end, and the telescope may be revolved over between the standards at the eye end. The cross axis has a large hollow ring turned in its centre, and the telescope is mounted in the centre of this ring in Y bearings so as to be capable of revolution on its own longitudinal axis in these, or turned end for end in them similar to that of the cradle theodolite. It is capable of adjustment to centre over spindle to centre of its cross axis, and to a right angle with the cross axis, striding levels are provided, reading to 10″ of arc, for the cross axis, and for the telescope tube. There is a verticle circle of 5 inches diameter reading to 20″ by two opposite double verniers. This circle is provided with a latitude level to 10″ attached (and adjustable for index error) to the vernier limb. This circle may be used

with the vernier clamped either to its circle or to the standards as may be desired, and in either case there are convenient adjustments for eliminating the index error or as the circle is secured to the cross axis by a clamp nut only, it may be easily removed from the instrument altogether. A long diagonal eye piece accompanies the instrument for sighting when the telescope is in a vertical position.

The eye piece for ordinary use is provided with a revolving disc covering an open sight, a colored glass for sun observations and a prism converting it into a diagonal for use when required, either may be revolved to the eye lens or changed to another without any risk of disturbing the setting of the instrument.

There is attached to the telescope, in front of the object glass, a small reflector that is fixed to an axis with adjusting screws, the axis itself being placed at right angles to the collimation of the telescope.* The reflector axis is clamped at one end by an arm carrying a veruier that subdivides an arc of a circle attached to the telescope to 10″, or in reality to 20″ effective reading, as it is used for measuring angles of objects seen by their reflections. This arc extends both ways from its zero point so as to read to about 30° plus or minus, and sufficient to include the sun in its range of declination, and in connection with this instrument it is the declination arc.

The cross wires at the focus of the telescope are six in number; two of them are at right angles to each other, placed in the collimation axis; the others are placed one on each side of these, at equal distances from them and parallel therewith, so as to form a square around the collimation, the size of the square being calculated to just enclose the sun's disc when at its greatest distance from the earth.

There are also graduated semicircles attached to the ring of the cross axis, having their centres adjustable to coincidence with the centre line of the telescope; either one of these may be read by means of an index or pointer on the telescope. They are intended to serve as hour arcs when the instrument is set equatorially. They are graduated to 4 minutes of hour spaces only, and are not subdivided by a vernier, this being close enough for the purposes of the instrument. Hour circles are not essential to the use of the instrument as a solar, but often are very convenient as finders. Only one of these arcs is used at the same time; the other one is necessary when the telescope tube is changed in its Y's.

When the instrument is used as an equatorial for finding the meridian the adjustments should be very carefully made; they consist of say about nine in number, as follows:—

Placing collimation in centre of telescope.

Adjusting plate levels to right angles to spindle.

Latitude or cross wires and its striding level to right angles with the spindle.

Centre of cross wires to right angles with cross axis, and in centre over spindle.

Collimation horizontal, latitude zero and tube, striding level, and latitude level.

Reflector axis (declination axis) perpendicular to collimation and hour circle zero.

Reflector parallel to its axis.

Equatorial cross lines parallel to declination axis.

Declination zero, or the reflector at 45° to the collimation.

Several methods may be adopted for performing any one of these, and any one may be made independently of another or without reference to the sun or other heavenly object. It is not thought to be necessary to tire your patience

* This axis and reflector standing in front of the object glass obscures, of course, some of the light from the object glass, but not enough to be a serious detriment for ordinary work, and observations may be had directly through the telescope or indirectly by reflection.

with explanations of any methods of doing these now, but should anyone desire I will be glad to explain.

