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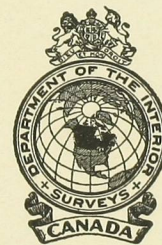
Manual of Instructions

FOR THE

Survey of Dominion Lands

*Issued by authority of the Honourable
the Minister of the Interior*

EIGHTH EDITION



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NOTICE TO DOMINION LAND SURVEYORS.

This Manual has been prepared for the guidance of surveyors of Dominion lands who are to be governed by its provisions in making any survey of these lands, in so far as they are applicable to the particular survey then being executed.

Any Dominion land surveyor subscribing the affidavit mentioned in section 31 of the Dominion Lands Surveys Act is to consider this Manual and the instructions embodied therein, as forming part of the instructions of the Surveyor General referred to in the said affidavit.

E. DEVILLE,
Surveyor General

DEPARTMENT OF THE INTERIOR,
February, 1913.

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SYSTEM OF SURVEY
AND
INSTRUCTIONS TO SURVEYORS

37715—1

5. The Principal meridian passes about twelve miles west of the city of Winnipeg in longitude $97^{\circ} 27' 30''$ west of Greenwich.

The Second meridian is placed in longitude 102° (very nearly), the Third in 106° and so on, each initial meridian after the Second being four degrees west of the preceding one.

There is also the Coast meridian of British Columbia upon which are based the townships of the "Fifth System," hereinafter described.

6. The sections are laid out of the precise width of eighty chains on certain lines called "*base lines*," with a road allowance adjoining each section, and the meridians between the townships are drawn from such bases, north and south, to the depth of two townships, that is to say, to the correction lines hereinafter mentioned. The townships south of each base measure therefore in an east and west direction more than four hundred and eighty chains exclusive of the road allowances, while those north of the base measure less than this. The interval between any base line and the next is equal to the depth of four townships.

7. "*Correction lines*" are those upon which the "*jog*" resulting from the want of parallelism of meridians, is allowed, or in other words, they are those township lines running east and west, equidistant from the bases at the depth of two townships. The interval between correction lines is equal to the depth of four townships.

8. The first base line is the forty-ninth parallel of latitude or international boundary; the second base is between townships four and five; the third between townships eight and nine; the fourth between townships twelve and thirteen; the fifth between townships sixteen and seventeen, and so on, northerly, in regular succession.

9. The first correction line is between townships two and three; the second between townships six and seven; the third between townships ten and eleven, and so on, northerly, in regular succession.

10. Each section is divided into quarter sections of one hundred and sixty acres, or one-half mile square, more or less.

11. To facilitate the descriptions for letters patent of less than a quarter section, every section is taken to be divided into quarter quarter sections each of forty acres, more or

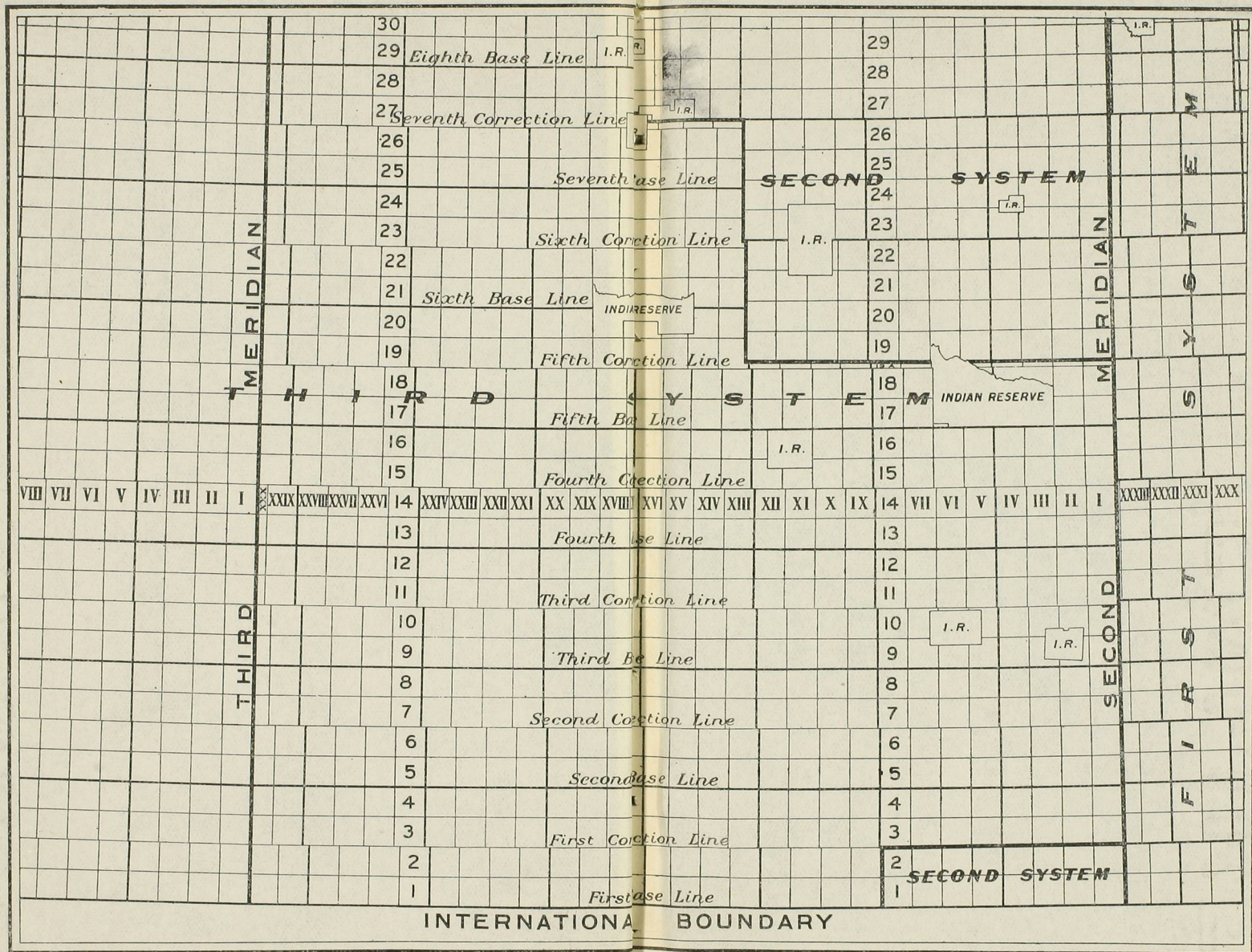


FIG. 2. ILLUSTRATING THE SUBDIVISION OF THE COUNTRY INTO BLOCKS AND TOWNSHIPS.

less, and such quarter quarter sections are styled "legal subdivisions" and are bounded and numbered as shown in the following diagram of a section:—

				N.							
				13	14	15	16				
W.	12	11	10	9					E.		
				5	6	7	8				
				4	3	2	1				
				S.							

Fig. 3. Division of a section into quarter quarter sections, or legal subdivisions.

An authorized subdivision is any subdivision of land surveyed under the authority of the Dominion Lands Surveys Act.

12. Preliminary to the subdivision into sections of any given portion of country, the same is laid out into townships by projecting the base lines and the meridian outlines from the base lines to the correction lines and connecting by straight lines the township corners on the meridians.

13. In the case of the townships between the first and second bases, the meridians are surveyed south from the second base to the first correction line, and thence south to the first base line, giving the "jogs" their theoretical lengths.

14. In the survey of any township outlines or the subdivision of any township, the surplus or deficiency found on meridians when closing on the correction line is left in the last quarter section adjoining said line; except on meridian outlines closing on the first correction line, on which outlines the quarter sections adjoining the correction line are given the theoretical depth of forty chains. On all the meridians of township one, the deficiency or surplus, as the case may be, must be left in the quarter sections adjoining the first base line or international boundary.

15. In the case of the fractional range adjoining an initial meridian, when the initial meridian intersects the "jog" (that is when there is one more range south of the correction line than north of it), the last quarter section

on the meridian township outline surveyed from the south is made of the same depth as that on the next meridian township outline on the east. See Fig. 7.

16. On the township outlines, all township, section and quarter section corners are marked at the time of the survey and these corners govern in the subsequent subdivision of the block or township.

SYSTEMS OF SURVEY IN DIFFERENT DISTRICTS.

17. All Dominion lands are laid out in the manner above described, but the number of road allowances between sections and their widths are not the same in all parts of the country. There are also differences in the methods of subdividing townships. Hence arise different "systems of survey," five in all, styled the "first," "second," &c., systems of survey.

18. The instructions hereinafter are drawn up for the third system, but, unless otherwise expressly provided, apply also to the other systems.

19. Since in all the systems of survey the townships and ranges are based upon the forty-ninth parallel and the initial meridians, and are not, on account of the varying widths of the road allowances, of the same dimensions, there occur fractional townships and ranges at the junction of different systems.

20. The fractional township or range lying between two townships or ranges numbered consecutively, but surveyed according to different systems, is designated by the larger number followed by the letter A, as for instance:

Township 19, A,

for the fractional township between townships 18 and 19 west of the Second meridian, and

Range 21, A,

for the fractional range between ranges 20 and 21 west of the Second meridian.

21. The line between two parts of the country surveyed according to different systems is established as a correction line, that is to say, posts are planted on both sides of the road allowance on such line, each row governing the position of the boundary lines on its own side. Such road allowance is one chain and fifty links wide, except in the case of the

dividing line between the third system of survey and the fourth system in force in the "railway belt" in British Columbia hereinafter described; here the road allowance between the systems is one chain wide. Between the fourth system and the fifth system no road allowance is left, but two sets of monuments are placed on the line dividing the two systems to govern the corners of townships, sections and quarter sections on each side respectively.

FIRST SYSTEM OF SURVEY.

22. In the first system of survey there is a road allowance of one chain and fifty links on every side of a section.

23. The township, therefore, measures on each side four hundred and eighty-nine chains, subject to the deficiency or surplus resulting from the convergence or divergence of the meridian outlines.

24. In the survey of the township the deficiency or surplus resulting from the want of parallelism of the meridians is set out and allowed in the range of quarter sections adjoining the western boundary of the township. It follows that generally the lines bounding sections on the east or west sides are not meridians, but lines parallel to the eastern boundary of the township. All quarter section sides are theoretically forty chains, except in the western range of quarter sections of a township and in the sections adjoining a correction line which are subject to the discrepancies of the survey.

25. The operation of the first system of survey is restricted to the area bounded as follows, viz. :—

To the south by the international boundary line, to the west by the Second meridian, as far as the eighth correction line; by said correction line as far as the meridian between ranges twenty-eight and twenty-nine west of the Principal meridian; by said meridian between ranges twenty-eight and twenty-nine, as far as the seventh correction line; by said correction line as far as the meridian between ranges seven and eight east of the Principal meridian; by said meridian between ranges seven and eight as far as the shore of lake Winnipeg at the point where it intersects the east boundary of township nineteen, range seven; by the shore of lake Winnipeg and the southwesterly bank of the Winnipeg river as far as the fifth correction line; by the said correction line as far as the meridian between ranges ten and

eleven east of the Principal meridian; by the said meridian between ranges ten and eleven east as far as the third correction line; by the said correction line as far as the eastern boundary of the province of Manitoba; by said eastern boundary as far as the international boundary line.

Also township 44, range 21; townships 45, ranges 21, 22, 26, 27 and 28; township 47, range 24; townships 46 and 47, ranges 25, 26, 27 and 28; townships 48, ranges 24, 25 and 26, and that portion of township 48, range 27, lying south of the Saskatchewan river, all west of the Second meridian.

Townships 42 to 47 inclusive, range 1; and townships 43 and 44, ranges 2 and 3, west of the Third meridian.

SECOND SYSTEM OF SURVEY.

26. The second system of survey is similar in all respects to the first system, except in regard to the deficiency or surplus from the convergence or divergence of meridian outlines which is distributed equally among all quarter sections as in the third system.

27. The operation of the second system of survey is restricted to townships 1 and 2, ranges 1 to 8 inclusive; townships 19 to 30, ranges 1 to 12 inclusive; and townships 27 to 30, ranges 13 to 16 inclusive; the above ranges being all west of the Second meridian.

THIRD SYSTEM OF SURVEY.

28. The third system of survey covers all the territory not expressly reserved for the other systems.

29. Road allowances of one chain in width are allowed along each section line running north and south and along every alternate section line running east and west, that is, along the north and south boundaries of the township and along the second and fourth section lines north of the south boundary of the township.

30. The township, therefore, measures along its east and west boundaries, four hundred and eighty-three chains, and along its north and south boundaries four hundred and eighty-six chains, subject to the deficiency or surplus from the convergence or divergence of meridian outlines.

31. The deficiency or surplus from the convergence or divergence of meridian outlines is distributed equally among all quarter sections involved, so that the lines bounding sections on the east and west sides are theoretically true

meridians, and those on the north and south sides are parallel to the north and south boundaries of the township.

32. In the survey of township outlines, the surplus or deficiency found on meridian outlines when closing on the correction line is divided equally between the quarter sections adjoining that line, except in the case of the closing on the first correction line where the surplus or deficiency, as above stated, is carried to the first base line, or forty-ninth parallel of latitude.

FOURTH SYSTEM OF SURVEY, OR SYSTEM OF SURVEY IN RAILWAY BELT, BRITISH COLUMBIA.

33. The system adopted for the survey of the lands within the belt of twenty miles on each side of the Canadian Pacific Railway in British Columbia, is the third system, modified by adding to each quarter section of one hundred and sixty acres, an allowance of three acres for roads, instead of locating this allowance along section lines.

34. This allowance is provided for by making each quarter section on the base lines forty chains and fifty links, and on the meridians forty chains and twenty-five links.

35. The dimensions of the townships are therefore the same as those in the third system of survey, namely, four hundred and eighty-three chains north and south, and four hundred and eighty-six east and west. Since the townships of the third and fourth systems are based upon the forty-ninth parallel and the same initial meridians, there is no fractional township or range between them where the systems adjoin, but the northern boundary of the fourth system township coincides with the southern limit of the road allowance on the southern boundary of the third system township adjoining it to the north, and the eastern boundary of the fourth system township coincides with the western limit of the road allowance on the western boundary of the third system township adjoining it to the east.

36. In the fourth system of survey only one line is surveyed along a correction line and on this are placed two sets of monuments marking respectively the corners of townships, sections and quarter sections north and south of the line.

37. The correction line is established by projecting the meridian outlines from the base lines on each side of the correction line, and dividing the surplus or deficiency equally between the quarter sections on each side of the correction line. The corners thus established for the townships south of and adjoining the correction line are joined by straight lines, upon which are placed the posts marking the township, section and quarter section corners for townships on both sides of the correction line.

The directions for the survey of township and section lines may in the mountains, have to be departed from, but must be adhered to as closely as the nature of the ground will allow.

