PROCEEDINGS

OF THE

ASSOCIATION OF DOMINION LAND SURVEYORS

AT ITS

FIRST ANNUAL MEETING

HELD AT

OTTAWA, FEBRUARY 19 and 20, 1884.

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THE ASSOCIATION OF DOMINION LAND SURVEYORS.

Organized April 24th, 1882.

OFFICERS FOR 1884.

PRESIDENT	OTTO J. KLOTZ.
VICE-PRESIDENT	A. C. TALBOT.
SEC.-TREASURER	A. F COTTON.
EXECUTIVE COMMITTEE	WM. PEARCE. G. C. RAINBOTH. J. P. B. CASGRAIN.
AUDITORS	C. F. MILES. E. BRAY.

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Armstrong, F. W.	Dupuis, Z. C.	Ogilvie, Wm.
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Bray, Edgar	Francis, Jno.	Pearce, Wm.
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Burke, Jas.	Garden, J. F.	Purvis, F.
Breene, Thos.	Gore, T. S.	Patton, T. J.
Beatty, D.	Hermon, R. W.	Robertson, H. H.
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Cotton, A. F.	Kains, T.	Sing, J. G.
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Crawford, Wm.	Miles, C. F.	Simpson, G. A.
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Drummond, Thos.	McArthur, J. J.	Wilkins, F. W.
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Doupe, J.	Mountain, G. A.	Wagner, Wm.

HONORARY MEMBERS.

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

FIRST ANNUAL MEETING

—OF THE—

ASSOCIATION OF DOMINION LAND SURVEYORS

—HELD AT—

Ottawa, February 19 and 20, 1884.

THE ASSOCIATION assembled Tuesday, February 19th, in St. Andrw's Hall, at 3:30 P.M.

OTTO J. KLOTZ, President, in the Chair.

On motion, the minutes of the preceding meeting were confirmed.

The President then delivered his Annual Address:

GENTLEMEN—It affords me pleasure at again meeting you at this our first annual meeting of the Association of Dominion Land Surveyors. The object of our Association is, as stated in the Constitution, "the promotion of the general interests, and elevation of the standard of the profession."

As all beginnings are difficult and arduous, the record of our first year is naturally small, but I think a foundation has been laid, upon which a permanent structure can be raised creditable to the members; but we must bear in mind that no achievement can be attained without labor and perseverance, and unity of purpose. We have already strengthened the bond of friendship and sympathy, and may it so continue.

To revert to the proceedings of the year. Our meeting last year, as you are aware, was called specially for the purpose of considering certain matters to be brought before the Government. At that time a memorial was drawn up and presented by the members to Sir John A. Macdonald, who promised to take the matter into consideration. To this memorial no further reply was ever made than an official acknowledgment of the receipt thereof. Semi-officially we were informed that certain recommendations had been suggested by officials in the Department to the Minister, which were favorably received by us, but whether they have been acted upon I am not aware. I regret in my last year's address having unconsciously omitted to insert an extract from the Surveyor-General's report of 1876. I will read the original to you:—

"The cost of block lines surveyed to the present time averages $36.83 per mile.

The cost per acre of subdividing the blocks of four townships into sections and quarter-sections has been 2.91 cents, adding the cost of the block lines

to the above acreage rates, makes the total cost of all the township lands surveyed to date to be 3.83 cents. The survey of the settled lands in the parishes on the Red and Assiniboine rivers has been more expensive, having cost $27\frac{3}{10}$ cents per acre. This, however, cannot be considered an extravagant price, when it is remembered that an immense amount of work was involved in surveying and mapping the lands in the several parishes, showing all the holdings, with the exactness required to admit of their being described in Letters Patent; adding the expenditure for Settlement Belt surveys to that for subdividing township lands, we obtain the average cost for all farm lands surveyed to this date 4.57 cents per acre.

Let us compare the Township Survey rates proper, *i.e.*, 3.83 cents, with the relative cost of township surveys in Quebec and Ontario.

It may be premised that previous to the Union of Upper and Lower Canada, in 1841, the surveys in the respective Provinces were performed with the ordinary Surveyor's compass, the lines being run by the magnetic needle, and were therefore subject to gross errors, arising from the effect of local attraction upon the needle; also from Surveyors not ascertaining the variation of the latter when making their surveys; and further, no check lines were drawn in any of these surveys previous to the year 1829, the result of all which was that the lots of land were not of the form or area intended, the concession or range lines in some cases being so crooked as to reduce some of the lots to one-fourth of their intended area, and increase others proportionately, giving rise to subsequent endless law suits and difficulties between owners of the adjoining lands.

Further, surveys made by the magnetic needle did not involve the opening out of lines by cutting down trees, &c., and Surveyors could therefore draw their lines much more rapidly than by the astronomical method, which requires all obstacles to be cleared.

Since 1841 Crown Land surveys have been performed astronomically, and check lines have been run, thus ensuring accuracy in the form and area of the lots or sections.

In stating the average cost per acre of the earlier Crown land surveys in Upper and Lower Canada, the amount of work performed in surveying is not shown, so that the rate cannot be fairly compared with the present rates. In the former only one boundary of the lot, the front, was surveyed, at present all the four are drawn, thus in the old surveys the running of one mile of line gave 800 acres, now it gives only 160 acres.

The average cost of the Crown Lands surveyed in Upper and Lower Canada, from 1841 to 1875, was $6\frac{4}{10}$ cents per acre, each mile bounding 200 acres.

The Dominion Land township surveys on the other hand have been made for 3·83 cents per acre, each mile bounding only 160 acres. At equal boundaries the proportion would be $6\frac{1}{10}$ to to $3\frac{8}{10}$ cents per acre.

It is, therefore, respectfully submitted: "That taking in consideration the great distance of Manitoba from the older Provinces, and from its basis of survey supplies, Chicago or Ontario, the increased cost of supplies, and the

larger pay, and the travelling expenses of surveyors and their parties, and finally, looking at the superior character of the Dominion Land surveys, the latter have been economically performed."

Now, gentlemen, in the report for 1881, we find the cost of block lines given at $19.20, and of township outlines at $19.10 per mile, only about fifty per cent. of the cost in 1876; and last year I doubt whether some of the block lines will be $15.00 per mile, or only forty per cent of what Lieut.-Col. Dennis considered reasonable.

The question now arises, how has this change been brought about? To which the answer is, I think, that the allowances have been curtailed and the surveyors have performed more work in a season. We must admit, though, that where so large a staff is employed, as the last few years, things had to be carried on in a more business-like manner than when the number was small. for this reason no exception shall be taken to such departmental regulations as involve only business principles.

In a paper on "Legislative Needs of Surveyors," read before the Michigan Association of Surveyors and Engineers, the author says: "The legislative needs of surveyors themselves are very few, and considering the evident disposition of the Legislature to so regard them, we are reminded of the couplet:

"Man want but little here below,
And ——— he gets it."