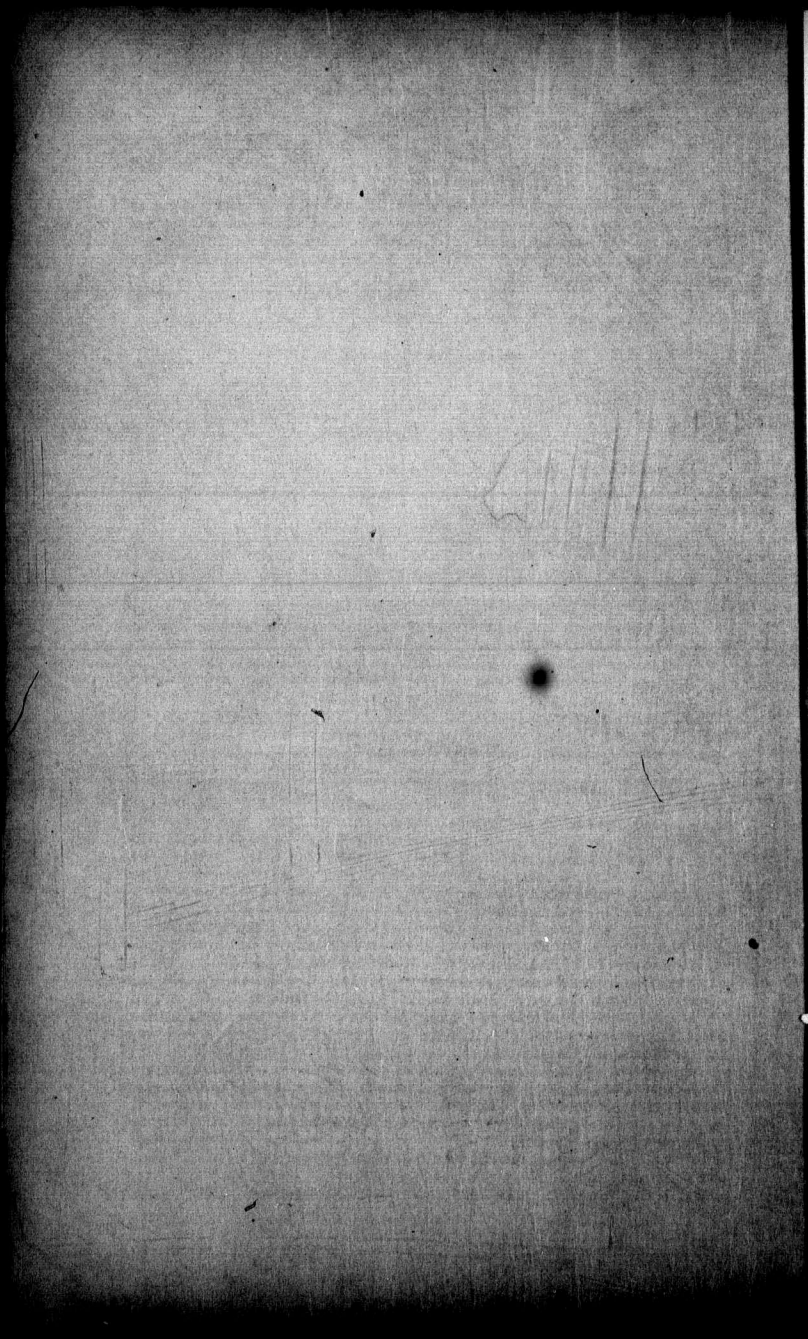
When all is adjusted, in order to find the meridian, I would suggest the following routine: Set up the instrument over the desired point with the latitude ascertained and laid off on the verticle circle, and the telescope (either end of it) elevated to that of the Pole, and with the sun's declination calculated for the time and place and corrected for the refraction, due to the latitude, declination, and hour angle of the observation, laid off on the declination arc, and also with the telescope revolved in hour arc to the apparent time of the day, turn the instrument on its spindle till the sun's image is seen by reflection through the telescope nearly in its centre, clamp the plates, then by either the lower or venier plate tangents, and by revolution of the telescope in hour arc bring the sun's image precisely into the centre of the cross web square. The collimation of the telescope should then be in the meridian. The plates may be read at this or a mark set up in line. Next elevate the other end of the telescope to that of the Pole by laying off the latitude on the other side of the zero on the verticle circle; also set off the corrected declination on the other side of its zero on the declination arc as before. Revolve the vernier plate around 180° in azimuth, and by revolving the telescope in hour arc, etc., as before, bring the sun's image again into the centre of the web square, when the collimation should again be in the meridian. Read the plates or set a mark, and if not in same line as the first the mean between should be a close approximation.