38. In the case of these correction lines the rule prescribed for reestablishing lost corners on a township outline (see clause b, subsection 1, of section 66, of the Dominion Lands Surveys Act) is modified in that the straight line joining the corners of the township south of the correction line must govern the alignment of the posts.

39. The western limit of the third system follows the summit of the Rocky Mountains, which is the boundary between the provinces of Alberta and British Columbia, except between the northern boundary of township 25, range 15, and the eastern boundary of township 31, range 19, west of the Fifth meridian, where the following lines separate it from the fourth system, namely:—

That part of the northern boundary of township 25, range 15, which lies west of the summit of the Rocky Mountains; then, in succession, the eastern boundary of township 26, range 16 to the seventh correction line; the seventh correction line as far as the southeast corner of township 27, range 17; the eastern boundaries of townships 27 and 28, range 17 the northern boundary of township 28, range 17; the eastern boundaries of townships 29 and 30, range 18; the eighth correction line as far as the southeast corner of township 31, range 19; the eastern boundary of township 31, range 19, as far as the summit of the Rocky Mountains; thence northerly along the said summit; all these ranges being west of the Fifth meridian.

40. All Dominion lands to the west of the above described boundary are surveyed under the fourth system, excepting the territory in which the fifth system, hereinafter described is in force.

FIFTH SYSTEM OF SURVEY.

41. Certain townships in the railway belt in the lower valley of the Fraser river were surveyed by the provincial government according to the local system of survey, previous to the transfer of the lands to the Dominion. The townships are six miles square and are divided into thirty-six sections, as in the other systems. There are no allowances for roads, except in townships 12, 40, 41 and 42 where road allowances were laid out at the time of survey on every side of each section. The basis of the system is the forty-ninth parallel and a meridian which passes near the junction of Fraser and Pitt rivers. This meridian is called the Coast meridian. The townships are individually numbered, and not according to the general system of townships and ranges. The common designation of a township is "Township No.—, E.C.M." or "W.C.M." (east or west of Coast meridian).

42. The boundaries of the fifth system are as follows:— Beginning at the point where the eastern boundary of township 25, E.C.M., intersects the international boundary between Canada and the United States; thence northerly along the eastern boundaries of townships 25 and 26, E.C.M., to the northeast corner of said township 26; thence easterly along the southern boundary of township 27, E.C.M., to the southeast corner of said township 27; thence northerly along the eastern boundary of said township 27 to the first correction line of the Dominion lands system of survey; thence westerly along the said correction line to the Seventh meridian of the Dominion lands system of survey; thence northerly along the said Seventh meridian to the northern boundary of township 24, E.C.M., thence westerly along the northern boundaries of townships 24, 21, 18, 15 and 12, to the southeast corner of section 6, in township 42, E.C.M., thence northerly along the eastern boundaries of sections 6, 7, 18, 19, 30 and 31, in said township 42 to the northern boundary of said township; thence westerly along the northern boundary of said township 42 to the southeast corner of township 41, E.C.M.; thence northerly along the eastern boundary of said township 41, to the northeast corner of section 12, in said township; thence westerly along the northern boundaries of sections 12 and 11, in said township 41, to the northwest corner of section 11, in said township; thence southerly along the western boundaries of

sections 11 and 2, in said township 41, to the northern boundary of township 40, E.C.M.; thence westerly along the northern boundaries of township 40, E.C.M., and township 39, W.C.M., to the western limit of the forty-mile railway belt; thence southerly following along the said western limit to the international boundary between Canada and the United States; thence easterly along the said international boundary to the point of beginning.

SETTLEMENT SURVEYS.

43. Land bordering on any river or lake, or other body of water, or on a public highway, and upon which settlements are in existence, may be laid out and divided into lots of a certain frontage and depth in such manner as appears desirable. In each settlement the lots are numbered, in regular order from one upwards, each lot being given a separate number. This system of numbering must be adhered to even when a settlement is laid out in ranges, instead of giving the same number to corresponding lots in the several ranges.

44. The width of the lots in a settlement is laid out on a line, called the base line, established near the front of the settlement and perpendicular to the side lines of the lots.

The base line is offset when it is desired to change its position, either for bringing it closer to the improvements or for any other reason, without changing its direction and that of the lot lines.

The base line is deflected when it is desired to change the direction of the lot lines, the latter remaining perpendicular to the base.

45. The side lines of a settlement lot are parallel lines except at the places, if any, where the course of the base line changes. Subject to the same exception, the rear boundary of a settlement lot is parallel to the base line.

46. Boundary monuments are established at the intersections of the base and rear lines by the side lines of the lots.

47. A road sixty-six feet in width is laid out across the settlement in the most convenient location, also such further roads of the same width as may be necessary to give access to every settlement lot.

GROUP LOTS.

48. In remote parts of the country, separate lots, not exceeding one hundred and sixty acres each, may be laid out, each lot being designated by an individual number, by the number of the group to which it belongs and by the name of the province or district.

A group includes all the lots in a territory of convenient size.

49. A group lot is in the form of a rectangle, the length of which does not exceed twice the breadth. A departure from this rule is allowed when the lot is bounded by a road, the shore of a lake or stream, or by another lot, in which case it is made as nearly rectangular as circumstances permit.

50. The breadth of a group lot fronting on a road or on a navigable river or lake must not be made greater than the depth.

51. As far as practicable, the boundaries of a group lot are straight lines running north and south, or east and west.

52. A group lot does not exceed one hundred and sixty acres. When a larger area is to be covered, it is subdivided into such a number of lots that none exceeds one hundred and sixty acres.

TOWN SITES.

53. A town site is made by the subdivision into town lots of a section, group lot or settlement lot, or of portions thereof.

In unsurveyed territory, the land is laid out into sections, settlement lots, or group lots, before the survey of the town site is commenced.

54. On flat ground, the streets and avenues of a town site generally cross each other at right angles, but different angles may be adopted wherever they are considered preferable.

As a general rule, streets and avenues are not made less than sixty-six feet in width unless their number is so increased as to provide means of communication at least equivalent to the normal number of streets and avenues sixty-six feet in width.

The main streets and avenues may be made wider than sixty-six feet, where it is anticipated that the extra width will be required for accommodating the traffic.

Where it is presumed that the adjoining land will be subdivided in the future, a half street or lane may be laid out along the boundaries of the property.

When the parcel to be subdivided adjoins land previously subdivided, a sufficient number of streets in the previous subdivision are produced into the new subdivision, all unnecessary jogs being avoided.

The direction of the streets and avenues is made to conform to the natural features of the ground, the avenues following what is expected to be the direction of the main traffic.

55. Some systematic method of naming or numbering the streets must be adopted. For instance, one of the streets called "Centre Street" may be laid out through what is expected to become the centre of the town. The other streets are laid out parallel to and are numbered from Centre Street, the designation east or west, or north or south being added to the number of the street, for indicating on what side of Centre Street is the street in question.

The avenues are laid out and numbered in a similar manner.

Both streets and avenues may be given individual names when the surveyor's instructions call for such names.

56. In a town site fronting on navigable waters, an avenue or street is laid out along the shore, from which the numbering of the other avenues or streets may commence. It is advisable to make this avenue or street a wide one.

57. Lots are usually made sixty-six feet by ninety-nine feet or fifty feet by one hundred and twenty feet or more, but these dimensions may be departed from to suit the ground or to comply with special requirements. In what is expected to become the business portion of the town it may, for example, be advisable to make the lots narrower than those in the remaining or residential portion.

Except in special cases the distance between adjacent streets is not to exceed five hundred feet.

When lots are made sixty-six feet by ninety-nine feet the distance between the middle of two adjacent avenues, when there is no lane at the back of the lots, is four chains; between the middle of two adjacent streets it is eight chains, except when avenues or streets are more than sixty-six feet in width, in which case the above distances are greater.

When lots are made sixty-five feet or less in width, access is to be provided to the rear of every lot by a lane not less than twenty feet in width.

58. A town block is the land comprised between two adjacent streets and two adjacent avenues. With lots sixty-six feet by ninety-nine feet it is seven chains in length and three chains in width, provided no lane is laid out. With lots of a different size, the dimensions vary. A block five hundred feet in length by three hundred and twenty feet in width can be divided into two tiers of lots with ten lots in each tier, separated by a twenty foot lane, the lots measuring fifty feet by one hundred and fifty feet.

Blocks are numbered in regular succession and every block must have a distinct number or symbol.

59. A block is subdivided into fourteen town lots when the lots are sixty-six feet in width and into twenty town lots when the lots are fifty feet in width. When lots are made smaller the number in each block may be increased to make the block of normal size.

The lots in a block are numbered in regular succession and every lot must have a distinct number or symbol.

60. Iron posts are planted at all lot and block corners unless the surveyor is otherwise instructed.

61. The method of laying out town sites is modified to suit circumstances as appears desirable. In any of the provinces due attention must be given to the provincial statutes and regulations governing such surveys.

In the first system of survey, the meridional boundaries of sections, with the exception of the western outline of the township, are parallel to the eastern outline. Were the subdivision of the township perfectly accurate, all the meridional boundaries would be returned with the same bearing, $359^{\circ} 57'$, or thereabouts.

68. In subdivision surveys, the convergence of meridians may be taken as one minute of arc to a section on the international boundary. Thus the convergence between the meridians through the centre of township one and through its eastern or western limits, or the angle formed by these two meridians, is three minutes, that is to say, three times the convergence for one section.

For townships farther north, the approximate value is taken from the diagram in the Astronomical Field Tables. The exact value of the convergence for one range is given in Table VIII of the Supplement, under the headings "Deflection Sexagesimal" and "Deflection Decimal."

69. The point where an astronomical observation is made for ascertaining the direction of the meridian must

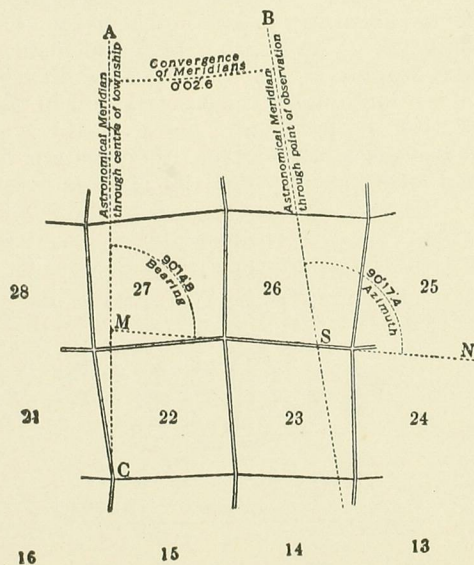


Fig. 5.

be located by the survey. Where necessary or desirable, the bearings are referred to the meridian of a point other than the point of observation by adding or subtracting, as the case may be, the angular convergence of the meridians.

The change of meridians is made by adding the convergence to the azimuths when the place of the astronomical observation is west of the meridian of the survey, and by subtracting the convergence when the place of observation is east of the meridian.

Let it be assumed, for instance, that in subdividing township 121, an observation for azimuth is made at a point S, Fig. 5, on the north boundary of section 23, twenty chains west of the northeast corner of the section, and that the azimuth of said north boundary is found to be $N. 90^{\circ} 17' 4'' E.$ This azimuth is the angle BSN formed by the section line and the astronomical meridian SB through the point of observation S. It has been explained that all bearings in the township must be referred to the astronomical meridian passing through the centre of the township, which is the northeast corner of section 16. It follows that the bearing of the north boundary of section 23 is the angle AMN formed by the production SM of the section line with the astronomical meridian CA through the centre, C, of the township. But the difference between the azimuth BSN and the bearing AMN is the angle between the two astronomical meridians SB and MA, which angle is the convergence of the meridians. By consulting the diagram of the Astronomical Field Tables, the convergence of the meridians for township 121 is found to be 1.5 minutes per section. The distance of the point of observation, S, from the central meridian being approximately $1\frac{3}{4}$ sections, the convergence between the central meridian and the meridian of observation is $1\frac{3}{4} \times 1.5$ minutes, or 2.6 minutes. The bearing of the north boundary of section 23 is accordingly found by subtracting the convergence 2.6 minutes from the azimuth $90^{\circ} 17' 4''$, which gives $90^{\circ} 14' 8''$ for the bearing.

70. The bearings of every survey are all referred to a single meridian so that the angle of any two lines of the survey may be given by the difference of their bearings.

A survey extending over such a distance in longitude that the application of the above rule would be inconvenient may

be divided into several portions, each with a separate meridian, but the angular change in the bearings in passing from one meridian to the next one, and the place where such change is made must be carefully noted.

71. Except in the survey of town sites, all lengths or distances are expressed in chains and links. In the survey of a town site, the lengths may be either all expressed in feet or all in chains and links, but in no case are both measures used in one survey. Heights and depths are in all cases expressed in feet.

72. Measurements are made with steel band chains, tested frequently during use by comparison with the subsidiary standard of the surveyor. Steel bands provided with means of adjustment must be corrected; in using bands not so provided, allowance is made for the error. Steel bands are very liable to break; this fact cannot be impressed too strongly upon the chainman. In case of accident the surveyor should be provided with some means of repairing breaks. The subsidiary standard is not used on field work, but is carefully preserved for purposes of comparison.

73. Previous to entering on their duties, the chainmen are to be sworn according to the form below, and such oath is filed with the returns of the survey:

I, A. B., do solemnly swear that I will discharge the duty of chaining and measuring with exactness according to the best of my judgment and ability, and that I will render a true account of my chaining and measuring to C. D., Dominion land surveyor, by whom I have been appointed to such duty. So help me God. (Signed) A. B.

74. In chaining over uneven ground, should the same be so broken as not to permit of the full chain being levelled, the measurement is made with such portion thereof as may be easily levelled, and particular care is taken at such times, in plumbing and dropping the pins, in order to obtain the accurate horizontal measurement.

Lines over sloping ground may be measured either by levelling the chain, as directed above, or by chaining along the surface of the ground, measuring the slope with a clinometer and applying the requisite correction.

75. In case the survey line be obstructed by a lake, pond, deep marsh or other obstacle, the surveyor may pass it by

right-angled offsets, or, if more convenient, ascertain the distance across by triangulation. The angle opposite to the base should be, whenever practicable, at least thirty degrees. It must never be less than fifteen degrees. The three angles of the triangle must be measured and recorded.

76. All lines established as boundaries in woods are to be well opened out and to be further marked by blazed trees at least at every chain on either side of the line. A tree is blazed on three sides, namely, on the side on which the line passes, and on the two adjacent sides. Blazes are to be placed on the trees most likely to live and are not to be omitted when there are trees more than two inches in diameter within fifty links from the line.