In this there is considerable force. But let not our energies flag even if in this direction our efforts have not been crowned with success, for there are other motives—worthier ones—the elevation of the standard of the profession that should stimulate us with renewed exertions.

In other countries similar associations exist and do good service, not only by diffusing knowledge, by interchange of ideas. by discussing practical problems, but it also places before the public the surveyors as a profession, commanding respect which must result to our pecuniary benefit. In the neighboring State of Michigan an association was formed four years ago, it now numbers about 150 members, and here are their proceedings of last year, a most interesting and instructive book it is. It contains "papers" on various subjects. Their meeting extends over three days and evenings. Another one here is from Germany, and so there are many of others in America and Europe. With these facts before us, should there be any reason why we could not do likewise. I see none.

Every member can furnish his quota towards the ultimate success. Every one meets with difficulties in his work and overcomes them; notices defects in instruments, or improves devices; learns or discovers certain facts in nature by experience—all topics that can be prepared into a "paper" and read at our meetings. Nor is this all. In books we find a great many things that we want and many things we don't want. Again, certain subjects we will perhaps find curtailed, or not in a desirable form for a surveyor. Here is a field for preparing a "paper" by compilation or condensation, so as to make it meet the wants of many. Really, original professional papers and books, there are far less in the world than one imagines. They are mostly compilations of

already known facts, but put into such a form as to meet the wants of a particular class. As an instance, I lately received a work "The Topographer," having read a favorable review of it in *Engineering Magazine.* After perusal of the same I said to myself, "Well there is scarcely anything in this that I have not read somewhere before. But instead of being obliged to wade through many books, I have here the matter gathered in one, although little or ginal, yet acceptable.

It will be necessary, in order to do justice to our annual meeting, that the same be extended beyond one evening's session. Members shall be permitted to ask questions on professional subjects which will be submitted to a committee for reply. It would be desirable also to obtain the proceedings of other associations for distribution among our members.

I am glad to see the meeting of the 14th inst. adjourned till to-day for the purpose of joining our Association. I understand that there has been some correspondence with the various railway companies with a view of obtaining reduced rates; such reduced rates to be given to surveyors upon production of a certificate entitling him thereto. Such certificate should naturally issue from the Association, and not from the Government; for in the first place it is doubtful whether the Government would take the matter in hand, even with the surveyors in their service and certainly not for outside surveyors, thus debarring a number of surveyors from such reduction who are fully entitled to the same.

With reference to incorporation, I see no advantage to be gained by incorporation unless it were desirable to obtain control of the examinations for Dominion Land Surveyors. I think these examinations are carried on in a very efficient manner, by impartial examiners, under appointment from the Government, and therefore have very grave doubts whether an improvement can be made in this direction. Otherwise I think we have, as it is, all ample privileges and power to do our legitimate business; besides, incorporation would probably cost us $100. In any resolution that we may pass for our guidance, we must trust to the integrity and honor of every one for its individual adoption, and no Act of Parliament would add anything to its force; and it is questionable whether very extensive power would be granted us by Parliament.

It seems an anomaly that in our Dominion there should be so many examinations for Surveyors, each one with limited jurisdiction. Instruments, mathematics, astronomy, and the stars are certainly equally applicable from British Columbia to Nova Scotia. The difficulty lies in the Act pertaining to the method of survey. Each Province has her own Crown Lands, and makes her own laws relative to the survey thereof and other lands in general. Consequently if there be no consolidation of "the Land Act" of the various Provinces, there can be no general examination for Dominion Land Surveyors, in the full sense of the term.

I think I have alluded to the important points necessary for the continuance of our Association—that it may exist and thrive, and not only vegetate—trusting that we all, in this matter, will show that perseverance and endurance so characteristic of a Surveyor in the field.

On motion of Thos. Drummond, seconded by William Crawford, the following Dominion Land Surveyors were elected members of the Association, subject to payment of the fees :—

G. B. Abrey,	J. A. Kirk,	J. F. Snow,
Jos. Burke,	C. Aylen,	J. A. Snow,
Thos. Breene,	P. C. Talbot,	Wm. Wagner,
Peter Burnet,	L. M. Duchesne,	R. Rauscher,
Willis Chipman,	Z. C. Dupuis,	A. Driscoll,
J. J. Dufresne,	G. E. McMartin,	J. P. B. Casgrain,
J. W. D'Amours,	L. J. Michaud,	W. Beatty,
P. T. C. Dumais,	G. A. Mountain,	D. Beatty,
J. J. Burrows,	L. Patrick,	G. A. Simpson,
Jno. Francis,	F. Purvis,	Wm. Murdoch,
T. S. Gore,	H. H. Robertson,	Geo. McPhilips,
Robt. McPhilips,	Geo. Bemister,	J. Kirk,
M. J. Charboneau,	R. J. Jephson,	J. McAree,
A. C. Webb,	J. B. Lewis,	T. J. Patton.

It was moved by A. F. Cotton and seconded by Thos. Drummond and

Resolved, That Captain E. Deville, W. F. King, Andrew Russell, Prof. Selwyn, Prof. Dr. Bell, Prof. Macoun, Prof. Harrington, E. E. Taché and Dr. G. Dawson, be honorary members of this association.

Wm. Crawford reported the offers of various railroad companies granting reduced rates to surveyors of the association.

EVENING SESSION.

OTTO J. KLOTZ, President, in the Chair :

The officers for the ensuing year were then elected.

Thos. Fawcett and A. C. Talbot acted as scrutineers.

President—Otto J. Klotz.

Vice-President –A. C. Talbot.

Sec.-Treasurer—A. F. Cotton.

Executive Committee—Wm. Pierce, G. C. Rainboth and J. P. B. Casgrain.

Auditors—C. F. Miles and Edgar Bray.

It was moved by Thos. Drummond and seconded by Thos. Fawcett that at the next general meeting the words "be held" in clause seven of the constitution be changed to "commence."

It was moved by Thos. Fawcett and seconded by Thos Drummond that the President, together with the Executive Committee, J. A. Snow, Wm. Crawford and Wm. Wagner, be appointed to communicate to the representatives of the railways, the action of this meeting, and make further inquiries in in regard to certificates which shall be adopted by the Committee appointed.

It was moved by Wm. Ogilvie, seconded by J. P. B. Casgrain, and

Resolved, That the Secretary be authorized to correspond with the various instrument makers and dealers, and outfit supply dealers with a view of obtaining reduced rates thereon to the members of this association.

It was moved by Jos. Burke, and seconded by A. W. McVittie, and

Resolved, That this association communicate, through its Secretary, with the cattle association of Fort Macleod, with a view to procuring the liberty of one Wm. Adshead, an employee of Mr. L'Amours, D. L. S., who, in Sept. 1883, was sentenced to a term of two years' imprisonment for killing a beef, the property of Emerson and Lynch, of High River.

FEB. 20.—AFTERNOON SESSION.