If now the telescope be reversed end for end in its own Ys, two more settings may be obtained for the meridian and the mean of all may be had; during all these the striding level for the cross axis may remain on and the cross axis kept horizontal during the series, it being only necessary to keep the striding and latitude levels in their places for good results.

I had intended making some observations with the instrument to put its theory to a practical test, but have been so long getting it from the instrument makers, arranged as I desired that no satisfactory series of observations has been taken. I might say that during last fall I had the instrument with me on a survey, but only during one day did I get time to attempt to put this use of it in practice. The instrument then was not arranged quite as it is now; the declination was read off the verticle circle by means of a level instead of an arc of its own as now; neither was there the conveniences for adjustment. I took some observations for meridian in the manner above suggested; the result was, on the first trial with the declinating zero, not well defined, a difference of 24′ in plate readings with circle first E., then W., or an error of 12′ from the mean. I moved the instrument to the mean and adjusted the declination zero on the sun in this position. Then repeated the observation for meridian and obtained closely the same reading of the plates at both observations.

Since the instrument has been completed I have only been able to observe the sun a short time on Sunday last. I had not finished all the preliminary adjustments, but on the sun appearing a short time, I set it up out of doors and got a couple of pairs of observations on it, the result of which was a difference of ′, or 2½′ from the mean; both pairs gave the same mean. From my experience, I believe the mean of a pair of observations will ordinarily be much within a single minute of the true meridian. There is, of course, no calculation necessary after the observation is taken in the field, but the meridian is ascertained instrumentally, and lines in any desired azimuth may at once be set out. Also observations of this kind may generally be taken as quickly as they could on a back picket, and therefore on sunshine days lines may be produced or checked by an astronomic setting at every station.

All other field equitorials, or solars as they are usually called, that I have seen, or seen described, arranged as they are so as only to be capable of single



settings for meridian, and their various arcs reading only on one side of their zero points, and never capable of accurate adjustment, must necessarily always, if any or every part is not precise and as intended, run a curve on one side of the meridian during one half of the day and probably a curve more or less similar during the other half of the day.

Those defects, it is assumed, are eliminated by the mounting of the instrument described in the present paper.

The Auditor's report was read, and on motion adopted.

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## AFTERNOON SESSION.

Otto J. Klotz, President, in the Chair:

Thomas Fawcett read the following paper on "Selection, Equipment and Management of a Survey party."

## THE SELECTION, EQUIPMENT AND MANAGEMENT OF A SURVEY PARTY.

*Mr. Chairman and Gentlemen:—*

A subject like the one I have selected would doubtless have been treated much more exhaustively by one of the veterans in the profession, whose experience has extended over many years of work in the field. The subject is one in which all of us who have any experience whatever have had to interest ourselves. And my paper if it serves no better purpose may be the means of bringing out the experiences of those who are the most competent to deal with the matter. I may say in justification of myself for having brought the subject before you that in my practice as far as it has extended I have met with a fair degree of success, and without wasting your time over preliminaries, I will at once proceed to the matter of my paper as announced.

It is well known that the success of any expedition depends not only on the chief, the captain, or general, but upon every member of that expedition doing his part and co-operating with a view to the accomplishment of the work in hand. This can only be realized in the case of a survey party when every member of that party is a man of principle, and not that species which we sometimes read about that is always "looking for meal time and sundown." The important question here is—how are we to avoid worthless men? Some, in order to avoid imposition select their party from acquaintances. Should a sufficient number of desirable persons of our acquaintances wish to go there would be no necessity for selecting from strangers, and I can only see one objection to such a party, *i. e.* if there should be a disposition on the part of the members of the party to oppose the wishes of their chief. A party of old acquaintences would be more likely to form a combination against their chief than strangers would be, especially if restraint had been placed upon the familiarity with which they had been in the habit of meeting under other circumstances. That too much familiarity should exist between the chief and the members of his party is very undesirable. The position should be such that the word of the chief would be regarded as law and beyond questioning by every member of the party. The prerogative of the chief to direct and that of the members of the party to carry out the directions given—but more on this topic under the head of management of a survey party. I have advanced what appears to me to be the principal objections to a party made up entirely of acquaintances. But picked and tried men who have had years of experi-

ence, and whom you know are willing to go through fire and water if necessary, are among the most desirable class to select from—and as their services are worth more to the surveyor, more to the Government, and deserving of better remuneration than other members of the party, I may as well say here that the system of paying men in proportion to the value of their labors—a principle which is acknowledged to be right and fair—would be very desirable on a survey, and while the remuneration for the services might and should be limited, the surveyor should have the right to say who was worth 80 or 90 cents a day and who should receive $1.10 or $1.20. We know that on the Government surveys some men are paid ten dollars a month more than they are worth while others are paid that much too little.