77. Under the provisions of section 62, of the Dominion Lands Surveys Act, the boundary lines of townships, sections, legal subdivisions, lots, &c., are declared to be the lines defined by the mounds, posts or monuments placed or planted at the angles thereof.

When the closing error of a trial line opened out in woods is not more than the maximum error allowed for such a line, the post may, except on township boundaries, be established by offsetting without opening the true line. In order that the post which has been offset may be readily found, it is connected with the trial line by opening an oblique line making an angle not greater than five degrees with the trial line. Blazes are omitted from the last portion of the trial line, the oblique line being blazed instead. Offsetting the posts in this manner is, however, allowed only when the trial line strikes within fifty links of the corner; when the trial line strikes more than fifty links from the corner, the true line must be opened out, surveyed and blazed, whether the discrepancy be due to an error in the outlines or to any other cause.

Table XVIII. of the Supplement may be used for correcting the trial line; it gives the deflection of a line for offsets of from one to one hundred and forty-nine links at the end of eighty-one chains.

The trial line run for the north or the south outline of a township will seldom if ever strike the post at the opposite corner. On such a line offsetting the posts is not allowed. The line must be run again throughout its whole length as a true line.

Should a meridional section line closing on the north or south boundary of the township strike more than fifty links and not more than one chain from the corner, it must be run again as a true line across the last section. Should the line strike more than one chain and not more than one chain and fifty links from the corner, it must be run again across the last two sections; and so on adding one more section for each increase of fifty links in the closing error.

Should the trial line run from a section corner along the northern limit of a section strike more than fifty links from the opposite section corner, the true line must be opened out surveyed and blazed.

TOWNSHIP OUTLINES.

78. Whenever the nature of the country permits, the first operation in laying out a given portion of country for settlement consists in the survey of "blocks."

In the first system of survey, a block contains four townships being bounded by a base line, a correction line and two meridians. The base line is first surveyed, then the meridians, and the correction line across the two ranges is surveyed, first as a trial line, then as a true line. The block is "quartered" into townships by straight lines by the township subdivider. Otherwise the manner of survey is the same as under the third system, and since very little of the territory in which this system is in force remains to be surveyed, no further description of it is necessary.

79. In the second system, the block contains sixteen townships included between successive correction lines and meridians four ranges apart. All the territory of this system being already laid out into townships, no description of the method of survey of blocks is necessary.

80. In the third system a block embraces sixteen townships, bounded by two base lines and the meridians, four ranges apart, from them to the intermediate correction line.

The surveyor of township outlines divides the block into townships by projecting the interior meridians of the block, and surveys the other outlines of the townships by joining the corresponding corners on the meridians by straight lines, although this latter operation is generally left for the surveyor charged with the duty of subdividing the townships into sections.

81. Frequently, however, mountains, large lakes, or other natural obstacles prevent the survey of the block as a whole. In such cases the interior lines of the block are projected according to the general rules in so far as they apply to the case.

82. The eastern and western exterior boundaries of the blocks are broken lines, each consisting of two meridians separated by the "jog" at the correction line. The northern and southern limits (base lines) are parts of a polygon described on a parallel of latitude, by laying off, as chords thereto, the successive township sides, forming, as the case may be, the northern or southern outline of the block.

83. The road allowances along meridians are in all cases to be of the prescribed theoretic width. That the distribution of excess or defect is among the sections, and is not applied to the roads, does not materially affect the bearing of the north and south lines involved; the displacement at the extremes—but two-thirds of a link on each mile—being less than ordinary chaining is at all accurate enough to indicate.

84. In surveying meridian exteriors the surveyor of township outlines commences at one of the township corners of the base line. He carefully measures one or two miles of the base before beginning the subdivision of the block; this enables him to compare his chaining with that of the lines previously run.

85. The meridian is carried only as far as the correction line where a temporary post is left. The corresponding meridian is then surveyed from the township corner on the next base to the same correction line, and an instrument line run connecting the two meridians. Where the jog is short this line may be turned off at 90°, but where the jog is forty chains or more in length account should be taken of the convergence of meridians. The road allowance is taken into consideration and the north and south closing error is distributed equally between the two quarter sections adjoining and on each side of the correction line so as to make both quarter-sections of the same depth. The monuments for township corners are then permanently established.

An exception to the above method occurs on meridian outlines closing on the first correction line, on which

outlines the quarter sections adjoining the correction line are given the theoretical depth of forty chains.

On all the meridians of township one the deficiency or surplus as the case may be must be left in the quarter sections adjoining the first base line or international boundary.

No monuments are erected by the surveyor of township outlines between the township corners on the correction line.

86. Any difference in the chainage of two meridians causes corresponding deviations on the east and west lines joining the same; great care must therefore be bestowed on the measurements and every precaution taken to ensure accuracy.

87. In running across a block between two base lines or in establishing a meridian outline from a base line to the correction lines on both sides, the surveyor must observe for azimuth at least once upon every meridian.

88. Surveyors of township outlines are requested to plant firmly and carefully the pickets marking their instrument stations near the township corners, so that the subdivider may readily obtain the correct direction for starting his lines.

SUBDIVISION OF TOWNSHIPS.

89. A township is subdivided by first projecting the meridians, and then joining the corresponding section corners on them, first by trial and then by true lines. Table XVIII of the Supplement may be used for correcting the trial line; it gives the deflection of a line for offsets of from one to one hundred and forty-nine links at the end of eighty-one chains. Except on township outlines, posts may be offset from trial lines. Should the closing error of a trial line opened out in woods, whether it be a meridional line or a line along the north boundary of a section, be not more than 50 links, the line may be established by offsetting the last quarter section post without opening the true line.

Should a meridional section line closing on the north or south boundary of the township strike more than fifty links and not more than one chain from the corner, it must be run again as a true line across the last section. Should the line strike more than one chain and not more than one

chain and fifty links from the corner, it must be run again across the last two sections, and so on, adding one more section for each increase of fifty links in the closing error.

Should the trial line run from a section corner along the northern limit of a section strike more than fifty links from the opposite section corner, the true line must be opened out, surveyed and blazed.

90. The only section lines to be surveyed, established and permanently marked as boundaries, are those along which the road allowances are. Their total length for a township of the third system is forty-two miles and twenty-seven chains, more or less, exclusive of township outlines, and for a township of the first or second system sixty-one miles and ten chains more or less.

91. In the fourth system the lines to be surveyed are those corresponding to those surveyed in the third system; that is, all the north and south, and the alternate east and west section lines.

92. Before starting for his survey, the subdivider receives from the head office diagrams of the outlines previously surveyed. Should these diagrams not be forthcoming, the subdivider must call attention to the matter and ask for them.

93. Upon arriving at the township corner from which the survey is to be started, the subdivider measures carefully a mile of the township outline. This enables him to compare his chaining with that of the lines previously run, and to adjust his measurements so as to strike the corners on the outlines, but he must not make any change in his chain, and the distances recorded in the field book must be those actually found on the ground after proper tests of the chain with the subsidiary standard.

The surveyor endeavors to find the pickets marking the instrument stations on the outline which are better guides for direction than the monuments.

94. The meridian outlines of a township having been previously established the subdivider commences his operations by running the north and the south outlines of the township if they have not been previously surveyed.

In order to do so he joins, by a trial line, the opposite township corners and then plants the posts permanently on the true line, making all quarter sections equal. It is to be observed that the whole line across the township must

be resurveyed as a true line; offsetting the posts is not allowed for the outlines of townships. Table XVIII of the Supplement, gives the number of minutes by which the course of the trial line is to be altered in order to strike the post. The course of the true line, not of the trial line, is to be entered in the field notes.

Only one limit of the road allowance along a correction line is surveyed at one time, but connections must always be made with all monuments established on the opposite limit and these connections must be recorded in the field notes.

95. In running the north or the south limit of the road allowance along a correction line when the opposite limit has been previously established, the subdivider may find that owing to irregularities in the prior survey, the width of the road allowance at some points differs from the normal width by twenty links or more. If it is found that the irregularity is due to an error of more than one chain and fifty links in the position of one of the adjacent township corners, the surveyor may resurvey or retrace the meridian outline as provided hereinafter. If the error in the position of the township corner is less than one chain and fifty links, or if the correction cannot be made, he must deflect his own line at some section or quarter section corner so as to leave a road allowance of normal width.

When a correction line has to be deflected across the last fractional range in order to close on an initial meridian, the south or the north side, as the case may be, of the road

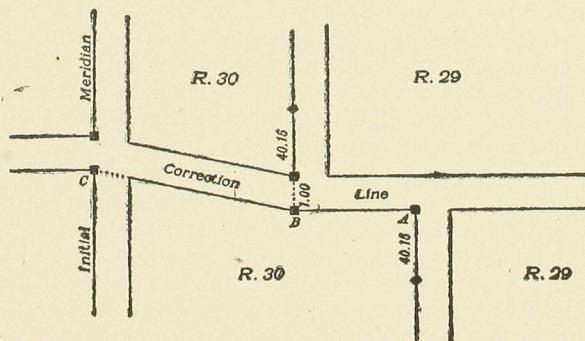


Fig. 6.

allowance is broken in such a way as to leave the full width of one chain for the road (one chain and a half in the first and second systems of survey).

The general case is represented in Fig. 6.

The northeast corner, A, of the township south of the correction line is joined by a straight line to a point, B, one chain south of the post at the west end of the "jog", and this point, B, is again joined by a straight line to the corresponding post, C, on the initial meridian. The point, B, is marked by a monument similar to that at a section or quarter section corner. The north outline of the township south of the correction line is thus a line, ABC, broken at B.

Another position of the lines is shown in Fig. 7, the initial meridian intersecting the "jog". The last quarter section on the meridian township outline surveyed from the south is made of the same depth as that on the next meridian township outline on the east.

The southeast corner, A, of the township north of the correction line is joined by a straight line to a point, B, one chain north of the post at the eastern end of the "jog", and this point, B, is again joined to the corresponding post on the initial meridian. The point, B, is marked by a monument similar to that at a section or quarter section corner. The south outline of the township north of the correction line is thus a line, ABC, broken at B.

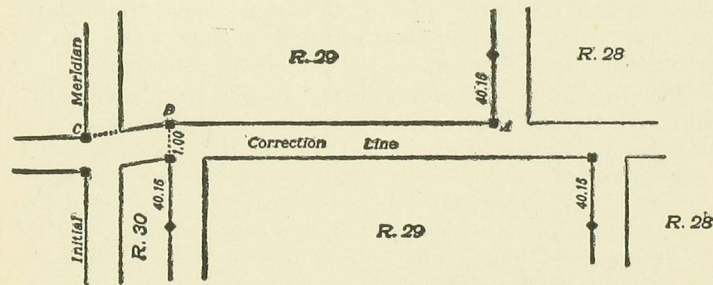


Fig. 7.

96. It has been explained, in the exposition of the system of survey, that sections in all the systems except the first, are of unequal width on account of the convergence or divergence of meridians. To better illustrate this fact the convergence has been exaggerated in Fig. 4.

The angle formed by the meridional section lines with the east and west lines is different for each line, and varies uniformly from one corner of the township to the other. The surveyor must not, therefore, start his meridional section lines at right angles to the township lines, but he must, in each case, calculate the angle formed by the lines from the data supplied to him on the diagram of township outlines or from his own measurements.

Supposing for instance, the bearings of *ae* and *dh* (Fig. 4) to be $359^{\circ} 59'$ and $0^{\circ} 05'$, the meridional section lines at *b*, *c*, etc., shall be run upon bearings of 360° , $0^{\circ} 01'$, $0^{\circ} 02'$, $0^{\circ} 03'$ and $0^{\circ} 04'$. These courses are turned off the line *ad*, the bearing of which is either given on the diagram of outlines or has been ascertained by the subdivider in surveying it.

The bearings on Fig. 4 are the theoretical bearings for township 29.

97. In the first system of survey, as already stated, the meridional section lines are not true meridians, but are parallel to the east outline of the township, and make with the south outline of the township angles equal to the southeastern angle of the township. All the meridional section lines are therefore started upon the same bearing, that is to say, upon the bearing of the east outline.

98. In starting from a correction line, the surveyor gives to the adjoining quarter section a depth proportional to those of the quarter sections at each end of the tier, as shown on the diagram of the township outlines.

99. In closing with a meridional section line on the north or south outline of a township, the last section post on such meridional section line is, with the exception noted below, at once planted permanently and connected by a straight line with the section corner on the outline of the township. The surplus or deficiency is left in the quarter section adjoining the outline. The true course of the deflected line is entered in the notes.

In order that the quarter section post which has been offset may be readily found, it is connected with the trial

line by opening an oblique line making an angle not greater than five degrees with the trial line. Blazes are omitted from the last portion of the trial line, the oblique line being blazed instead.

Should a meridional section line strike more than fifty links and not more than one chain from the corner, it must be resurveyed as a true line across the last section. Offsetting the post is not sufficient; a new line must be run, and, if in the woods, opened throughout.

Should the line strike more than one chain and not more than one chain and fifty links from the corner, it must be run again across the last two sections, and so on, adding one more section for every increase of fifty links in the closing error.

If a trial line run from a section corner along the northern limit of a section, strikes within fifty links of the opposite section corner, the quarter section post is offset north or south to its true position. Should such trial line strike more than fifty links from the opposite corner, the true line must be opened out, surveyed and blazed.

A line started upon an assumed bearing from an outline surveyed by another surveyor must be connected by angular measurement with at least one line of which the bearing has been deduced from the subdivider's astronomical observations, so that the proper correction may be applied to the assumed bearing before entering it in the office copy of the field notes. The connecting angle or angles must be recorded.

100. With the exception noted above for the first system of survey, the quarter section sides on east and west lines are made equal; that is to say, after the road allowance has been laid off from the west end of the section line, the remainder is divided into two equal parts and the quarter section corner placed at the middle point.

In all the systems of survey also, the quarter section on the east side of an initial meridian contains all the deficiency.

101. When a township, whether fractional or otherwise adjoins land surveyed under a different system, all lines within such township must be stopped at the inner side of the road allowance dividing the two systems and a corner post or monument erected at the point of intersection. In no case must a line be extended across the aforesaid road allowance.

102. A road allowance of the same width as in the adjoining township is, if necessary, laid out along the boundary of an Indian reserve. In determining whether a road allowance is necessary or not, the invariable rule is that every quarter section shall be rendered accessible by a road. Road allowances may also be laid out along a reserve boundary if they are considered necessary to provide the means of going from one part of a township to another by a reasonably direct route, thus overcoming the inconvenience which might result from the closing of some of the regular roads by the reserve.

The intersections of the section lines with that side of the road allowance which adjoins the township are indicated by proper monuments. When a reserve not yet surveyed is formed of a certain number of full sections, the surveyor, in establishing the same, plants the posts as usual on the west and south boundaries; but on the north and east sides they are planted in the north or east limit of the road allowance. The side of the road allowance adjoining the township is the only one posted by the surveyors who are subdividing Dominion lands. If no road allowance is left, all surveyed lines closing on the Indian reserve are posted on the reserve limit.