OTTO J. KLOTZ, President, in the Chair :

It was moved by J. H. Reiffenstein, and seconded by G. C. Rainboth, and

Resolved, That Mr. Bolton McGrath be an honorary member of this association.

It was moved by Wm. Crawford, and seconded by G. C. Rainboth, and

Resolved That in the opinion of this association the members should patronize the Chicago, Milwaukee and St. Paul Railroad, as they have shown more willingness to meet our views.

It was moved by Wm. Crawford, and seconded by G. C. Rainboth, and

Resolved, That a copy of the recommendation in favor of the members of this association, travelling via the Chicago, Milwaukee and St. Paul Railroad and of this resolution be forwarded to Mr. Stephenson, General Passenger Agent of the Grand Trunk Railway. And that the Secretary shall call the attention of Mr. Stephenson to the fact that the Grand Trunk is the only railway between here and Chicago, mentioned on the back of the certificate of members of this association obtaining special rates.

The President then read the following papers on projections :—

My object in selecting this subject was to compile in a condensed form the principal methods used in Projections, as the subject is barely touched upon in works on surveying, and thus difficulty is experienced in obtaining information thereon. The best treatise on the subject is found in the United States Coast Survey Reports.

The object of Maps and Charts is to represent a portion of the Earth's surface upon a plane surface and a reduced scale with as much accuracy as possible. As it is impossible to represent a spherical surface exactly on a plane surface, different devices or methods have been adopted according to the extent or position of such portion of the Earth to be shown, or to meet special requirement.

The oldest forms of Projections are the perpective projections, as these depend upon the position of the observer's eye. Commencing with these we have :

FIRST—The "Orthographic Projection," in which the eye is supposed to be situate at an infinite distance, the projecting rays being parallel. The

plane of that circle of the sphere on which the representation or projection is made, is called the Primitive Plane; and the intersection of this plane with the surface of the sphere the Primitive Circle. In figure 1, the projection is made on the plane of a meridian, the parallels of latitude being projected into straight lines and the meridians into ellipses, the major axes of which equals the diameter of the sphere, and the minor axes to twice the cosine of the inclination between the plane of projection and the plane of the circle to be projected. In figure 2, we have the equator for primitive circle, and as the intersection of the planes of the meridians lies in the axis of the primitive circle, the meridians will be projected into straight lines and the parallels of latitude into concentric circles with radii equal to the cosine of the latitude, It will be noticed that in this projection the outer portions of the sphere are very much contracted.

SECONDLY—Comes the "Stereographic Projection." In this the eye is supposed to be upon the surface of the sphere, and to occupy the pole of the primitive circle, from which it is seen that all circles—the planes of which are parallel to the primitive plane—are projected into circles, the radii of which are equal to the semi-tangents of their polar distances. Also the projections of all circles, the planes of which are oblique to the primitive planes and whose planes do not pass through the eye, are circles. This property is demonstrated by the sub-contrary section of an oblique cone with a circular base. Another property of this projection is, that if two arcs cut each other upon the surface of the sphere at a certain angle, their projections will have the same angle. In figure 3 the projection is made on the plane of a meridian, and in figure 4 on that of the equator. This method wus invented by Hipparchus 150 B.C., the most eminent of the ancient astronomers.

THIRDLY—Supposing the eye placed in the centre of the sphere and the primitive plane tangent to the surface: this produces the Gnomonic or Central Projection, and was introduced by Thales of Miletus 600 B.C. The eye being in the intersection of the planes of all meridians, it follows that they will always be projected into straight lines. A hemisphere can not be shown by this method as the projection would be at infinity. In figure 5 the primitive plane is tangent at the pole, the radii at the projected circles being equal to the tangent of the polar distance.

In figure 6 the primitive plane is tangent at the equator.

This method has been employed for the construction of star charts, and more recently for delineating the apparent track of shooting stars, on account of the facility with which the radiant point can be found; great arcs of the sphere appearing as straight lines on the projection.

FOURTHLY.—The "Globular, or equi-distant Projection," in which the eye is supposed to be $\sqrt{\frac{1}{2}}$ times radius, or Sin. 45° radius above the sphere in the axis of the primitive circle. The principle involved becomes apparent from figure 7, in which E is the position of the eye or projecting point, E C being equal to Sin. 45°; and A B the trace of the primitive plane upon which the projections are made. Both parallels and meridians are projected into ellipses. This method was proposed by Lahire in 1701, and

was designed to avoid, as far as may be, the contraction of the orthographic, and the exaggeration of the stereographic projection near their respective outer portions.

The foregoing perspective projections are usually employed for the representation of hemispheres, but are not well adapted for maps or charts on a large scale, showing more limited portions of the earth. For this reason another system was devised, that of development. As a spherical surface, can it itself not be developed, a cone or cylinder is supposed tangent to the sphere, the former generally at the middle latitude, *i.e.* of the area to be represented, and the latter at the equator. Sometimes the cone is supposed to make double intersections with the area, for closer representation of the different systems having straight lines for both meridians and parallels.

"Mercator's Projection" is the most important. (See figure 8.) It is named after the inventor, who lived in the sixteenth century; and is generally employed for the purposes of navigation. The axis of a cylinder tangent at the equator is coincident with the axis of the sphere, and in developing the cylinder the projected meridians become parallel and equi-distant straight lines. These are intersected at right angles by straight lines, representing parallels so drawn that at every point of the chart the ratio of the degree of longitude to the degree of latitude is preserved the same as on the corresponding point of the sphere. Any straight line on the chart represents a rhumb line, and indicates a particular mutual bearing of two places so connected On the spheres such a line is a loxodromic curve, and it possesses the property of cutting the meridians at equal angles. In the higher latitudes, in consequence of enormous exaggeration, the projection loses its value. Its want of uniformity of scale of distances is its great defect, and renders it useless for any other than the special nautical purpose for which it was designed.

In the following method but one system of straight lines is presented.

"Flamsteed's Projection." (See figures 9 and 10. Here a straight line is taken, equal to the rectified arc of the middle meridian, between the latitudes L and L' (in figure 9 equals $\widehat{\frac{1}{2}}$); upon it equal distances for equal differences of latitude are laid off, and through the points of division perpendiculars to the meridian are drawn, which represent parallels of latitude. Upon these parallels distances are laid off, bearing the same proportion to the distances on the meridian as the cosine of the latitude of each parallel does to radius unity. Finally drawing through the points of the same longitude thus determined curved lines, which will represent the various meridians.

In figure 9, the co-ordinates of any point P would be

$$x = \widehat{\pi}\ r\ \mathit{Cos}\ l\ \frac{n^{\circ}}{180}$$

$$y = \widehat{\pi}\ r\ \frac{l}{180}$$

in which r = radius, l = latitude, n° = difference of longitude.

Its principal defect is the obliquity of intersection of the projected parallels and meridians, especially in the higher latitudes and at some distance from the central meridian. It preserves, however, the proportionality of areas of zones in the projection and on the sphere. It is most effectively employed in mapping equatorial countries.