You ask, what has this to do in the matter of selecting a survey party? I answer, the better class of men would have some inducement not only to join a survey party, but encouragement to do their best after they did engage if they could be assured that they would be paid according to their work. Before the selection of men could be intelligently made, a surveyor must have some knowledge of the character of the country where his season's work will be situated, since a class of men who would be desirable for prairie work might be altogether unsuitable for the woods, and where boating or canoeing must be done it is very desirable that men who have had experience be engaged for this work. Could I procure such a party as I would wish to prosecute a bush survey, I would only take men who could handle an axe and shoulder a pack. Then if it should become necessary in order to dispatch or to overcome difficulties, that all hands take an axe or carry a pack, the labor would be lightened and performed much more rapidly and pleasantly. And to this end, in engaging men and causing them to sign a contract, it is well to specify that they will be required to perform any labor required of them, as I have frequently heard of men finding fault if asked to carry a pack, to take an axe and chop, or to take a spade and build a mound, giving as a reason that they were engaged to chain, to picket, to team, to cook or something else which they had been told would be their work, or which had been specified in the agreement which they had signed. I believe in engaging my men from the assistant down, so that I can require him and them individually at any time I may think necessary to perform any work in connection with the survey. In regard to ages, I would select young men from eighteen years of age upwards. I would take young men about twenty in preference to unmarried men of thirty-five and upwards, as men of that age have generally acquired the habit of saving themselves when exertion would be much more desirable. And I always take unmarried in preference to married men. Most of us could infer a reason for this from experience, but for the benefit of those who have had no experience in the matter, I may say, that while young men as a rule become more contented the longer they are out in camp, married men become dissatisfied and find it almost impossible to stay until the end of the season. Again, men of intelligence I would always prefer to the illiterate, other things being equal. We generally find that fault-finding, insubordination, dissatisfaction, arises through ignorance and narrow-mindedness. It is not always easy to secure men of intelligence and ability for surveys where much labor is required, but when they can be obtained they are to be preferred. It may be well here to mention a few persons who are not desirable as members of a survey party: The man whose only object in going out is to see the country, because in many cases such parties are disappointed. They may have to take the train to where they will pass over a great part of the plains in the night time, or if during the day, they see very little of the country, and they may have to spend the entire season in bush and swamp fighting flies and mosquitoes, spending a miserable time uttering imprecations against the country generally and against surveys in particular. Another undesirable class are those who are delicate and wish to go out for the good of their health.

While some such may be benefited, and may acquire strength enough to endure the hardships, and return after the season's labors better and stronger men, yet they are liable to find themselves in positions which would tax the powers of endurance of the strongest, so that such run a risk which I would consider unwise, and not to be compared with many other methods of restoring to health. Another class is composed of those who think a survey an easy place to secure a good time, and at the same time earn some money; those who speak of a survey as a government pic-nic, and who wish to get a position with the party—not for the purpose of doing a fair day's work for a fair day's pay, but whose design is to do as little work as possible, while they expect as much pay as the best. Such men are indolent and the party is better without them. Nor are men who profess to know all about the work from the management of the instrument down always much of an acquisition. As far as my experience goes in the matter, those who professed to know the most knew the least, and were much more stupid than others who made no boast of their knowledge. In fact you sometimes meet men of this nature who are unteachable, and whom years of experience will not fit for becoming useful men on a survey. Nor are an armful of certificates and recommendations always evidence of ability. So little confidence do I place in certificates that I never ask a man to produce one. I found the best men I ever engaged had none, while other men whom I considered inferior could produce them in numbers as evidence of ability which they never possessed. In engaging men for a survey, I do not fail to tell them that they will be expected to do all the work they can, and that they needn't expect to have an easy time. It may not be out of place here to say a few words in regard to the appointment of assistants or an assistant. This is an important element. Since the assistant will require different qualifications according to the nature of the survey to be performed, he should therefore be appointed by the surveyor himself, or by some one personally acquainted with the man appointed with a knowledge of his fitness for the performance of the duties required of him. That men should be appointed to positions they are in no way qualified to fill is a mistake—shows a lack of judgment—as it is the cause of mistakes, which are annoying, disgraceful, and a source of loss in time and money.