Indian reserve boundaries and other lines must be retraced, when the areas of the quarter sections adjoining cannot be found without such a survey.

103. As a general rule, no lines are run in Indian reserves. Should it be necessary, in surveying a base line or other important governing line, to cross an Indian reserve, no posts are planted, nor permanent marks of any kind left within the boundaries of the reserve.

104. Connection is made with the corner of any group lot, mineral claim or other parcel of land previously laid out within the township, and with the monuments of surveyed roads. In the case of railways, connection is made with the nearest survey stake and the marks on it are noted.

105. A picket or hub, called "traverse hub," is firmly planted on every surveyed line near the point where the line intersects the bank of a lake or river which has to be traversed, as hereinafter explained.

106. Owing to the mountainous character of British Columbia, it is impracticable to survey the base lines and block and township outlines as on the prairie. All the surveys

in the railway belt are based upon a traverse survey made along the main line of the Canadian Pacific railway from which the positions of the corners of the sections through which the railway passes have been computed.

These positions have been tabulated and printed in a list of "Positions of Stations on the C. P. R. Traverse," copies of which are furnished to surveyors making surveys in the railway belt.

In this list the actual position of the instrument in the traverse survey is given by reference to the northeast corner of the section in which the point lies.

107. The surveyor first finds the instrument station, and then measures the given distances east and north; this gives him the point at which he is to place the section corner post.

The instrument station was usually on or near the track, and hence the hub is generally not to be found, being covered with ballast. Reference is made in the list to bearing trees or posts, called C. P. T. (Canadian Pacific Traverse) posts.

The given azimuths and distances from the station to the post enable the surveyor to locate the station when he finds the bearing post.

Surveyors are warned that some of these bearing posts have been moved; to avoid error, it is necessary to connect with two or more of them.

108. When the section corner has been placed in the manner aforesaid, the survey of the section lines is continued therefrom by laying off the theoretical widths and depths of sections.

109. Where cairns or posts have been established by the trigonometrical survey in the mountains, the sectional survey may be based, in like manner, on their tabulated positions.

110. The outer limit of the railway belt follows section lines as shown on the sectional maps of the belt.

In making a survey for the purpose of determining the limits of the belt, the surveyor may run township or section lines, or make a traverse of some stream, road or lake leading to the limit, from which he can locate the section lines in that vicinity, but the survey must be checked by another surveyed line forming a closed circuit.

111. In subdividing townships, at least one astronomical observation for ascertaining the direction of the meridian is made in each township, but two or more are desirable.

A record of the observations and of their calculations must be furnished.

In an ordinary subdivision survey, the section lines are run as trial lines between posts previously established. When the weather is not favourable for observing, the subdivision may be commenced with an assumed meridian, using for instance, the bearing of one of the township outlines given on the diagram of outlines. The astronomical observation is taken when a favourable opportunity occurs, but no change is made in the field notes until the subdivision of the township has been completed, when all the bearings entered are corrected by adding or subtracting as the case may be, the error of the assumed meridian deduced from the astronomical observation, due allowance being made for convergence when the observation is made elsewhere than on the central meridian of the township.

In resurveys, retracements, etc., astronomical observations are to be taken as in original subdivision and as often as may be necessary for keeping within the limit of error allowed.

112. The limits of error in subdivision surveys are as follows:—

When the closing error of a trial line opened out in woods is not more than fifty links, the line may, except on township outlines, be established by offsetting the last quarter section post without opening the true line. In order that the monument may be readily found it is connected with the trial line by opening an oblique line making an angle not greater than five degrees with the trial line.

When a meridional section line closing on the north or south boundary of a township strikes more than fifty links and not more than one chain from the corner, it must be run again as a true line across the last section. Should the line strike more than one chain and not more than one chain and fifty links from the corner, it must be run again across the last two sections; and so on, adding one more section for every increase of fifty links in the closing error.

Should the trial line run from a section corner along the northern limit of a section strike more than fifty links from the opposite section corner, the true line must be opened out, surveyed and blazed.

The trial line run for the north or the south outline of a township will seldom if ever strike the post at the oppo-

site corner. On such a line offsetting the posts is not allowed. The line must be run again throughout its whole length as a true line.

For convenience of reference in checking the closings of surveys, the term *block* is used to denote a section in the first and second systems and to denote two sections contained within surveyed boundaries in the other systems. This term must not be confused with the "block of sixteen townships" mentioned in connection with base line surveys.

When the whole survey around a *block* is made by one surveyor, the limit of error allowed in the closing is fifty links. Should the block not close within fifty links the section lines around it must be retraced so as to obtain correct bearings and lengths. When part of the survey only is made by the surveyor, the limit of error allowed is one chain and fifty links. If the error exceed this limit, the previously surveyed lines must be retraced or resurveyed as provided for hereinafter.

Before leaving a locality the surveyor must check the closings of all the blocks affected by his surveys. It is not necessary to make an accurate determination by means of latitudes and departures; the closing may be easily and quickly checked by the use of Table XVIII of the Supplement to the Manual. If the error should exceed the prescribed limit, the determination of the bearings and distances must be repeated until the closing error falls within the limit. It may not be necessary to retrace all the boundaries of a block to locate the error. The retracement of a portion of the boundary may be all that is necessary to effect a proper closing. It is important that this matter should not be overlooked, as, when errors are found in a surveyor's returns, another party has to be sent out to retrace the lines in order to ascertain the correct bearings and lengths.

The limit of error allowed in the plot of a traverse between two hubs when all the sections lines of the block have been run by the surveyor making the traverse, or in the traverse of a lake lying wholly within a block as above defined, is fifty links. Should the error exceed fifty links the courses of the traverse must be redetermined. When any of the section lines of the block have been run by another surveyor the limit of error allowed between two hubs is one chain and fifty links.

The closing errors of these plots are checked in the examination of the field notes.

A surveyor is expected to do his work with reasonable care. No survey will be accepted in which the number of errors indicates carelessness, although each individual error may be within the limit of error allowed.

113. No township or section line, except in subdivided townships, the section lines along which there are no road allowances, is surveyed without instructions from the Surveyor General. In the railway belt in British Columbia, instructions are required for all township or section lines without exception.

A surveyor who is requested to survey such lines must apply for instructions before commencing the survey.

SETTLEMENT SURVEYS.

114. Before proceeding with the survey of a settlement, the surveyor shall make a rough compass survey of the road or shore upon which the settlers are located and of their improvements; he shall also inquire into the claims of each.

Upon the plan of the compass survey, he shall endeavour to lay out the land into lots of such size and shape as will best meet the wishes and legitimate claims of the occupants. It is essential that each settler shall remain in possession of his improvements and the lots should be laid out accordingly as far as it can be done. A lot must not, as a rule, exceed one hundred and sixty acres. With a view to avoiding causes of future boundary disputes the mode of division adopted must be as simple and regular as the circumstances of the case permit. Preferably, the lots should be laid out north and south or east and west. Where this would prove inconvenient, a direction can usually be found to which all the lots will be parallel. In some cases, the improvements are so placed that lots have to be laid out in several directions, but the changes of direction should be as few as possible.

A base line is located approximately upon the plan of the compass survey, placing it close to the improvements and perpendicular to the lot lines. The base line is offset along lot lines where necessary for keeping close to the improvements; it is deflected at the places where the direction of the lots changes, so as to remain perpendicular to the lots.

115. The surveyor now proceeds with the survey of the base line. The direction of the meridian is ascertained by an astronomical observation before commencing the survey or a conventional meridian is assumed, the bearings being corrected after the survey is completed.

The surveyor shall observe at least twice for azimuth during the course of the survey.

The limits of the lots are marked upon the base line.

116. The rear line is next established parallel to the base line and the rear corners of the lots marked. Connection is made at suitable intervals between the base and the rear line by running some of the lot lines.

117. The front of the lots, whether a river, a road or the shore of a lake, is now traversed. To be suitable as a water front, the river or lake must have well-defined banks; the edge of a marsh is inadmissible as a boundary and must be replaced by straight lines. The middle of an unnavigable river may, when the river is well defined, be adopted as a boundary.

118. The survey is completed by laying out the public highway across the settlement, and such additional roads as are necessary for giving access to all the lots or for other purposes. Care must be taken to provide access to the rear of the lots by road allowances at distances not greater than two miles. The survey of the roads is connected to the base or rear lines at suitable intervals.

The survey must be connected to some previously confirmed survey, if there is any such within two miles, and with all previously established survey monuments within ten chains of the limits of the settlement.

SURVEY OF GROUP LOTS.

119. Before undertaking the survey of a group lot, the surveyor must apply for a lot number.

120. An astronomical observation for ascertaining the direction of the meridian is made before commencing the survey, unless the said direction can be obtained from the lines of an adjoining survey previously confirmed.

121. Having fixed upon the initial corner of the lot, the surveyor runs from this corner and marks the limits of the lot. Where a part of the limit is over inaccessible ground, the limit is run as far as it can be done, and the corner is indicated by a witness monument which is connected to the

next limit by a traverse. Proper monuments are erected at the other corners. Except as stated above, all the boundaries of the lot must be surveyed.

122. Where the shore of a lake or stream forms a boundary, it is traversed, and a monument is established near the shore upon each of the lot lines.

123. The survey must be connected to some previously confirmed survey, if there is any such within two miles, and with all previously established survey monuments within ten chains of the limits of the lot.

In the absence of any confirmed survey within two miles, the lot must be connected to some prominent, permanent and well-defined natural feature.

TOWN SITE SURVEYS.

124. A town site is laid out by surveying both sides of the streets, both sides of the avenues and both sides of the lanes where lanes are provided. In blocks where there are no lanes the line at the rear of the lots is to be surveyed. A post is placed at each corner of every lot and at each point of deflection of a street, avenue or lane not coinciding with a corner of a lot. No post is located by offset from a surveyed line.

Natural boundaries for town lots are undesirable; when adopted they must be well defined and carefully traversed.

125. The survey of a townsite is to be properly connected with the boundary monuments of the section, quarter section, river lot or other parcel of land in which the town site is situated.

At least one street is to be connected with each road allowance along the boundaries of the quarter section.

SURVEY OF PUBLIC HIGHWAYS.

126. A public highway is surveyed either along the centre of the highway or along one of its limits. In a wooded country it is preferable to follow the centre line, while in prairie it is more convenient to follow one of the limits.

127. The starting and closing points of the highway must be connected to some monument of Dominion land surveys; connection is also made with a section or quarter section

monument upon every surveyed section line intersected, and with monuments at suitable intervals in settlements or group lots.

When either end of a highway is not connected with some other surveyed street, road or road allowance, the boundary at the end is definitely located on the ground and indicated in the field notes.

128. In running his lines, the surveyor sets the transit so as to give by direct reading the bearings of the lines in the manner hereinafter described for traverse surveys.

129. When the survey is made along one of the limits of the highway, monuments are established at all points of deflection, hereinafter called "stations." The position

of the monument in the opposite limit of the highway is determined by taking the mean of the bearings of the front and back courses, and either adding or subtracting 90° . This gives the bearing of the line bisecting the angle formed by

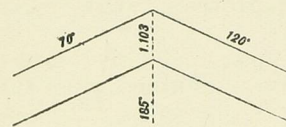


Fig 8

the two courses. For instance, the bearing of the back course being 70° and of the front course 120° , (Fig. 8,) the bearing of the line bisecting the angle formed by the two courses is:

$$\frac{70^\circ + 120^\circ}{2} + 90^\circ = 185^\circ$$

Had the survey been made along the other limit of the road, the bearing would be:

$$\frac{70^\circ + 120^\circ}{2} - 90^\circ = 5^\circ$$

The distance in chains along the bisecting line thus found to the opposite limit is, for a highway one chain wide, equal to the secant of one-half the difference of the bearings of the front and back courses. Thus in example above given (Fig. 8), one-half the difference of bearings is:

$$\frac{120^\circ - 70^\circ}{2} = 25^\circ$$

the secant of which is 1.103.

The distance to the opposite limit is therefore one chain ten links and three-tenths of a link.

This distance is given for differences of bearings from 0° to 120° in Table XX. This table, printed on cardboard for carrying in the pocket, may be had upon application to the head office.

Monuments on the opposite limit, other than corner monuments, are established by right-angled offsets.

130. When the survey is made along the centre line, the positions of the stations on the limits of the highway are determined in the same manner as above except that the distance measured along the bisecting line in each case is only one-half of the distance given in Table XX.

131. Additional monuments are placed to define the highway when the stations are more than twenty chains apart.

In some cases, the monuments upon one of the limits of the road are omitted; the surveyor is informed when they are not needed.

TRAVERSES.

132. In connection with surveys of Dominion lands, traverses are made for the following purposes:—

For defining the boundaries and the contents of a parcel of land fronting upon a river or lake.

For ascertaining the area of the portion of a parcel of land occupied by a body of water and thereby rendered useless for farming.

For connecting a point or line of a survey with another point or line of the same, or of another survey, or with some other reference object.

133. The traverse of a water front of a parcel is made for ascertaining the contents of the parcel and as a means of identification of the water boundary.

Other traverses, such as that of a lake entirely within a quarter section, are made only for the purpose of ascertaining the quantity of land subject to sale and to be paid for by the purchaser.

134. The courses of a traverse are not boundaries of the parcels fronting on bodies of water. Lands abutting on tidal waters are bounded by the line of ordinary high water mark. In the case of a lake or navigable stream, the

boundary is the edge of the bed of the lake or stream, which edge is called the *bank*.

The *bed* of a body of water has been defined as the land covered so long by water as to wrest it from vegetation, or as to mark a distinct character upon the vegetation and upon the soil itself where vegetation extends into the water. According to this definition, the limit of the bank is the line where vegetation ceases, or where the character of the vegetation and soil changes.

The *foreshore* or *shore* is the strip of land lying along tidal water, over which the daily tide ebbs and flows; it is the space between high and low water marks at ordinary tides.

In making traverse surveys, the surveyor must bear in mind the following rules determining the ownership of lands fronting upon bodies of water and the rights of the owners.

135. The grantee of a parcel of land fronting upon a lake or river acquires not only the land actually surveyed, but also the right to future additions to the parcel which may result from gradual alluvion or dereliction resulting from natural causes.

Where the land is slowly and imperceptibly added to, either by alluvion or by the recession of the water of a river or lake, whether navigable or not, the new land thus formed belongs to the riparian owner in front of whose land it is formed, and the process is held to be imperceptible where its effects are so gradual that it is not discernible from moment to moment, though the fact that there has been an increase in the land may be perceptible from year to year or at shorter intervals. The converse is also true, that lands gradually encroached upon by the water upon which they border cease to the extent of the encroachment to belong to the former owner.