The "Simple Conic Projection." (See figure 12.) In this a cone is supposed tangent to the middle parallel of that part of the sphere to be projected. The side of this cone will be the radius of the developed parallel and equal to (see figure 11) $r \cot l$, where l is the latitude of tangent point. The centre being in the middle meridian produced. From this centre also the other parallels are described. On the central or middle meridian and parallel the degrees of latitude and longitude respectively are laid off according to scale and proportional to those on the sphere, *i.e.*, as $r : \cos l$.

From the centre of the tangent cone straight lines are drawn through the located points on the middle parallel cutting the other parallels; these straight lines represent meridians. The length of degrees on all parallels excepting the middle one is but slightly different from what it would be were they of their true length proportional to those on the sphere.

"Bonne's Projection." (See figures 13 and 14.) This most useful and extensively used projection differs from the simple conic development in this, that each of the concentric parallels of latitude is divided the same as on the sphere; through these points of intersection the curved meridians are passed. The radius of development is determined as before, being equal to the co-tangent of the latitude of the middle parallel. It preserves the proportionate equality of the areas of the sphere and on the projection. This projection was adopted by the *Dépôt de la guerre* at the beginning of this century for a large map of France. As this projection is a modification of the simple conic another modification, however, becomes apparent when it is noticed that for very large areas, and particularly in the higher latitudes, the meridians and parallels intersect quite obliquely. This defect is, in a great measure, overcome by

"The Polyconic Projection." (See figure 15.) This projection, as its name implies, employs many tangent cones, theoretically an infinite number. We have, as before, the rectified arc of the middle meridian divided into equal parts, but each parallel of latitude is independently developed from its tangent cone; the developed arcs are therefore not concentric, and hence the degrees of latitude, east or west of the middle meridian, somewhat increased above the true length which is only preserved on the middle meridian. The parallels are divided into equal parts, such parts bearing the ratio to similar parts on the middle meridian as $\cos l$ to unity. Curved lines then join points of equal longitude. The intersection of meridians and parallels forms right angles along the middle meridian only, but nowhere do the angles differ much from the same, so little that even on a map of large extent the eye can barely detect it. Hence the similarity of the figures on the sphere and the corresponding ones on the projection is very close. This projection is due to the United States Coast Survey, being one of the many inventions and improvements brought forth by it.

In the construction of maps and charts representing large areas, by this projection it will be necessary to construct arcs of very long radius; as this is difficult by the ordinary method, another one has been devised. This is accomplished by the method of co-ordinates. In figure 16 let A B be the arc

to be drawn, D E a tangent thereto, at the middle meridian C F; F the centre of the developed cone; *l* the latitude of the parallel; G the point thereon, whose co-ordinates are to be found; N, the normal for latitude *l*; *n* the difference or longitude between G on sphere and middle meridian; O, the angle subtended by *n*, at F, and the middle meridian and tangent the axes of reference. then—

$$Radius\ of\ parallel = N\ Cos\ l.$$
$$Radius\ of\ developed\ parallel = R = N\ Cot\ l.$$

(For more accurate results the normal is employed, instead of the radius of the earth.)

But as arcs of equal length subtend angles inversely proportional to their respective radii, we have

$$n : O :: N\ Cot\ l : N\ Cos\ l,$$
$$\therefore\ O = n\ Sin\ l.$$

The co-ordinates of any point G, are GI and GH.

$$GI = CH = x = R\ Sin\ O.$$
$$GH = IC = y = R\ versin\ O = 2\ R\ Sin^2\ \tfrac{1}{2}\ O = x\ tan\ \tfrac{1}{2}\ O.$$

These are the absolute values of the co-ordinates, but for small differences of longitude the arc GC and chord G C may be considered coincident, and the angle GCH being equal to ½ O, hence

$$x = GC\ Cos\ \tfrac{1}{2}\ O$$
$$y = GC\ Sin\ \tfrac{1}{2}\ O$$

the different values of which have been tabulated for the construction of maps.

In this manner successive points are established from the tangents for the various parallels, and lines joining those of equal longitude form the meridians.

Places given in latitude and longitude are located by means of the previously established meridians and parallels.

For small values of O, the ordinates may be considered to vary as the square of the abscissæ, *i.e.*, in figure 16: if MC = 2 HC then KM = 4 GH.

This property is, strictly speaking, confined to the parabola.

Wm. Ogilvie then read the following paper, on "The Relative Value between Ordinary Chaining and Absolute Distance:"—

In the summer of 1881, while detained at Qu'Appelle waiting for supplies, I made some experiments to ascertain approximately the value of chaining as prescribed in the Manuel when compared with the absolute distance.

The ground around Qu'Appelle is very favorable for such operations, as in the valley around the Fort the surface is very smooth and level, while along the hillside forming the valley as rough ground as one can wish for can be found; and by a combination of both, lines can be found of various degrees of roughness.

The nature of the ground and the extent of my determinations are shown in the following diagram.