In regard to the second part of my paper, viz: the equipment of a survey party, I need say very little, as experience has taught most of us what is needful; and those who have not had experience themselves can easily avail themselves of the experience of others in this respect. The great object to be attained is to secure as great an amount of comfort as possible, without increasing the bulk and weight of the outfit to unnecessary proportions. How this can be accomplished may be best studied out by every man for himself.

Persons who have had no experience in camp life are liable to take a great many things out to camp which are unnecessary, while they may not take a sufficient supply of such things as they require. It is therefore better to instruct each member of the party in regard to this matter before starting out, so that each may be properly equipped for the expedition. In regard to instruments, no one should start out without two of each kind that are absolutely necessary for continuing the work, as no one can tell what day he may find it necessary to use the second. At two different times last season, had I not taken two instruments, I could not have proceeded with my work. In the first place, while fording the Cascade river, I was swept off my feet by the strength of the current, and my instrument was broken. About six weeks later, after I had got the broken part repaired and returned to me, when crossing the Bow river, where the current was very rapid, my boat sank, and the instrument, which was on the tripod, was all broken to fragments by dashing against the rocks. From that I learned that it was not only necessary to have two instruments, but to have them in repair. If one should be broken, to at once take steps to have it repaired. Of course mine was an exceptionally

dangerous locality, but in any locality it is always better to be on the safe side, and have duplicates of everything that is perishable or liable to be lost or broken.

But leaving this matter to your own judgment, we will proceed to make a few remarks concerning the management of a survey party. And here a great deal depends on a proper organization, which will not be a difficult matter if the selection has been a good one. That surveys should be conducted, as far as possible, on a military basis is a provision eminently calculated to insure success, and as before stated, the word of the chief should be law when it becomes necessary for him to give directions; but that he should have to interfere where his experience and professional knowledge does not make it necessary—in matters where intelligent men should be able to discern their duties—is not desirable. In the first place, every man should receive the fullest information in regard to what he is expected to do. The sooner he is made acquainted with what is required of him the better; not only that, but let it be understood that no other course would be satisfactory or admissible. Let this be fully understood at the commencement, and as a rule there will be no trouble afterward, and it only becomes necessary for the interference of the chief when he sees on the part of any member of the party a disposition to neglect or shirk his duties. If the party should be made up of strangers it is needful that the chief should keep his eyes open, so that the person neglecting his duties should have his attention immediately directed to the matter. Should there be several disposed to shirk their duties, by discharging the worst one the defect would generally be remedied. If the party should be travelling in the absence of the chief, the movements should be directed by the person best fitted by experience and judgment to direct the movements. I need not say that this person should not always be the assistant. A person might be fitted by education and experience to assist in survey operations and perform the calculations who would be in no way competent to direct the movements of the party; and in that case it would only be necessary to ask the assistant to accompany the party which were travelling under the direction of the person appointed. It is always well to place someone in authority, and the person appointed should be a man who would put his shoulder to the wheel and take the lead—someone who, if the horses and carts got fast in a mud hole, would say come, and not a person who, from his seat in the saddle or buckboard, would say go. To illustrate my meaning, I may relate an incident which occurred to my knowledge. While two parties were travelling out with their carts together in the season of 1882, they came to a bad mud hole. In connection with one of the parties the assistant and all the men plunged into the mud up to their middle and lifted on the wheels to help the carts through, while every man of the other party sat on the top of his loaded cart and whipped his poor beast until it managed to plunge through if it could. One of the horses, with the teamster on the cart, got mired and down in the slough, while the poor fellow was on his load in the middle of the mud and water. I don't know what he would have done had not the assistant who had taken the water called to his men to come and give a hand. While they unhitched the horse and got it out, the man on the top of his load started to take off his boots, but the assistant told him to sit still or he might get his feet wet; so he sat there on the top of his cart while the members of another party pulled it out of the mud and took him to dry land, where he wouldn't have occasion to wet his precious feet. There we have an example of a party of men who knew their duty and who did it, while the other party were certainly making a bad start, whatever the end might be. On the one hand we see experience and ability displayed, on the other inexperience and donothingness. Nor do the men respect the chief who requires them to do things which are in themselves disagreeable any the less. They can see the wisdom of the step and are more likely to admire than disrespect. It raises within them a