On the other hand, sudden and sensible additions to or subtractions from lands arising from similar causes do not cause any change in ownership.

136. Riparian owners whose lands border upon unnavigable waters are held to be the owners of the bed of such waters in front of their holdings *ad filum aquae*. Their rights in this regard may depend to some extent upon the precise terms of the description by which their lands have been conveyed to them. An exception is made by the Irrigation Act for the provinces of Saskatchewan and Alberta and for

the Northwest Territories, except the provisional districts of Mackenzie, Franklin and Ungava, Section 7 of the Act providing that no grant shall be made by the Crown of any exclusive property or right in the land forming the bed or shore of any lake, river, stream or other body of water. The word shore in this section is presumed to be intended to designate that part of the bed which is uncovered when the water is low.

137. From the foregoing it follows that along tidal waters the line to be traversed is the high-water mark at ordinary tides.

For a lake or navigable river, and also, where the Irrigation Act applies, for a river not navigable, the line to be traversed is the bank. A parcel fronting on the lake or river does not include the bed, nor does it include the adjoining islands unless the survey shows distinctly that they are included.

Where the Irrigation Act does not apply, the middle of the main channel is the line to be traversed for an unnavigable stream which is adopted as a boundary between the adjoining lands. In such a case, a parcel fronting on the stream includes the bed of the stream and the adjoining islands as far as the middle of the stream.

138. The edge of a marsh, or any other natural feature which is not susceptible of a precise definition, is inadmissible as a boundary. When a parcel of land extends to such a feature, as in settlements or group lots, the limit is to be defined by one or several straight lines, the corners being indicated by witness monuments if their positions are unsuitable for the erection of monuments.

139. In subdividing townships all lakes over ten acres in extent and any islands containing not less than five acres are to be accurately surveyed. Any island smaller than five acres is to be located by offsets to its extremities and its width measured. Where the Irrigation Act applies, all rivers averaging one chain or more in width are to be traversed. Where the Irrigation Act does not apply, all navigable rivers averaging one chain or more in width and all unnavigable rivers averaging three chains or more in width are to be traversed. Section lines are to be extended across all islands struck by them and section and quarter section corners falling thereon are to be established in the regular way.

140. The bank of a river is referred to as the *right* or *left* bank, according as it is to the right or to the left, looking down the stream.

141. The area occupied by the bed of a river is deducted from the area of a subdivision when the river, although not navigable, is more than three chains in width. In such a case both banks of the river are traversed, a separate traverse of the middle being omitted, although the middle remains the boundary between the adjoining lands in territory outside of the jurisdiction of the Irrigation Act. When both banks are traversed, the middle of the river, if required, is located by offsets from the banks. Islands less than twenty acres in extent may be included in the adjoining fractional subdivisions.

Where the Irrigation Act applies, the area of every river, whether more or less than three chains in width is deducted from the area of a subdivision. An unnavigable river averaging more than one chain, but not more than three chains in width is not surveyed along both banks, but by a single traverse line, its area being calculated by means of the width measured at proper intervals. In both cases islands may be included in the adjoining subdivisions.

142. Many of the small bodies of water found in the West and commonly called lakes are in reality not permanent lakes but shallow depressions in the ground filled with surface water the depth and extent of which vary greatly at different seasons and from year to year. When the country is opened up and drained they dry up and disappear more or less completely. If the edge of such a body of water varies ten chains or more it is not to be traversed; the land is dealt with by selecting the legal subdivisions and quarters of legal subdivisions which are not rendered worthless by the water. A sketch must be furnished by the surveyor indicating the said legal subdivisions and quarters thereof.

Similar remarks apply also to marshes and to lakes surrounded or partially surrounded by marshes.

A marsh producing hay must not be traversed.

143. A traverse survey is commenced at one of the traverse hubs planted by the surveyor while running the section or lot lines, and is closed upon the next traverse hub or upon a section, quarter section or lot corner. The traverse

of a lake or island lying entirely within a section or lot must be properly connected with the rest of the survey.

144. In running his lines the surveyor must set his transit so as to give by direct reading the bearings of the lines, that is to say, the instrument must be so placed that it shall read 0° when the telescope is pointing north, 90° for east, 180° for south, and 270° for west. In order to do so, the instrument is placed over the traverse station and after levelling it, the vernier is clamped to read the bearing of the last course. The telescope is next turned on the back picket and the whole instrument is clamped in that position by clamping the lower plate. The vernier plate is then unclamped, the telescope is transited around its horizontal axis and directed upon the front picket. The bearing of the front course is now read upon the instrument. The compass may be used to advantage as a check on the orientation of the instrument for preventing mistakes.

Traverses made by means of deflection angles or by measuring the angles between successive courses will not be accepted.

145. A traverse, the object of which is merely to ascertain an area, may be made with a stadia or micrometer of an approved pattern. The stadia rod employed in making such a traverse must also be of an approved pattern and accurately graduated to at least links and tenths of links.

The stadia or micrometer must be tested on a measured base and a table must be prepared giving the distances corresponding to the readings.

The number of points of the bank or traversed line fixed by the survey is determined by the irregularity of the shore line, but such points must not be more than ten chains apart on township surveys and five chains on other surveys. Distances measured by stadia or micrometer must not exceed one-half mile. In chained traverses, offsets must not be greater than four chains on township surveys and two chains on other surveys.

Offsets should be taken at right angles to the course, or where otherwise taken the bearing of the offset should be given.

Other traverses must be chained unless permission is obtained to use the stadia or micrometer.

No blazes or permanent marks of any description are made on traverse lines.

146. Every lake or river traversed must be given a name or designation so that it may be referred to in describing parcels of land fronting upon it.

147. As a general rule, subject to exceptions, a quarter section is considered as sufficiently surveyed for disposal when two of its corners are indicated on the ground, either by corner or witness monuments. A quarter section made fractional by water or otherwise must have its area ascertained before it can be dealt with.

It is essential that a surveyor commencing a survey should complete it to such an extent that the land may be thrown open for entry or sale, and no traverse should be omitted which is necessary for that purpose.

BOUNDARY MONUMENTS.

148. Having ascertained by exact running and measurement the proper point for establishing the township, section or quarter section corner, as the case may be, the surveyor, in marking the same, is governed by the following directions:—

149. Only a single row of monuments to indicate the corners of the townships, sections or quarter sections (except as hereinafter provided) is placed on any survey line. These monuments are placed in the west limit of the road allowances on north and south lines, and in the south limit of the road allowances on east and west lines, or on the line between the sections where there are no road allowances and with the exceptions given hereinafter they fix and govern the positions of the corners of the adjoining townships, sections or quarter sections on both sides of the road allowance or line.

In exceptional cases it may be necessary to place a post at the centre of a section.

150. The township, section and quarter section corners on correction lines, and on lines between different systems of survey, are in all cases indicated by monuments erected and marked independently for the townships on each side; those for the townships north or east of the line, in the north or east limit of the road allowance, and those for the townships south or west, in the south or west limit. Where a road allowance is left along an Indian reserve such road allowance also is posted on both limits, on one limit for the

reserve and on the other limit for the township; but the limit adjoining the township is the only one posted by the surveyors who are subdividing Dominion lands.

151. A township, section or quarter section corner is indicated by a pointed iron tube marked as hereinafter described and driven to within ten inches of the top. The iron tube for township corners is five feet long and one and three-eighths inches in diameter and weighs about nine pounds and three ounces. That used for section and quarter section corners is three feet long and three-quarters of an inch in diameter and weighs about two pounds and eight ounces. The upper end in both cases is squared and a crown is stamped on one of the faces together with the following inscription "Penalty for Removal, Seven Years Imprisonment."

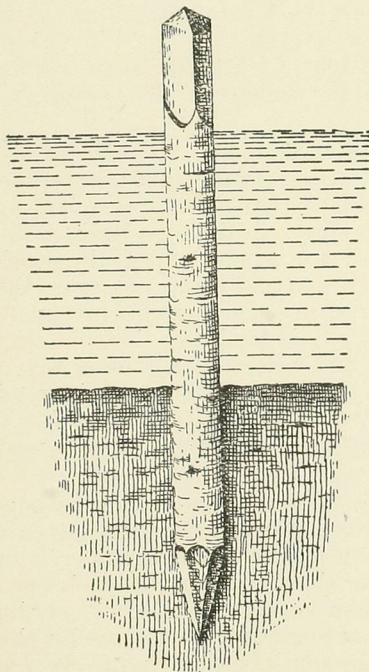


Fig. 9. Long post in shallow water at section corner.

When a township or section corner in bush country falls in a marsh or slough not over three feet deep, necessitating the erection of a witness monument more than five chains distant from the true corner, such corner must also be indicated by a wooden post planted at the true corner. The post used for this purpose must be of the most durable wood obtainable in the vicinity. It is squared at the top and inscribed with the same marks and planted in the same manner as prescribed for iron posts at section corners. It must be not less than five inches in diameter and long enough to be driven firmly and show the marking thereon above the water.

The position of the monument erected at a section, quarter section or other corner may be witnessed by ascertaining the bearing and distance therefrom of one or more adjacent trees, where the nature of the woods is such that the trees will be permanent marks. A blaze is cut on the side of the tree facing the post and the letters "B T" and the distance from the post to the tree are marked on the blaze with a knife or scribing iron. The bearing from the corner to the tree is recorded in the field notes and may be marked on the blaze with red chalk or paint. The size and description of the tree are also recorded.

152. A quarter section corner falling in a lake or marsh not over three feet deep is marked by a wooden post, flattened on two sides and marked as described below. The post must be not less than five inches in diameter and long enough to be driven three feet into the ground and to show six inches above the water.

A quarter section post whether wooden or iron is marked on one side with the fraction " $\frac{1}{4}$ " (fraction wise) to identify it as a quarter section post.

153. The post or tube is in all cases placed exactly at the corner it is meant to indicate. A mound or pits, or both, must also be made, except at quarter section corners in marshes where it is not possible to dig pits.

154. Mounds (Fig. 10) are of the form of square-based pyramids, six feet square at the base and three feet high for township corners, and five feet square by two and one-half feet high for section and quarter section corners.

155. In the formation of mounds, the earth is taken from four several "pits" three feet square and eighteen inches deep, the centre of the pits being four feet six inches outside and opposite the centres of the respective bases (Fig. 11). These mounds are formed of solid earth, roots and all foreign substances being excluded, and the earth well pressed down with the spade during the process. In order to facilitate the speedy erection of a mound, a rope skeleton may be used. By taking hold of each corner and making a knot of the three lines running to it, the line is carried without becoming tangled; or the spade used may have marked on it the distance from the centre to the corners of the mounds and to the sides of the pits, and small pickets may be planted at those distances and in the proper directions. The contents of a pit are 13.5 cubic feet.

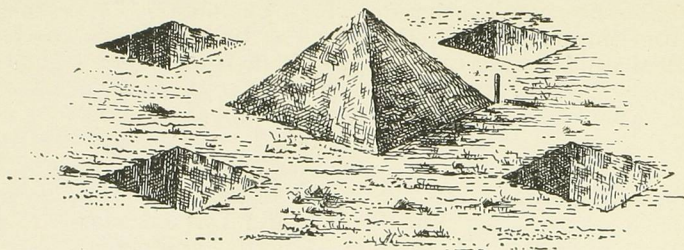


Fig. 10. Post, mound and pits—Perspective.

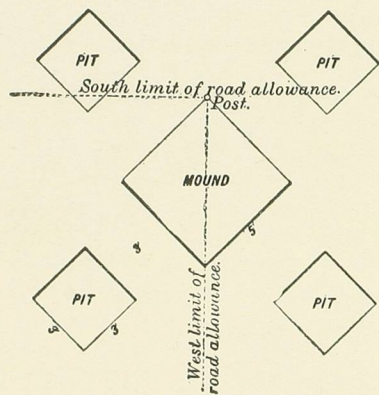


Fig. 11. Post, mound and pits—Plan.

156. Whenever stones can be readily procured, mounds may be built of stones properly piled so as to conform as nearly as possible in size and shape to the earth mounds (Fig. 12). Pits are not required for a mound built wholly of stones.

On rocky ground where the iron posts cannot be driven in, the stone mound should be so built that the post stands in the centre of the mound.

157. In prairie, at township, section and quarter section corners, pits are dug but mounds are not built. When the mound is not built the pits are placed at the same distances from one another as if the mound were built and at the same distance from the post as they would be from

the centre of the mound. (Figs 13 and 14). The earth from the pits is scattered about so that they may not be filled again by cattle pawing the earth into the pits.

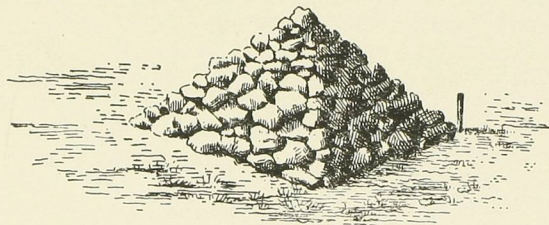


Fig. 12. Stone mound—Perspective.

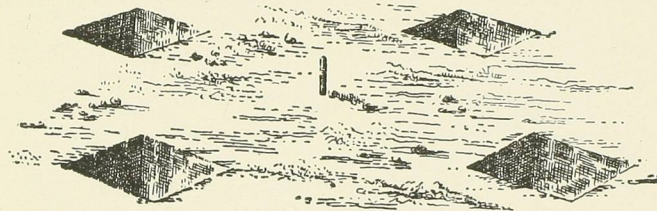


Fig. 13. Post and pits—Perspective.

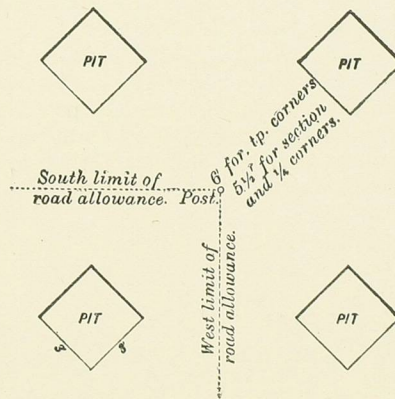


Fig. 14. Post and pits—Plan.

158. In woods, willow, or other scrub a mound and pits are made at all corners.

In wooded spots, the positions of the pits relative to the directions of the lines may, when necessary, be altered to suit circumstances, provided the distances between them and from the centre of the mound are preserved. One of the pits may be omitted, when, on account of large trees or other obstacles, it is found impracticable to dig the four pits.

Small openings of two chains or less in extent, in continuous bush country, are not to be classed as prairie, and therefore mounds should be built in such places. If a corner falls in a wooded bluff, two chains or more in extent, in prairie country, it is preferable to erect a mound instead of pits only.