Orthographic Projection

on plane of Meridian

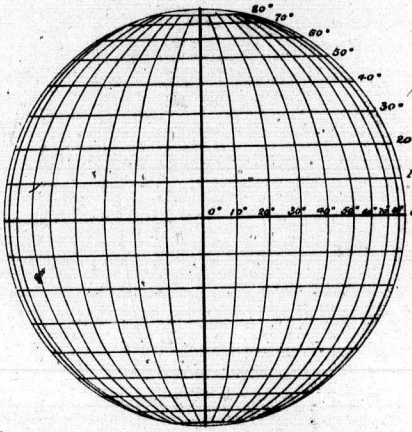


fig 1

on plane of Equator

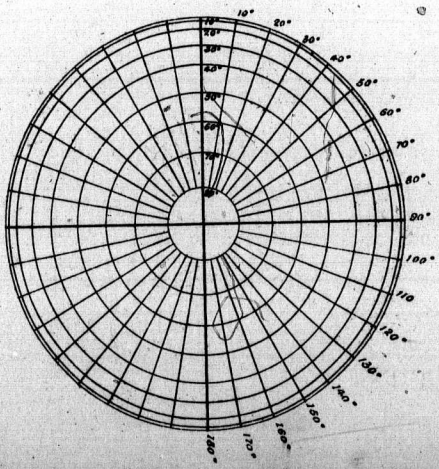


fig 2

Stereographic Projection

on plane of Meridian

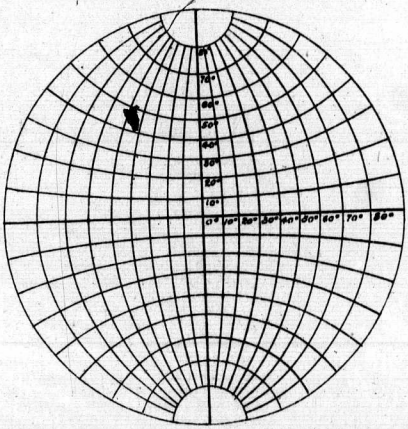


fig 3

on plane of Equator

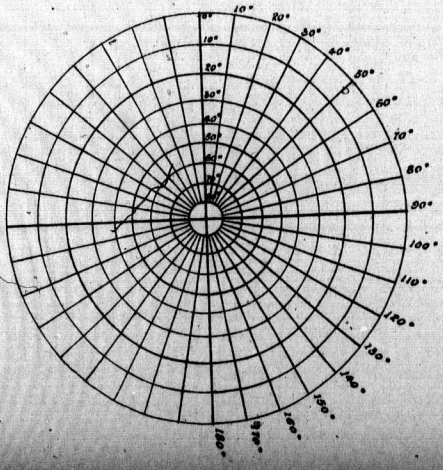
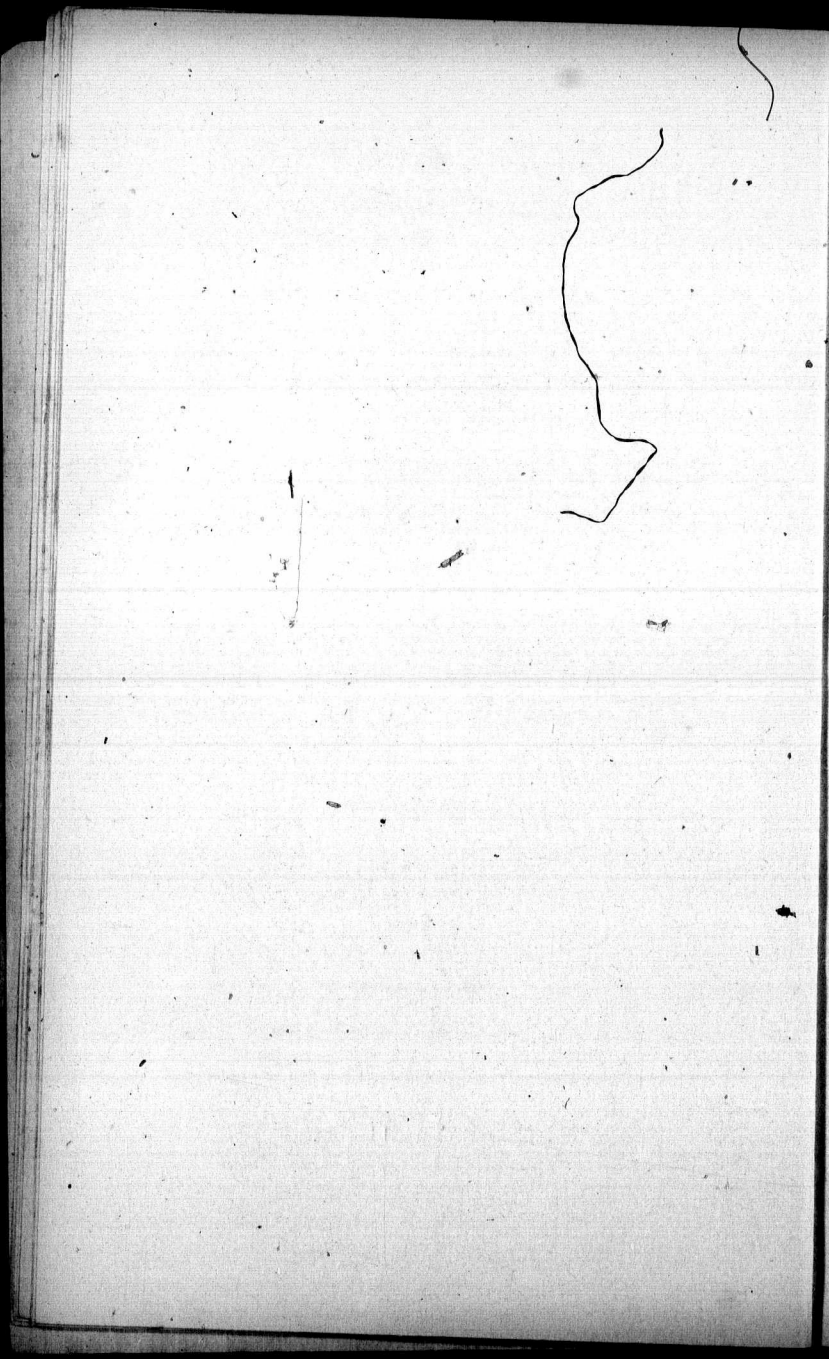