competitive spirit and they begin to take an interest in the success of the expedition. When once that feeling of interest is aroused the men feel that they are laboring towards an end, and that that end can only be reached by exertion on their part individually.

Sometimes surveyors meet with what seem to be insurmountable difficulties, obstacles which seem insuperable, and the surveyor himself is puzzled in regard to what method to adopt in overcoming the obstacle. If it is something that must be overcome, it is not best to admit that the task would in any way prove difficult. It might be best in some cases to camp for the night until plans shall have been matured. It is not best to act too hurriedly, nor is worth while to spend as much time thinking out an easy way as it would take to accomplish the work by labor. If a way of overcoming the difficulty is readily seen, go in with a will, and what at the first view seemed to possess mountainous proportions will dwindle down until it is transformed into a small hill, and we are led to wonder after the work is done, that we ever thought it such a difficult task. When ordinary obstacles are met with it always facilitates things if the picket man or some man ahead on the line is competent to take the necessary steps to overcome it. A lake or stream to be triangulated will generally involve much less loss of time if there is some one to lay out the base or, if in the woods, have the timber cut away and have all ready for measuring the angles when the instrument is brought forward. I have been asked the question: When you come to a place so rough that you cannot use your horses in packing without spending more time in making a good road than it would take to pack the camp along the line how do you proceed? In my experience I have had the camp carried along as the line was produced. The party being too small to appoint any of the men to that part of the work exclusively. Every man was required to carry a pack at times, but in very heavy timber the chainman and cook were generally able to keep the camp outfit up to the line, but every one was expected to take hold and assist in the work when there was occasion for him to do so. But it would be impossible to lay down any set rules for guidance in the management of an expedition when the circumstances vary so often as they do on our surveys. There will be no such thing as success attend the movements of an expedition of any kind unless there is executive ability on the part of the leader. Not only must he be ready to encounter difficulties, endure hardships, be exposed to danger, submit to isolation, but he must be determined to succeed. Let nothing cause him to lose courage. As the courage of the leader on the field of battle seems to electrify and to impart nerve to every soldier under his command, just such effect is produced by the energy of the leader of a party that is battling with the forces of unsubdued nature.

In conclusion I would say to every member of the profession in the language of the poet, Holmes,

> Be firm; one constant element of luck
> Is genuine, solid, old Teutonic pluck.
> Stick to your aim: the mongrel's hold will slip,
> But only crowbars loose the bulldog's grip;
> Small though he looks, the jaw that never yields
> Drags down the bellowing monarch of the fields!

Honorary Member Prof. Macoun, upon request of the President, made some very practical and useful remarks regarding the "Collection of Natural History Specimens by Surveyors."

Honorary Member Dr. Bell, who was also present, was unable on account of a severe cold to favor the meeting with some remarks.

It was moved by Wm. Ogilvie, seconded by G. B. Abrey, and

Resolved, That a deputation consisting of the President, Secretary and Executive Committee wait upon the Honorable the Minister of the Interior and urge upon him the necessity and justice of having the survey of that part of the Province of British Columbia, granted to the Dominion Government by the Government of that Province for railway purposes, made in accordance with the system of survey which governs the survey of other Dominion Lands, and by Dominion Land Surveyors only.

It was moved by Tom Kains, seconded by Wm. Ogilvie, and

Resolved, That the voice of this Association be conveyed to the Minister of the Interior, that when the vacancy of Chief Inspector of Surveys is to be filled, the appointment of the present Inspector of Surveys to the same would give universal satisfaction to the Profession.

It was moved by Thomas Fawcett, seconded by C. E. Wolff, and

Resolved, That the words "be held" in clause seven of the Constitution be changed to "commence," notice of such proposed change having been given at the last annual meeting.