159. In prairie the rule as to size, depth and position of pits will be rigidly enforced.

160. The mound built at a township, section or quarter section corner is so placed that the post stands at the northerly angle or point thereof, and that the mound stands diagonally to the cardinal points (Fig 11).

An exception is made in the case of rocky ground where the iron post cannot be driven in and where a stone mound is built. Such mound is built so that the post stands at its centre.

161. Except also that on correction lines, the lines between different systems of survey, the outer limits of the roads around Indian reserves, and generally all lines the posts on which mark the boundaries of lands on one side only of the line, the township, section and quarter section corner mounds are so placed that the post stands precisely in the centre of the north, east, south or west side of the base of the mound, according as the corner is intended for lands south, west, north or east of the line, the mound

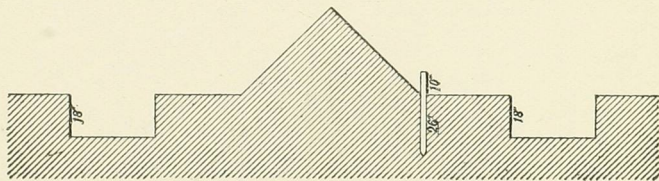


Fig. 15. Post, mound and pits on correction line—Section.

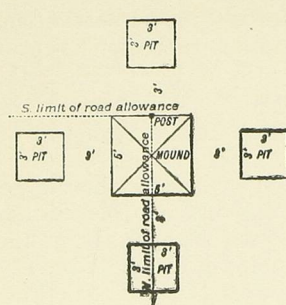


Fig. 16a. Post, mound and pits for section and quarter section corners on correction line, south limit of road allowance—Plan.

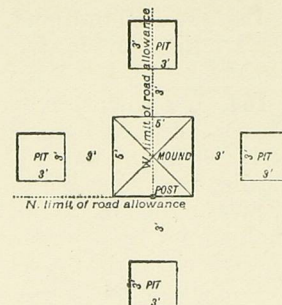


Fig. 16b. Post, mound and pits for section and quarter section corners on correction line, north limit of road allowance—Plan.

being placed square to the cardinal points (Figs. 15, 16a and 16b).

162. In prairie, where there is no mound, the square formed by the four pits stands square with the cardinal points at corners which govern lands on both sides of the line, and diagonally to the cardinal points at corners governing one side only. The post stands at the intersection of the diagonals of the square (Figs 14 and 17).

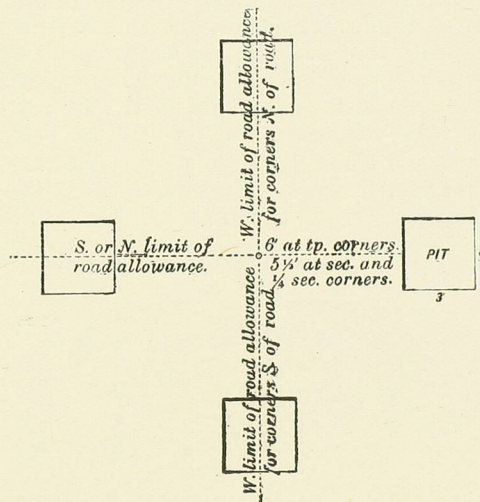


Fig. 17. Post and pits on correction line—Plan.

163. The mound and the pits for a quarter section corner are the same in size and position as those for a section corner.

164. If a township or section corner or a quarter section corner except as hereinafter provided, fall in a lake, in the bed of a stream, on an inaccessible mountain or in any other locality unfavourable to the planting of a post, the digging of pits or the erection of a mound, the surveyor perpetuates such corner by a witness iron post with trench, or mound and trench, at the nearest suitable point of the surveyed line, that is either north, south, east or west of the true corner. The distance in chains and the bearing of the site of the true corner from such witness post are cut on the post, the bearing being indicated by one of the letters N., S., E. or W. By placing the monument at any number of full chains from the corner, the marking of the post is simplified. Care must be taken to indicate the bearing from the witness post to the true corner; thus, a witness post south of the true corner is marked with letter "N" for north.

A witness monument must not be placed on a road allowance, public highway, or travelled road.

A witness monument must not be erected when it is possible to make a permanent monument at the true corner.

165. A witness monument need not be placed to mark the position of a quarter section corner unless it is necessary to do so in order that at least two of the corners of each of the adjacent quarter sections may be marked on the ground, or unless in the judgment of the surveyor the circumstances are such as to call for it.

166. A witness trench is circular, of six feet inside diameter. The trench proper is twenty-four inches wide and twelve inches deep (Figs. 21, 22).

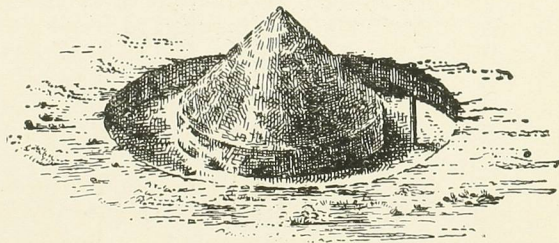


Fig. 18. Witness post and mound—Perspective.

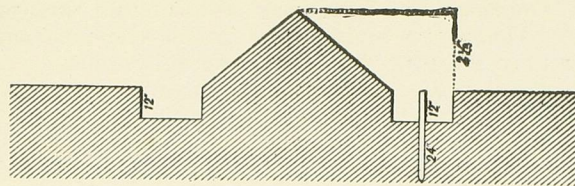


Fig. 19. Witness post and mound—Section.

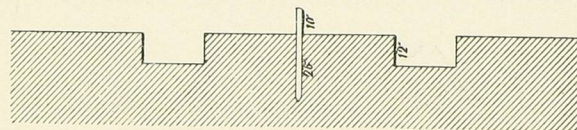


Fig. 20. Witness post and trench—Section.

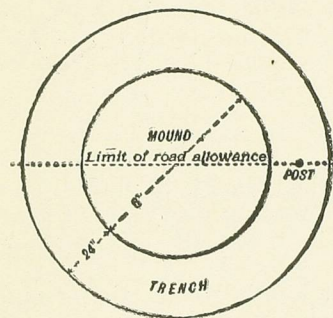


Fig. 21. Witness post and mound—Plan.

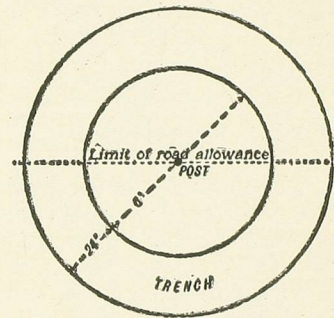


Fig. 22. Witness post and trench—Plan.

167. In prairie, the earth taken from the trench is scattered about, but in woods it is employed to build a conical mound, six feet in diameter and two and one-half feet high. In woods the post stands in the middle of the trench at the point nearest to the corner, while in prairie the post is at the centre of the circle formed by the trench (Figs. 18, 19, 20, 21 and 22).

Care must be taken to plant all corner and witness posts *exactly on line*, as well as at the correct chained distance.

168. A monument marking a boundary line or corner of a group or settlement lot, consists of an iron post and

pits in prairie, and of an iron post, mound and pits in woods. The shape and dimensions of the post, mound and pits are those prescribed for section corners.

When iron posts are not available, wooden posts may be used.

At a corner common to four or more lots in woods, the mound is placed diagonally to the line running most nearly towards the north and in such a position that the post planted at the northern corner of the mound is also at the corner of the lots (Fig. 23).

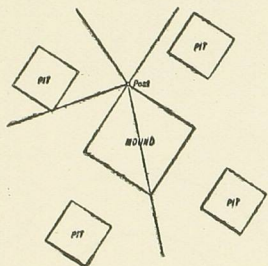


Fig. 23. Monument at corner of four lots in woods.

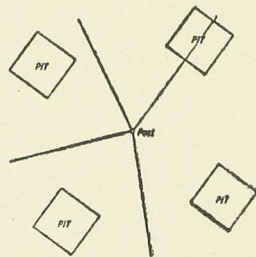


Fig. 24. Monument at corner of four lots in prairie.

The mound is omitted when the corner is in prairie, and the position of the pits is moved northerly so that the post planted at the corner stands in the centre of the four pits (Fig. 24).

At a corner common to three lots in woods, the mound is placed square on the line opposite the greatest of the

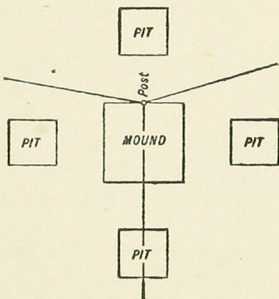


Fig. 25. Monument at corner of three lots in woods.

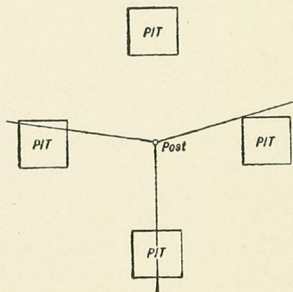


Fig. 26. Monument at corner of three lots in prairie.

three angles formed by the three limits of the lots, and in such a position that the post planted in the centre of the side of the base is also at the corner of the lots. (Fig. 25).

The mound is omitted when the corner is in prairie and the position of the pits is so moved that the post planted at the corner stands in the centre of the four pits (Fig. 26).

At the corner of a single lot in woods, the mound is placed square upon the western or the eastern boundary of the lot as the case may be. The post is planted at the true corner of the lot and the mound is so placed that the post stands in the centre of the northern side of the base of the mound at the northeastern and the northwestern corners of the lot, and in the centre of the southern side of the base of the mound at the southeastern and the southwestern corners of the lot (Figs. 27 and 29).

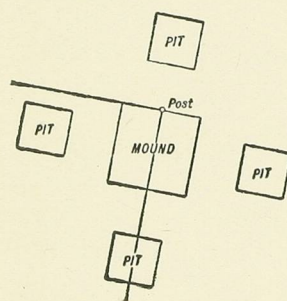


Fig. 27. Monument at the northeastern corner of a lot in woods.

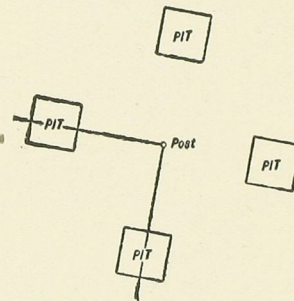


Fig. 28. Monument at the northeastern corner of a lot in prairie.

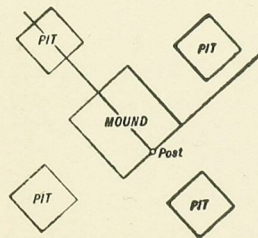


Fig. 29. Monument at the southwestern corner of a lot in woods.

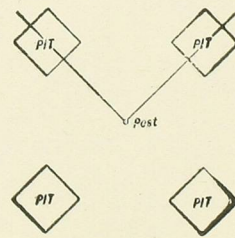


Fig. 30. Monument at the southwestern corner of a lot in prairie.

The mound is omitted when the corner is in prairie and the position of the pits is so moved that the post planted at the corner stands in the centre of the four pits (Figs. 28 and 30).

The mound on the boundary line between two lots or at a corner common to two lots is placed square on the line in such a position that the post, which is planted on the line or at the corner stands in the centre of the northern or eastern side of the mound (Figs. 31 and 32).

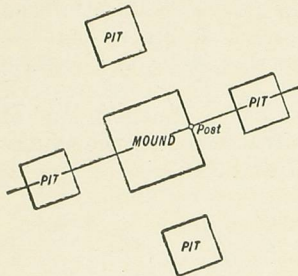


Fig. 31. Monument on a boundary line running northerly and southerly in woods.

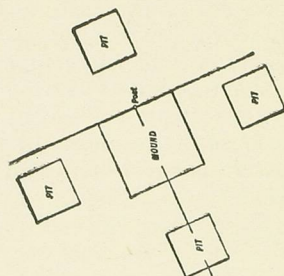


Fig. 32. Monument at a corner common to two lots in woods.

When the boundary line or the corner common to two lots, is in prairie the mound is omitted and the post is planted in the centre of the four pits.

A corner falling in a locality unsuitable for planting a post, digging pits, or erecting a mound, is indicated by a witness post, mound and trench, or a witness post and trench, as the case may be. The witness monument

must be placed upon one of the boundary lines of the lot or lots.

169. A wooden post if used to mark the corner of a group or settlement lot must be thirty-six inches long, eighteen inches in the ground and eighteen inches above. It is squared twelve inches from the top, and the faces must be at least three inches wide. The top is beveled to turn off rain. Such a post must be placed in the same position as an iron post would occupy.

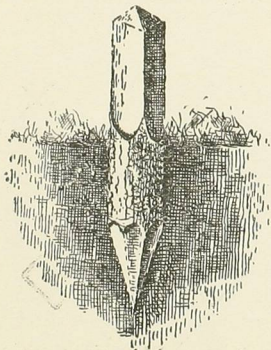


Fig. 33. Wooden post for lot corners and public highways.

170. The monuments erected for marking the limits of highways are the same as at section corners on correction lines. When monuments are erected in both limits, iron posts are used on one side, and wooden posts, like those prescribed for the corners of group and settlement lots may be used on the other side.

171. No mounds or pits are made for perpetuating corners in a town site. The iron posts for the corners of blocks and lots are the same as for section corners. When wooden posts are used they are three inches square and twenty-four inches long and are driven fifteen inches in the ground.

172. No monuments are erected in positions where they are liable to destruction; they must be placed far enough from rivers to be safe from obliteration by floods. When the site of a corner falls in an exposed position, a witness monument must be erected.

173. Mounds or pits must not be made on a travelled road or trail; a corner falling in such a place is indicated by a witness monument.

174. Surveyors are forbidden to erect a second boundary monument at a corner which they find already marked on the ground unless they are authorized to destroy the monument found. The position of the latter, if destroyed, must be accurately measured and noted. In case of doubt, the surveyor must telegraph for instructions.

MARKS ON POSTS.

175. The post planted at a township or section corner not on a correction line or on a line between different systems of survey or on an Indian reserve line, is marked on its southwest side with the number of the section the northeast corner of which the post is to indicate, followed by the numbers of the township and range in which that section lies. The number of the section is at the top of the post, then follows the number of the township and the lowest number is the range.

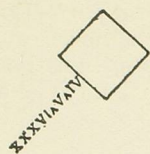


Fig. 34. Township corner.

For the corner between townships 5 and 6, and the 3rd and 4th ranges.

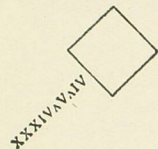


Fig. 35. Section corner.

For the northerly corner between sections 34 and 35, township 5, range 4.

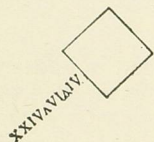


Fig. 36. Section corner.