fig 4


130°
120°
110°
100°
90°
80°
70°
60°
50°

Anomonic Projection

on plane tangent at Pole

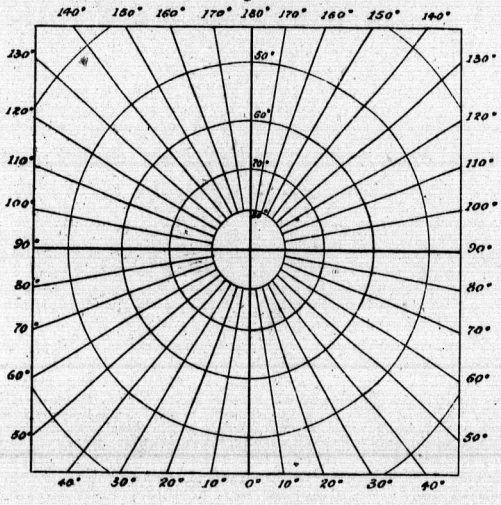


fig 5

on plane tangent at Equator

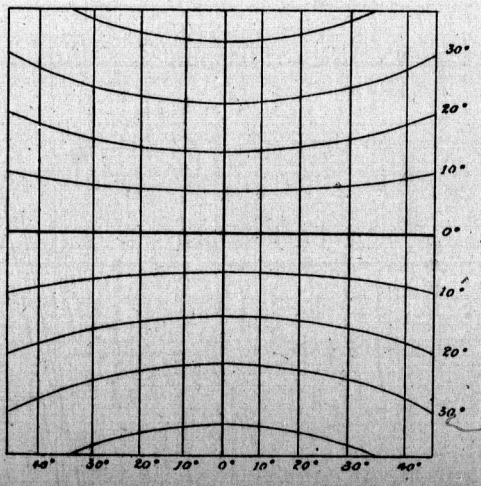


fig 6

Globular Projection

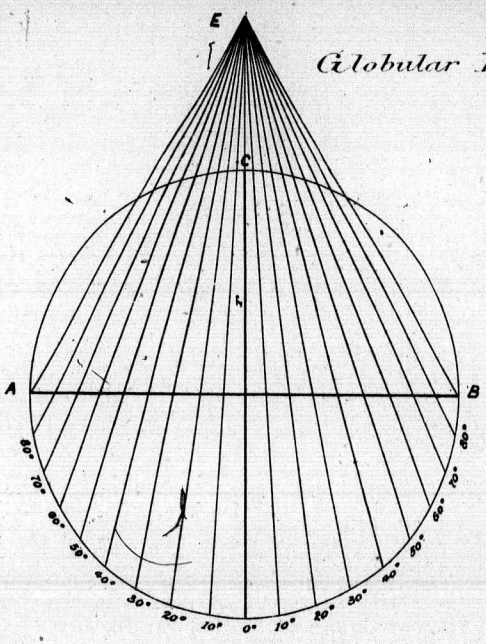


fig 7

Mercator's Projection

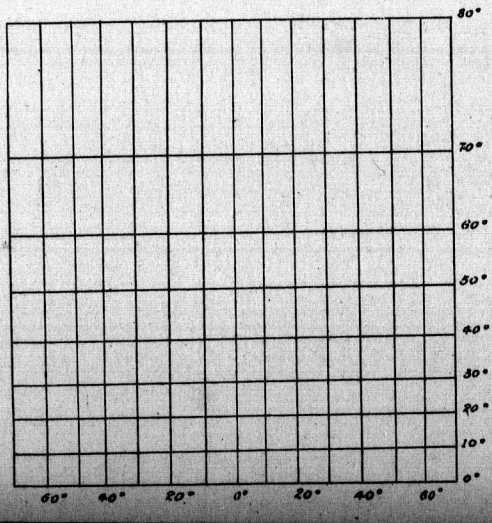


fig 8


90°
70°

Flamsteed's Projection

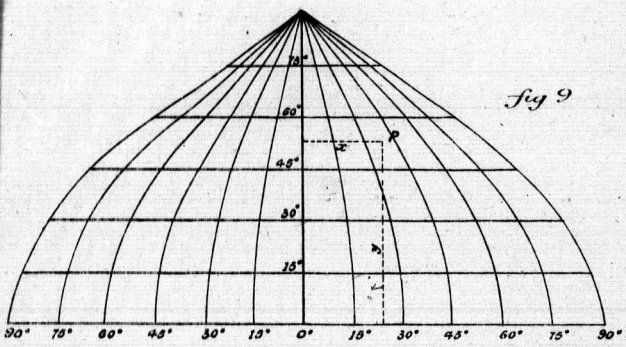
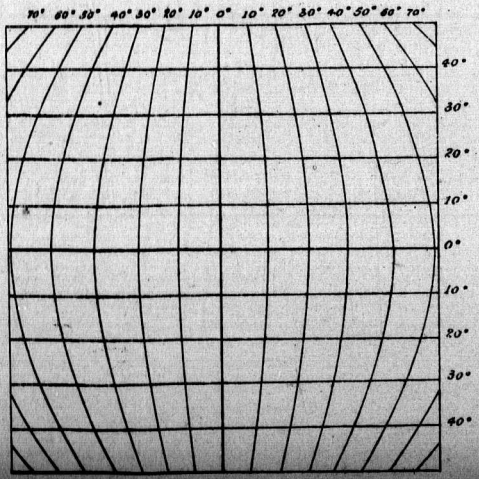


fig 9

fig 10



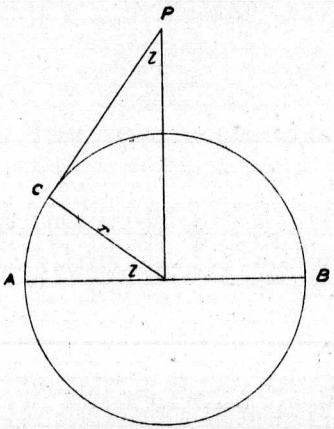


fig 11

Simple Conic Projection

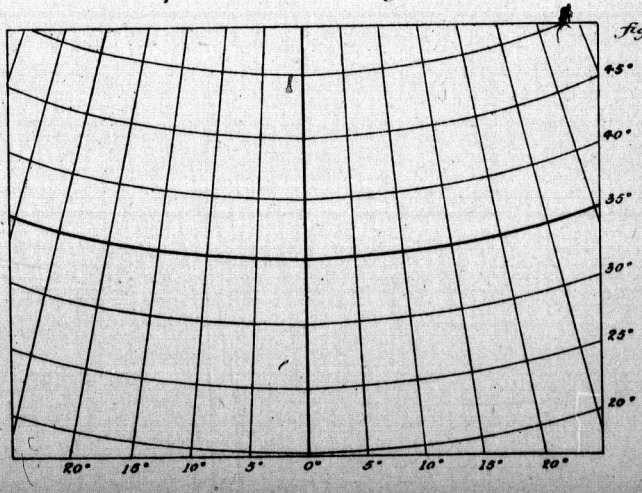


fig 12


75°
60°


25°
20°

Bonne's Projection

fig. 13

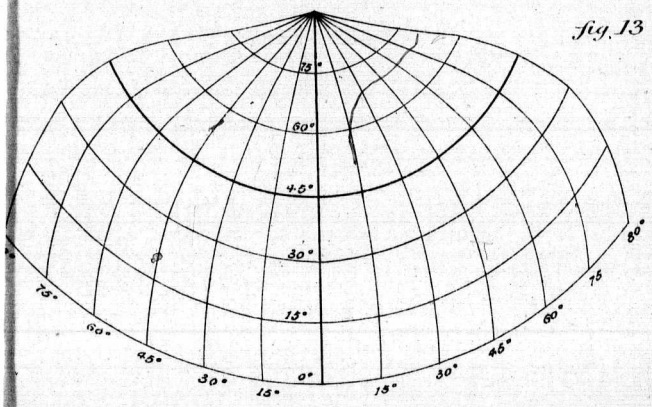
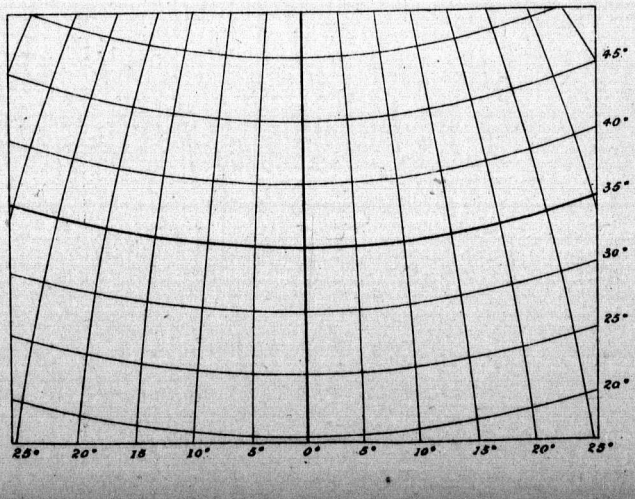