It was moved by Jno. A. Snow, seconded by J. P. B. Casgrain, and

Resolved, That the Association of Dominion Land Surveyors in their annual meeting assembled, considering the advantages that they would derive from incorporation, apply at once to Parliament for such legislation.

It was moved by Wm. Ogilvie, seconded by W. Chipman, and

Resolved, That the President, Vice-President, J. A. Snow, E. J. Rainboth, J. F. Snow, P. Dumais, C. A. Bigger, Tom Kains, C. E. Wolff and the Secretary form a committee to frame a Bill to be presented to Parliament to incorporate the Association of Dominion Land Surveyors, with such powers, privileges and prerogatives as may, in their opinion, conduce to the existence and well-being of this Association.

It was moved by C. F. Miles, seconded by Wm. Ogilvie, and

Resolved, That the necessary incidental expenses in connection with the incorporation of the Association of Dominion Land Surveyors be defrayed by this Association, and that the Secretary pay the expenses so incurred upon the order of the President.

It was moved by W. Chipman, seconded by Thomas Fawcett, and

Resolved, That the proceedings of the Association of Dominion Land Surveyors at its second annual meeting be printed, and that the Constitutino as amended, with the By Laws, be incorporated in the proceedings; also that the addresses, as well as the names of all the members of the Association be given.

It was moved by C. F. Miles, seconded by E. Bray, and

Resolved, That a vote of thanks be tendered the President, Messrs. Snow, King, Abrey, and Fawcett for their very interesting papers read before the Association during this session.

The annual meeting then closed.

(*Thursday, February* 19.)

The Railway Committee succeeded in making favorable arrangements for reduced rates with the Grand Trunk Railway, the Chicago & Northwestern, the Chicago, Milwaukee & St. Paul, and the St. Paul, Minneapolis & Manitoba Railway.

The Incorporation Committee was busy considering the various clauses for the proposed Bill.

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(*Friday, February* 20.)

The Incorporation Committee again met and discussed the various clauses for the proposed Bill As soon as the compilation thereof is made it will be submitted to the Minister of the Interior for his approval or rejection, for in the latter case it would not be brought before the House.

The proposed Bill contains amendments to the Dominion Lands Act, and will be a Public Act.

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## HONORARY MEMBERS PRESENT.

W. F. King, Inspector of Surveys. Prof. Macoun. Dr. Bell.

## MEMBERS PRESENT.

Otto J. Klotz,
Wm. Ogilvie,
Thomas Fawcett,
Edgar Bray,
C. F. Miles,
A. C. Talbot,
Willis Chipman,
C. A. Bigger,
G. B. Abrey,
Jno. A. Snow,
Tom Kains,
J. F. Snow,
J. J. Burrows,
S. L. Brabazon,
J. E. Sirois,
P Dumais,
J. W. D'Amours,
C. E. Wolff,
J. P. B. Casgrain.
J. S. O'Dwyer,
A. Niven,
T. D. Greene,
S. M. Starkey,
E. J. Rainboth,
A. O. Wheeler,
J. A. Kirk,
S. Bray,
A. F. Cotton.

## Treasurer's Statement of Receipts and Expenditure for the Year 1884

### ASSOCIATION OF DOMINION LAND SURVEYORS.

| RECEIPTS. | | | EXPENDITURES. | | |
|---|---|---|---|---|---|
| 1884. | | | 1884. | | |
| Feb. 20 | To Cash on hand | $ 86 60 | March | By Woodburn, printing | $ 28 25 |
| " | Fees for 1884 | 294 00 | " | " " " | 13 00 |
| " | Arrears | 10 00 | " | Hope, stationery | 3 55 |
| " | Memorial fund | 19 35 | " | Shepherd, blackboard | 5 50 |
| | | | " | Grignard, lithographing | 30 00 |
| | | | " | Woodburn, stationery | 4 00 |
| | | | " | " " | 2 50 |
| | | | " | " " | 3 00 |
| | | | " | Postage, telegrams, &c. | 9 57 |
| | | | " | Rent of room | 5 00 |
| | | | " | Postage and telegrams | 3 00 |
| | | | " | Secretary-Treas., services (three years) | 50 00 |
| | | | " | Balance | 252 58 |
| | | $409 95 | | | $409 95 |

Examined and found correct.