For the easterly corner between sections 24 and 25, township 6, range 4.

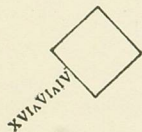
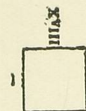


Fig. 37. Section corner.

For the corner between sections 15, 16, 21, 22, township 6, range 4.

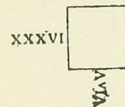
the number of section on the west side, and the number of township and range on the north or south side for posts north or south of the road allowance, respectively.

For instance:—



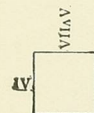
For the southeast corner of township 3, range 10.

Fig. 38. Township corner on correction line.



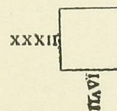
For the northeast corner of township 6, range 5.

Fig. 39. Township corner on correction line.



For the southerly corner between sections 3 and 4, township 7, range 5.

Fig. 40. Section corner on correction line.



For the northerly corner between sections 32 and 33, township 2, range 6.

Fig. 41. Section corner on correction line.

176. Posts at township and section corners on correction lines are marked exclusively for the townships and sections on the respective sides of the road allowance. They have

177. Posts at township and section corners on east and west lines dividing two systems of survey are marked in the same manner as posts on correction lines.

Posts at township and section corners on north and south lines dividing two systems of survey, are marked on their south side with the number of the section the north boundary of which they indicate, and with the number of the township and range on their east or west side, according as the posts are on the east or west side, of the road allowance respectively.

For instance:—

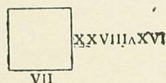


Fig. 42. Section corner on line between two systems of survey.

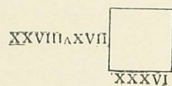


Fig. 43. Township corner on line between two systems of survey.

For the post marking the north-westerly corner of section 7, township 28, range 16, west of second meridian, on the east side of the road allowance dividing the second from the third system of survey.

For the northeasterly corner of township 28, range 17, west of the second meridian.

178. Similarly with posts planted on the limits of road allowances adjoining Indian reserves, and on the lines of other reserves, settlements, &c., the general rule being that mounds, pits, &c., which govern townships and sections on both sides of the road allowance are set diagonally, and the posts are marked accordingly; but those which govern only townships and sections on one side of the road allowance are set square to the cardinal points.

179. A quarter section post is marked on one of its sides with the fraction $\frac{1}{4}$, (fraction-wise).

A post at the centre of a section is marked with the fraction $\frac{1}{4}$, like other quarter section posts.

180. In ranges numbered from the principal meridian, the letter W. or E. is marked on the post after the number

of the range, to denote that it is west or east of the meridian, as for instance:—

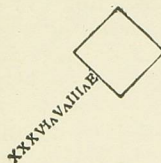


Fig. 44. Township corner east of Principal Meridian.

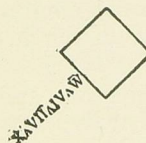


Fig. 45. Section corner west of Principal Meridian.

For the township corner between townships 5 and 6, and the 3rd and 4th ranges east of the principal meridian.

For the corner between sections 10, 11, 14, 15, township 7, range 4, west of the principal meridian.

The letters W. and E. are not to be marked for any meridian other than the principal meridian. The number of meridian is never to be marked.

181. A witness post for a township or section corner is marked on the side facing the corner with the distance in chains and the bearing thereto and on the opposite side with the number of the section, which number is to be the same as would have been marked on the post had it been placed at the true corner.

A witness post for a quarter section corner is marked on the side facing the corner with the distance in chains and bearing thereto, and on the opposite side with the fraction $\frac{1}{4}$, (fraction-wise).

The distance to be marked on the post is the distance to that corner where the corner monument would have been erected had the spot been suitable.

When a road allowance intervenes between a witness monument and the true corner, the distance marked on the post includes the width of the road allowance.

The section number to be marked on the post is the number which would have been marked on the corner post, which is not always the number of the section ad-

joining the witness post. Thus the witness post three chains north of the southeast corner of section twenty-nine (3rd system) must be marked IV. S. and XX., not IV. S. and XXIX. Thus:



For witness post standing four chains north of the northeast corner of section 20.

Fig. 46. Witness post.

182. A post on the line between two lots of a settlement is marked on two opposite faces with the numbers of the adjoining lots.

183. The number of the lot, the number of the group and the number of the corner are marked on the post at a corner of a group lot.

184. A witness post for a settlement lot has cut on two faces the numbers of the adjoining lots. Upon another face are cut or written in red chalk the bearing and distance from the witness post to the corner.

185. A witness post for a group lot is marked with the number of the lot, the number of the group, and the bearing and distance from the witness post to the corner.

186. A post between two town lots is marked on the faces perpendicular to the street or avenue with the numbers of the adjoining lots. In addition thereto, the number of the block preceded by the letter B is inscribed on one of the faces below the number of the lot.

At a block corner, the letter S is inscribed on the face next to the street.

187. The post at a station of a highway survey is marked on one face with the number of the station and upon another face with the letter R. Intermediate posts are marked with the number of the last station followed by the letter A or B or C, &c., for the first, second, or third post, &c., after the station. The letter R is inscribed upon another face. The posts on opposite limits of the highway are marked alike.

188. All marks on posts must be cut neatly and distinctly. No mark is made on the face of the iron post stamped with the Crown.

RESURVEYS, RETRACEMENTS AND RESTORATIONS.

189. A *resurvey* is a survey made for the purpose of placing in correct position, corner or witness monuments lost or incorrectly placed by a previous survey.

190. A *retracement* is the survey of a line of a previous survey for the purpose of plotting a plan representing correctly the line as it is on the ground.

191. A *restoration* survey is the survey made for the purpose of restoring the obliterated monuments of a previous survey.

192. A monument is *obliterated* when its position can be ascertained beyond reasonable doubt, either by traces of the original monument or by other evidence, although the monument itself has partly or entirely disappeared.

193. A monument is *lost* when its position cannot be ascertained beyond reasonable doubt.

194. It is the duty of a surveyor to report at once any error which he may discover in previous surveys or any duplicate monument which he may find. A surveyor is expected to restore every monument of a previous survey struck by his lines, when such monument is not in good condition.

A surveyor reporting on a lost monument must furnish full information regarding the nearest monument on each of the lines closing on its presumed position. In the case of an erroneous monument the investigation must be carried far enough to enable him to report fully on all monuments affected by the error.

Where any corners have been marked by wooden posts, the surveyor is to substitute iron posts and to build mounds or pits.

In restoring the monument at a section corner originally marked by a wooden post in mound, the surveyor must take care to place the iron post at the exact place formerly occupied by the wooden post, that is to say, in the centre of the old mound. The new mound and pits, if any be made, must be placed according to directions elsewhere given for monuments of original surveys.

195. Whenever a subdivider finds that a corner on the meridian outline of a township is more than one chain and fifty links from the place where it should be, according to the diagram of outlines, he may resurvey or retrace the

outline, as provided hereinafter. When a resurvey is made, it is desirable that it should be continued to the correction line, if necessary for making the meridian outline right.

The outline is resurveyed when the sections on both sides are vacant, or when the owners or occupants of lands affected by the correction give in writing their consent to the resurvey.

Any information required about patented lands will be furnished on application to the Department.

When the error is five chains or greater, and the owners or occupants of the lands affected do not agree to the resurvey, the circumstances of the case must be reported to the Department for further action under the authority of section 57 of the Dominion Lands Surveys Act.

When the error is less than five chains and the owners or occupants of the lands affected, refuse their consent to its correction or to the reestablishment of the lost corners, the defective outline is retraced, or the part where resurvey is objected to may be retraced and the remainder resurveyed.

When a correction is made on an outline adjoining a township previously subdivided, the section boundaries closing on the part of the outline corrected must be resurveyed and the quarter section monuments thereon moved if possible to correct positions. Lost monuments are reestablished when the lands affected are vacant or when the owners give their consent in writing. In case the owner affected by a lost corner objects to the reestablishment, the surveyor, instead of erecting a new monument may, in order to be able to carry out his survey operations, plant a temporary picket at the place shown by his survey to be the location of the corner, and connect to the picket the lines of his subdivision.

The positions of the original monuments must be accurately determined and noted.

No new monument is to be erected before destroying the old one.

196. A surveyor who is instructed to restore monuments on a line may retrace the line when it is not possible to locate the position of the monuments otherwise.

In retracing a line obliterated monuments must be restored and marked as in an original survey unless otherwise directed; no monument, however, is to be restored which is not in the place where it should have been erected in the original survey.

197. Correction surveys are made under the provisions of Section 57 of the Dominion Lands Surveys Act. No monument affecting the boundary of patented lands shall be displaced without the consent in writing of the owners thereof. Homesteaders have not the same rights as owners of lands patented. A monument defining the boundary of land held as a homestead or under lease, license or agreement of sale but not patented, must not be displaced without the consent in writing of the holder thereof, unless the error on the position of the monument is at least five chains, in which event the correction of the error may be made without the consent of the holder, but the person or persons acquiring through such correction any improvements on the lands transferred shall be required to pay the owner of such improvements therefor such an amount as may be fixed by the surveyor. In the event of a refusal to pay this amount, the surveyor is to leave the error uncorrected and to report the facts of the case to the Department. The amount to be fixed by the surveyor is the fair value of the improvements only. The value of the land is not to be considered.

In any case where a considerable error is found affecting lands which have been patented and the owners do not agree to a correction, the old monument must be left as it is without any restoration and the lines which are incorrect should not be interfered with, but actual bearings and distances must be ascertained and the facts of the case reported to the Department.

Any petitions or agreements for correction surveys signed by the settlers must be forwarded to the Department with the progress sketches of the survey for which they are obtained.

198. A resurvey for the purpose of restoring obliterated monuments and reestablishing lost corners may be ordered by the Minister under the provisions of Section 58 of the Dominion Lands Surveys Act, upon receipt of a petition representing that the monuments of the original survey are lost. Before the resurvey is commenced, public notice is given once a week for a period of four weeks in the *Canada Gazette* and in some newspaper circulating in the locality, calling upon any person claiming to know the positions of any of the survey monuments to notify the Minister on or before a certain specified date. When

instructions are sent to the surveyor he is furnished with the names and addresses of those who have offered to give information in this connection and with forms of notices to such persons. These forms are to be filled out in duplicate by the surveyor, specifying when and where the person is requested to appear before him. One copy is forwarded by registered mail to the party concerned and the other returned to the Department with the post office receipt.

If the person does not appear before the surveyor at the time and place specified no further notice is to be taken of his offer to furnish information and the resurvey is to be proceeded with. If, however, any person appears and gives evidence by which the position of any monument can be satisfactorily ascertained, such monument must be reestablished in its original position, unless it is in error, in which case it may be preferable to correct it, if possible, under the provisions of Section 57 of the Act.

It is to be understood that persons giving information under the provisions of this Section of the Act are not entitled to any remuneration or expense allowances. Lost corners may be reestablished without the consent of the owners of lands affected. An error on the outline of the township must be dealt with under the provisions of Section 57 of the Act, as far as the lands in the adjoining townships are concerned.

Where improvements are affected, corrections must in any case be made under the provisions of Section 57.

Under the provisions of Subsection 3 of Section 66 of the Act, the surveyor is not bound by the other provisions of that section when making resurveys under Section 58. Consequently the surveyor is at liberty to reestablish lost corners in any way suitable to the conditions on the ground, as for instance a corner may be re established to conform with an improved road, the road being considered as evidence of the original position of the corner.

He may also destroy any monuments of the original survey if they are found to be in error and erect new ones in proper position provided the lands affected by such monuments are unoccupied and the correction does not affect any improved roads or other improvements. Care must be taken by surveyors engaged on restoration

or correction surveys to leave road improvements within the limits of the road allowances.

When a monument is reestablished or its position moved to correct an error, all lines closing thereon must be resurveyed to the nearest existing monument in each case.

199. Where it is found impracticable to retrace a section line, the survey may be made by running a trial line near the section line, and locating the corners by offsets. When trial lines are run, it is not necessary to open or run the true lines. The trial lines may be deflected when and where convenient.

In any resurveys, retracements, etc., all water areas which would be traversed in the original subdivision must be traversed by the surveyor who makes the resurvey. It is impossible in many cases to make use of old traverses in connection with new surveys.

In addition to traverses required in connection with resurveys, retracements, etc., it is often necessary to traverse anew bodies of water which have changed since the original survey. In all such cases care must be taken that the new traverse is continued to such a point that the new survey may be combined with the old one in preparing a new plan. It is important that traverses which do not form closed circuits within themselves should be connected with the monuments of the Dominion Lands System at both ends so as to afford a check on the measurements.

THE FIELD BOOK.

200. The field notes must be a faithful, distinct and minute record of everything officially done and observed by the surveyor and his assistants pursuant to instructions in relation to running, measuring and marking lines, establishing monuments, laying off road allowances, &c., and in addition must present, as far as possible, a full and complete topographical description of the country surveyed. (See specimens, pages 69, 70, 71, 72, 73, 74 and 75.)

201. The bearings, distances, and other data must be entered in the field notes as actually found on the ground by the surveyor's own measurements, whether the same do or not do agree with previous surveys or with the provisions of the law or of the Manual of Survey. The entry of conventional, theoretic, assumed or supposed data is absolutely forbidden.

For resurveys, retracements, etc., the bearing of the trial line is entered at the top of the page; the offsets from the trial line to the monuments are shown, and the bearings of the true line are entered along the line joining the monuments. (See specimen, page 75).

202. The field notes of every section line surveyed must be complete in themselves, and must be placed on a separate page. Where a corner is marked by a witness post with a mound or trench, the position and character of the witness monument must be shown on each page of the field notes on which the corner appears. Section lines are to be entered in the field book in the order in which they are run. The chaining must, in all cases, commence on the inside of the road allowance, so as to show for the quarter section and section corners the distances from the corner of the section, and the measurements must be given in all cases exclusive of road allowances.

203. Section lines are described as north and east boundaries of sections, not as south or west boundaries, except on the north side of a correction line, where they are properly described as south boundaries of sections 1, 2, 3, &c. On Indian reserve boundaries and on lines between different systems of surveys, cases will also occur in which the lines surveyed must be designated as the south or west boundaries of sections.