fig 14



S

A

D

Polyconic Projection

fig 15

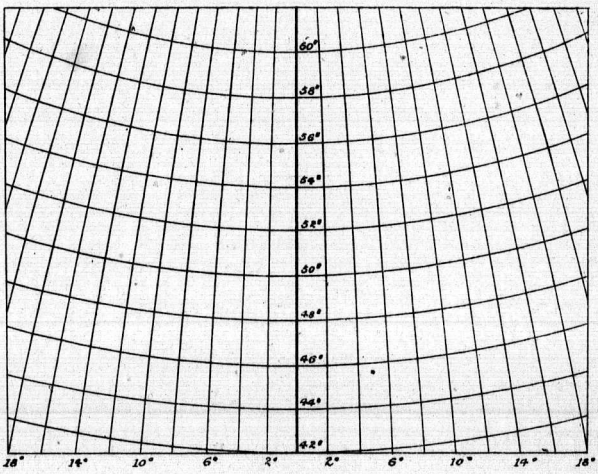
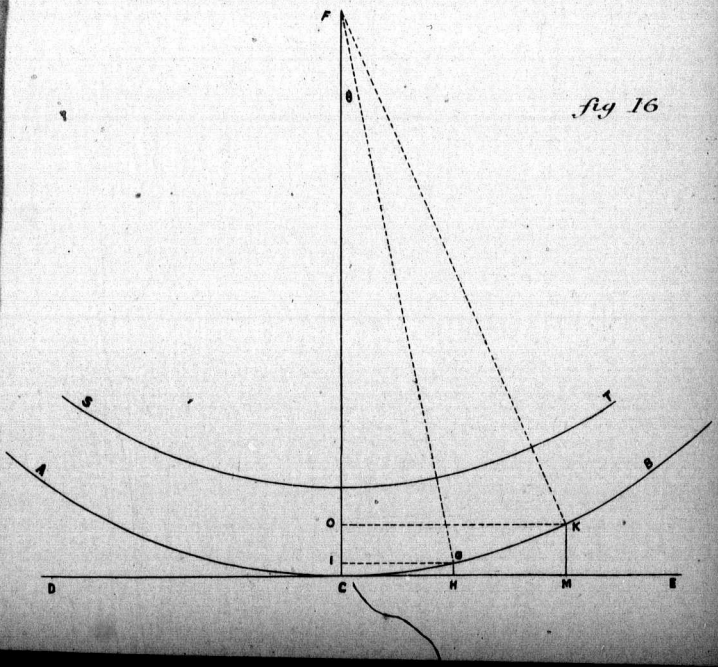
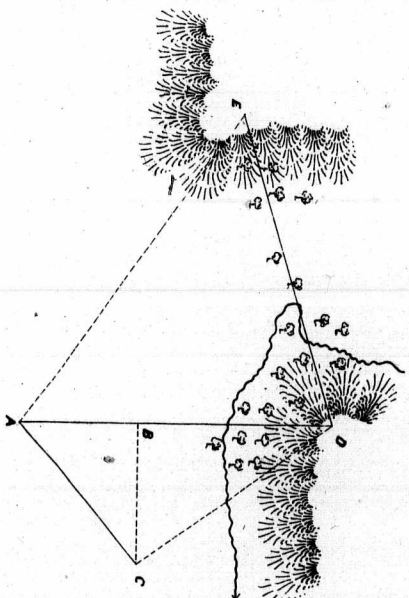


fig 16




A
B
C
D

The length of the base A B, was determined in the following manner: A post was firmly driven into the ground at A, a nail was driven into this post and a fine mark on the nail head was the initial point of the base. The transit was carefully set over this mark and the telescope fixed on a mark similarly established at B. Posts were then driven firmly into the ground 66 feet apart, commencing at A, until the whole distance was thus posted, care being taken that their tops were in the same plane vertically and horizonally as A B, the point B was found to be 3 feet 6 inches higher than A. A standard steel tape of known length was then stretched between those posts and supported at intervals of 8 feet, so as to be practically a straight line from the top of one post to the top of the next. A knife edge mark was then put in the top of the first post from A at the distance (by the tape) of 66 feet from the initial point in A; this knife edge mark served as the initial point for the next space where the same procedure was repeated, and so on to point B. The temperature of the tape was taken at the beginning, middle and ending of the measurement, and the mean of the three used in the reduction of the temperature correction. At a different time of the day and different temperature, this process was repeated from B to A, and on the following day again repeated from A to B. The three measurements, corrected for error of tape and reduced to the temperature of 60° Fah., stood thus:

1st	1236.588 feet
2nd	1236.556 "
3rd	1236.559 "
The mean is	1236.5676 feet.

The probable error of the mean is a small fraction of a foot, and for the purpose intended, the mean is near enough the absolute to make no appreciable difference in the result sought. The reduction of A B to the horizonal was not made as it would be inappreciable also. The mean reduced to Gunter's chains is 18.7358. The chains were put over the base and adjusted to give the distance as determined; this necessitated a length in the 66 feet chain of 66 feet and $\frac{76}{100}$ of an inch, and in the 100 feet chain 100 feet and $\frac{70}{100}$. This extra length eliminates the effect of curvature in my chaining, my pins being of such a length that the ends of the chains are generally about one foot above ground when they are being stretched.

The angles of the triangles as measured were as follows:

In triangle A B C . . .	A=50.3953
	B=91.4230
	C=38.1821
	180.0004
In triangle A D C . . .	A=50.3960
	C=94.1105
	D=35.4943
	180.0008

In triangle A D E

A=54.0463
D=72.5996
E=53.3540

179.9999

The side AC lay on very smooth prairie, its computed length is 30.30 chains, or 1999.80 feet. The mean of three independent measurements with each chain gave 30.202 chains, and 2000.02 feet, and their close interagreement justifies me in saying that, with fair care, on a very plain surface, one mile can be chained with our steel band chains and not be more than 6 inches from the absolute distance.

The computed length of AD is 52.051 chains, or 3435.36 feet. Three independent measurements back and forth with each chain stood as follows :—

Gunter's Chain—Error.	100-feet Chain.—Error.
	Feet.
1st. = 52.057 + .006	1st. = 3436.6 + 1.24
2nd = 52.046 − .005	2nd = 3435.2 − .16
3rd = 52.059 + .008	3rd = 3434.3 − 1.36
Mean = 52.054	Mean = 3335.36

The part BD of this line passed through scrub, and up a hill-side 240 feet high. The slope correction was determined independently for each chaining with the Abney Hand Chronometer.

In this case the mean is very close to the computed, but as great a difference as .8 of a link +, and .5 −, occurs with the Gunter's chain, and 1.24 feet +, and 1.36 feet −, with the 100 feet chain. So that proportionately on a mile of such ground we might anticipate an error of 1.8 feet in a single measurement, and the probabilities about even as to whether it would be + or −, as an inspection of the six measurements will show.

The line DE spanned from crest to crest a ravine 250 feet deep, crossed a creek several times, and ran over some sharp knolls in the bottom. More than half this distance was covered with thick scrub. Its computed length is 52.515 chains, or 3466 feet.