EDGAR BRAY,
C. F. MILES, } *Auditors.*

## LIST OF MEMBERS WITH RESIDENCE.

Abrey, G. B.....Toronto, Ont.

Bray, Edgar.....Oakville, Ont.
Bray, S..... .....Ottawa.
Bigger, C. A..... .....Ottawa.
Burke, Jos ..... .....Winnipeg.
Breene, Thomas .... .....Ottawa.
Burnet, Peter .....Orillia, Ont.
Burrows, J. J.....Ottawa.
Beatty, Walter.....Delta, Ont.
Beatty, David .....Delta, Ont.
Brabazon, S.L...Portage-du-Fort, Q.

Cotton, A. F.....Ottawa.
Chipman, Willis...Brockville, Ont.
Crawford, Wm .....Winnipeg.
Casgrain, J. P. B..... Quebec.
Carre, H .....Brockville, Ont.

Dufresne, J. J. .....St. Thomas de [Montmagny, Q.
D'Amours, J. W.....Quebec
Dumais, P. T. C.....Ottawa.
Drummond, T.....Montreal.
Doupe, J.....Winnipeg.
Duchesne, L. M.....St. Roch, Q.
Dupuis, Z. C.....Montmagny, Q.
Dudderidge, J.....Lachute, Q.
Deane, M..... ....Lindsay, Ont.

Ellis, H. D.....London, Ont.

Francis, Jno .....Winnipeg.
Fawcett, Thos....Gravenhurst, Ont.
Fitton, C. E.....Orillia, Ont.
Foster, F. L..... ....Toronto, Ont.

Garden, J. F..... Toronto.
Gore. T. S.....Gore's Landing, Ont.
Greene, T. D..... Ottawa.

Hermon, E. W ...Rednersville, Ont.
Hart, Milner.....St. Mary's, Ont.
Harris, J. W..... Winnipeg.
Hubbel, E. W..... ...Ottawa.

Klotz, Otto J.....Preston, Ont.
Kirk, J. A.....Stratford, Ont.
Kaine, Tom .....Hamilton, Ont.

Lewis, J. B..... ..... Ottawa.

Miles, C. F..... Toronto.
McMartin, G. E....St. Andrew's, Q.
Michaud, L. J..... Rimouski, Q.
McVittie, A. W....Calgary, Alberta.
Maddock, J .....Norwood, Ont.
Mountain, G. A..... .....Ottawa.
McPhillips, G..... Winnipeg.
McPhillips, R..... ..... Winnipeg.
McAree, Jno. A..... ....Toronto.
McLatchie, John..... .....Winnipeg.
McLean, J. K..... ....Elora, Ont.

Niven, Alex.....Haliburton, Ont.

Ogilvie, Wm..... ..... Ottawa.
Ord, L. R..... .....Ottawa.
O'Dwyer, J. S..... .... Granby, Q.

Pearce, Wm..... .....Winnipeg.
Patrick, L..Portage la Prairie, Man.
Purvis, F..... Eganville, Ont.
Patton, T. J.... ..... Toronto.

Robertson, H. H.....Montmagny, Q.
Rainboth, G. C..... Aylmer, Q.
Rauscher, R..... .....Ottawa.
Ross, Geo.... .....Beaverton, Ont.
Reid, J. L .....Port Hope, Ont.
Reiffenstein, J. H..... Ottawa.
Rainboth, E. J..... Aylmer, Q.

Snow, J. A..... ..... Ottawa.
Snow, J. F..... ..... Ottawa.
Starkey, S. M..... ....Starkey, N.B.
Stephens, H. H....Owen Sound, Ont.
Sirois, J. E..... .....Kamouraska, Q.
Simpson, G. A..Edmonton, Alberta.

Traynor, Isaac..... Dundalk, Ont.
Talbot, A. C.....Montmagny, Q.
Talbot, P. C.....Montmagny, Q.

Wolff, C. E..... .....Ottawa.
Wagner, Wm.....Ossowa, Man.
Webb, A. C..... ....Brighton, Ont.
Wheeler, A. O....Collingwood, Ont.