Five independent measurements of it, with each chain corrected to temperature, and the slope corrected for each measurement independently, as in AD, stood as follows :

Gunter's. Error.	100 feet. Error.
	Feet.
1st. = 52.544 + .039	1st. = 3465.1 − .9
2nd = 52.461 − .054	2nd = 3465.5 − .5
3rd. = 52.505 − .010	3rd. = 3464.3 − 1.7
4th. = 52.513 − .002	4th. = 3463.0 − 3.0
5th. = 52.484 − .031	5th. = 3465.5 − .5
Mean = 52.5016 − .0134	Mean = 3464.7 − 1.3

In this series the greatest error is 5.4 links, which proportionately would

give 8.22 links in a mile, which probably never would be exceeded on a survey after the men had become familiar with the chains in such ground as this. This was the first very rough chaining my men did that season.

An inspection of the errors shows that all but one have the minus sign: this I account for by the fact that on steep slopes more of the curvature is pulled out of the chain than the same tension would pull out of it on a level, or moderate slope. On this line nearly every chain had to be sloped and many of them very steep, some as much as 35°.

This series goes to show that on a mile of country as rough as it well can be without being precipitous, with green chainmen, we might anticipate as much as 8. links of an error, with the probabilities 9 to 1 that the correction has a + sign, or should be added to the chaining. This, however, would be an extreme case, and if the series is of any value in the way of supplying a theoretical correction to be applied to a section side, measured over such ground, the mean of the 10 measurements reduced to a section side would give + 2.5 links as the correction to be applied to chaining done as prescribed in the Manuel to reduce it to the absolute.

A not uninteresting appendix to those determinations will be the following statement of comparison between the distances as found by chaining over some very difficult ground on the 4th Initial Meridian, and the same distances as found by careful triangulation.

The line crosses the south branch of the Saskatchewan River three times, all very deep (350 feet) and rough.

1st crossing chained,	130.875 chs.	Triangle, 130.852
2nd "	96.136	" 96.036
3rd "	128.080	" 128.078

Over the valley of Battle Creek in the Cypress Hills, and over a couple of ravines in the same hills, all of which were very deep, rough and wooded; but where the chainmen had plenty of time to do their work very carefully, the measurement and triangulation stood as follows :—

Over Battle Creek, chaining, 324,065 chs.	Triangle, 324,095
Over the ravines it stood, chaining 172.84.	Triangulated, 172.89.

In the second crossing of the Saskatchewan, the principal and check chains differed 10 links, the check chain agreeing exactly with the triangulation. The bank of the river here was very steep and rocky, some places precipitous, which accounts for the difference, as the principal chain had frequently to be broken where the other spanned the obstacle. A correction deduced from the triangulations over the Saskatchewan, to be applied to chaining, would have a — sign, while one deduced from the work in the Cypress Hills would have a + sign; the later agreeing and the former disagreeing with that deduced from the determinations at Qu'Appelle. Before any definite value could be given to any such correction, it would be necessary to make a comparison of a much more extensive series of such determinations. To those of the profession who have kept notes of such matters, I hope these

statements will be of use, by enabling them to make a much more extended comparison.

It was moved by WM. WAGNER and seconded by J. B. LEWIS, and

Resolved, That the paper just read by the President be printed with the minutes of the Association, and also the paper of Wm. Ogilvie.

It was moved by WILLIS CHIPMAN and seconded by WM. WAGNER, and

Resolved, That the President, Vice-President, Secretary and the Executiv Committee make the necessary arrangements to have read before the next annual meeting of this Association a series of papers on practical and theoretical surveying; the Committee to print and distribute programme at least one month before such annual meeting.

It was moved by THOS. DRUMMOND, seconded by WM. OGILVIE, and

Resolved, That an engrossed address be presented to Mr. Andrew Russell as a mark of respect for his long and able services, and the many obligations the Profession are under to him; and that the President prepare the same and have it engrossed.

It was moved by THOS. DRUMMOND and seconded by WM. OGILVIE, and

Resolved, That the sum of five dollars be paid for the use of St. Andrew's Hall.

The annual meeting then closed.

HONORARY MEMBERS PRESENT.

W. F. KING Inspector of Surveys.

MEMBERS PRESENT.

Otto J. Klotz,	J. A. Snow,	J. B. Lewis,
Wm. Ogilvie,	P. C. Talbot,	J. F. Snow,
Thos. Fawcett,	G. A. Mountain,	J. Doupe,
Edgar Bray,	J. Dudderidge,	P. T. C. Dumais,
C. F. Miles,	J. Reiffenstein,	Thos. Breene,
Thos. Drummond,	Wm. Crawford,	J. J Burrows,
G. C. Rainboth,	Wm. Wagner,	H. H. Robertson,
A. C. Talbot,	Jno. Francis,	R. Rauscher,
W. Chipman,	J. W. D'Amours,	J. P. B. Casgrain,
C. A. Bigger,	Z. C. Dupuis,	T. R. Hewson,
I. Traynor,	L. M. Duchesne,	E. J. Rainboth,
A. W. McVittie,	J. J. Dufresne,	A. F. Cotton.
G. B. Abrey,	Jas. Burke,	

On the 22nd of March, 1884, the following surveyors—Otto J. Klotz, G. C. Rainboth, Wm. Ogilvie, Fred. Snow, C. Bigger, J. K. McLean, J. McLatchie and A. F. Cotton—waited upon Mr. Andrew Russell at his residence, and presented him with the following Address, which was very finely engrossed and illuminated, by Wm. Bruce of Hamilton :—

To ANDREW RUSSELL, Esq:

THE Surveyors throughout the Dominion of Canada take this opportune time for presenting you with this Address, expressing as it does in but a feeble manner the esteem in which you are held by the profession.

During your fifty-four years of public service in the Departments of the old Province of Canada, and of the Dominion of Canada, you have preserved throughout that high standard of public morality, integrity and faultless character so worthy of emulation.

In the Crown Lands Department, as well as in the Department of the Interior, you have left your ineffaceable mark ; ever prompted by the sense of duty, regardless of personal ends.

A generation has seen you in harness, unassuming, but treading the path of honor.

But our gratitude centres especially upon your professional career.

It was you who introduced into Canada the use of the transit theodolite upon the public surveys, displacing the less accurate and variable compass. It was you who pointed to the stars for a sure guide, instead of to the fickle magnetic pole.

Through your unceasing efforts surveying has attained its present high standard, ever aiming higher, and now is an honorable profession. Rightly may we style you the father of astronomic surveying in Canada, and proud are we of so worthy a progenitor.

May the laurel wreath you have won, resting in its snowy bed, brighten your remaining days in your quiet retreat.

And will posterity record :

"His work is well done."

Signed on behalf of the Surveyors, by

A. F. COTTON,
Sec.-Treasurer.

OTTO J. KLOTZ,
Pres. of Assoc'n Dom. Land Surveyors.