204. The following abbreviations will be allowed in the notes:—

A.	for acre
A.M.	“ forenoon
App.	“ apparent
Asc.	“ ascent
A.F.T.	“ Astronomical Field Tables.
Astro.	“ astronomical
Az.	“ azimuth
Bar.	“ barometer
Bea.	“ bearing
Bet.	“ between
B.T.	“ bearing tree
By.	“ boundary
Chs.	“ chains
Coll.	“ collimation
Cor.	“ corner
Corr.	“ correction

Cr.	for creek
Decl.	“ declination
Dep.	“ departure
Desc.	“ descent
Diff.	“ difference
Diam.	“ diameter
Dist.	“ distance
D.L.S.	“ Dominion Land Surveyor.
Elong.	“ elongation
E.	“ East
Ft.	“ feet
Fahr.	“ Fahrenheit
Frac.	“ fractional
H.C.R.	“ horizontal circle reading.
I.	“ iron
Ins.	“ inches
I.P.M.	“ iron post and mound
I.P. Pits	“ iron posts and four pits
I.R.	“ Indian reserve
Lat.	“ latitude
Lks.	“ links
Long.	“ longitude
L.S.	“ legal subdivision
M.	“ mound
Mag.	“ magnetic
Mer.	“ meridian
Mkd.	“ marked
N.	“ North
Obsn.	“ observation
P.	“ post
P.M.	“ afternoon
Pol.	“ Polaris
Pr.	“ principal
R.	“ range
Ry.	“ railway
R.A.	“ right ascension
R.O.	“ reference object
S.	“ South
Sec.	“ section
Sq.	“ square
Sta.	“ station
Stone M	“ stone mound
T.	“ trench
Temp.	“ temperature

T.H. for traverse hub
 Tp. " township
 Var. " variation
 W. " West
 Wit. " witness
 Wit. I.P.M. for witness iron post and mound
 Wit. I.P.T. for witness iron post and trench
 W.P. for wooden post.

205. The field notes must be always written down on the spot, leaving nothing to be supplied from memory, and are to give the following information in relation to the survey:—

(a) The length and exact bearing of every line run, noting all necessary offsets therefrom, with the reasons for the same.

(b) The course and distance for each witness monument.

(c) The character of monuments. For wooden posts the kind of wood is stated. "I.P.M." is entered for "iron post and mound," "I.P. Pits" for "iron post and four pits," "Stone M." for "stone mound," "Wit. I.P.T." for "witness iron post and trench," "T.H." for "traverse hub." The number of pits is stated when less than four. The above information is entered on each page for every corner shown thereon. When the corner was established by a previous survey, the fact must be stated and the description and state of preservation of the monument found on the ground must be given. If the corner was restored, the character of the new monument must also be given. The absence of remarks means that the corner has been established by the surveyor himself.

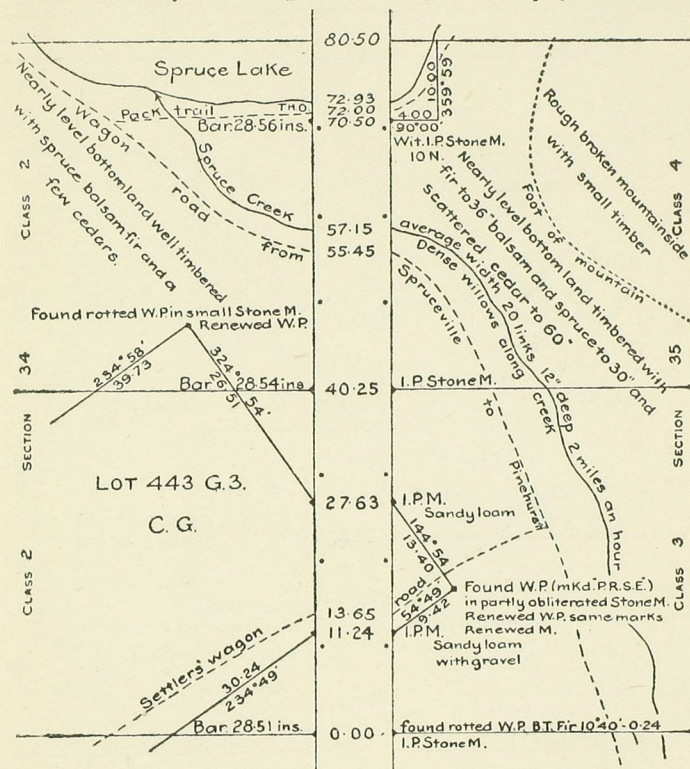
In surveys other than township outlines or township subdivision the field notes must show the markings made on all posts planted and the markings found on all posts closed upon.

(d) The bearing and distance to any stake or post of any railway or highway survey crossed by the line, and also to such corner or corners of any lot, mineral claim, timber berth, reserve, etc., within the survey, as may be necessary to afford proper connection between the several surveys.

(e) Sketches of settlers' improvements in their approximate position and the extent of the same.

(f) The distances at which the line first intersects, and also where it leaves settlers' claims or improvements, lakes, ponds, rivers, bottom lands, swamps, marshes, brush and

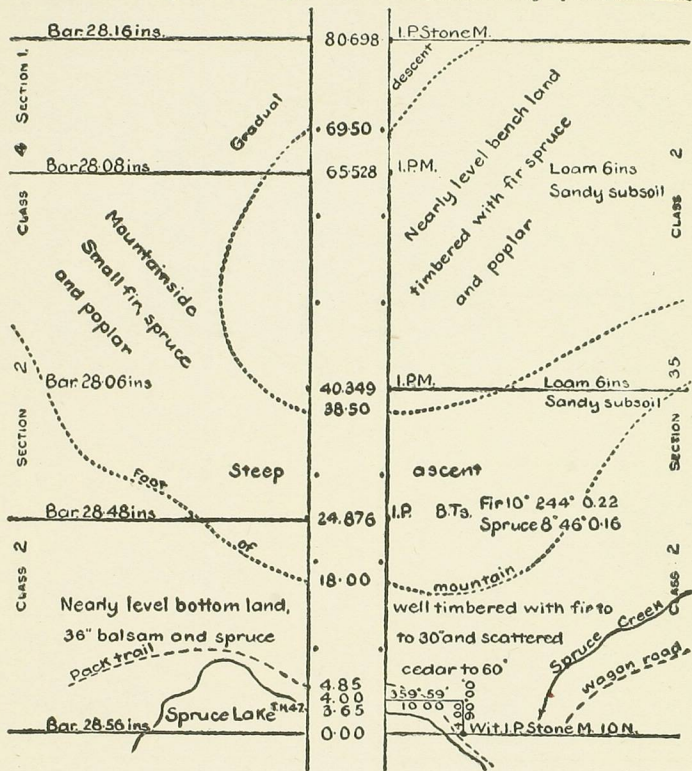
Tp. 22. R. 5. W. Mer. E. By. of Sec. 34. Course 359° 59'.
 derived from bearings Obsn. of By of Sec.



The above line was run on the 14th and 15th days of October 1912

SPECIMEN OF FIELD NOTES OF SUBDIVISION SURVEY (FOURTH SYSTEM).

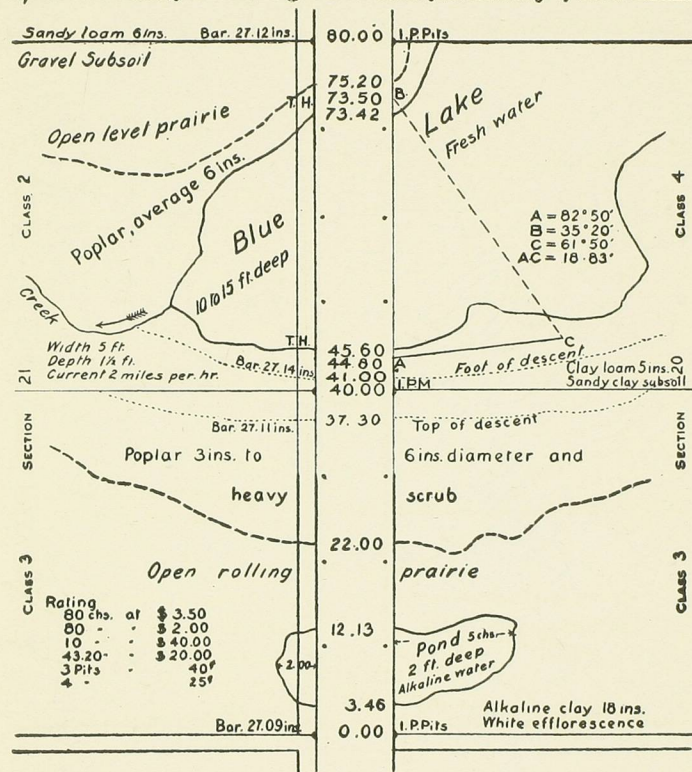
Tp. 22 R. 5 W. Mer. N. By. of Sec. 35 Course 90° 00'
 turned off from bearing 359° 59' of E. By of Sec. 34



The above line was run on the 15th and 16th days of October 1912

SPECIMEN OF FIELD NOTES OF SUBDIVISION SURVEY (FOURTH SYSTEM).

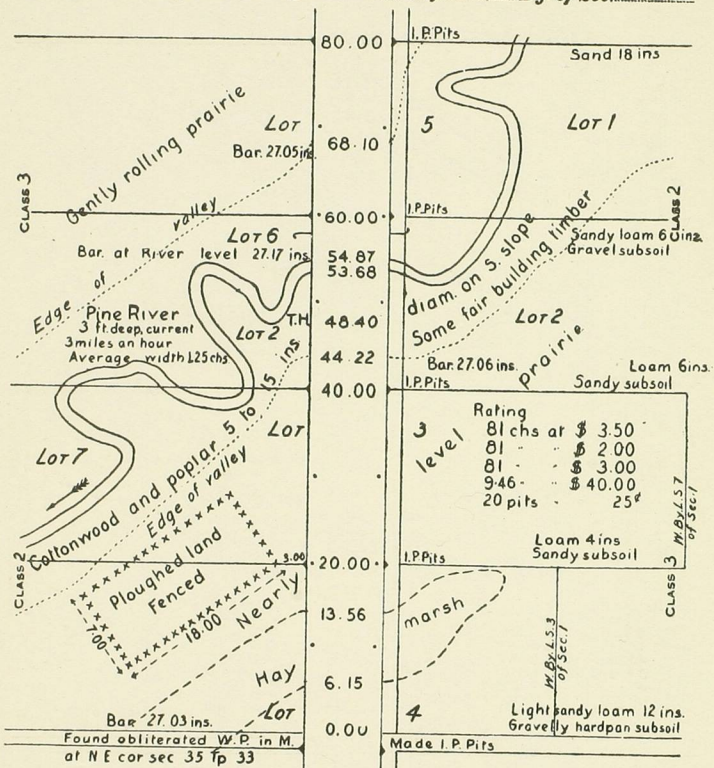
Tp. 34 R. 15 W. Mer. E. By. of Sec. 29 Course 180° 01'
 produced from bearing 180° 01' of E. By. of Sec. 29



The above line was run on the 20th day of October 1908

SPECIMEN OF FIELD NOTES OF SUBDIVISION SURVEY.

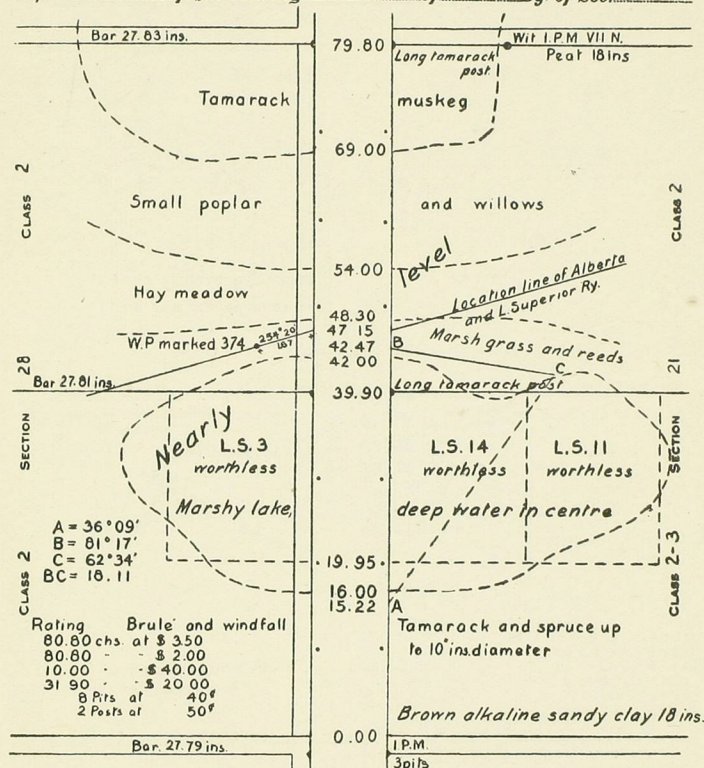
Base line across river lots
 Tp. 34 R. 15 W. Mer. By of Sec. Course $359^{\circ}58'$
 turned off from bearing $89^{\circ}59'$ of N By of Sec. 36, Tp. 33



The above line was run on the 31st day of October 1908.

SPECIMEN OF FIELD NOTES OF SUBDIVISION SURVEY.

Base line across river lots
 Tp. 35 R. 14 W. Mer. N By. of Sec. 21 Course $90^{\circ}00'$
 produced from bearing $90^{\circ}00'$ of N By. of Sec. 20



The above line was run on the 13th day of October 1909.

SPECIMEN OF FIELD NOTES OF SUBDIVISION SURVEY.

woods; also the beginning of ascent, the top and the foot of descent of all remarkable hills or ridges, with their estimated height in feet above the bottom lands near which they may be situated, or aneroid readings if crossed by the line; also where a stream, lake or pond is crossed, the data used for ascertaining the distance across it.

(g) The approximate course, direction, average width, depth, and rate of current of all streams, and whether the water is fresh or salt in the lakes which fall within the survey.

(h) Whether the surface of the country is level, rolling, broken or hilly.

(i) The nature of the soil, classifying it, according to its fitness for agriculture, as first, second, third, or fourth class—entering the class, at the time of survey, on each quarter section where indicated in the notes.

(j) Depth of loam and kind of subsoil, where pits are dug. (See following clause).

(k) If in timber, the kinds, quality and average dimensions thereof.

(l) Rapids or falls of water affording mill sites, with estimated fall and supply of water in general terms.

(m) Coal deposits, minerals (transmitting specimens of the same) and salt springs, &c., &c.

(n) The aneroid barometer reading in inches at the top or bottom of all prominent elevations or depressions, or when none such exist, at section and quarter section corners.

When a large valley is crossed by the line, aneroid readings should be taken at the bottom of the valley and at the top of each slope. These readings are recorded in the notes and take the place of an estimate of the depth of the valley.

The index error of the aneroid should be determined whenever convenient by comparison at a Meteorological Station or at the Department in Ottawa. At the same time no opportunities should be neglected of recording the readings at places of known elevation such as railway stations. From these readings the index error can be determined at the head office.

(o) The date of the survey.

(p) In contract surveys, the rating on every page of the field notes for the lines shown upon the page.

206. The topography of the interior of the sections must be sketched in the field book as far as it can be ascertained

without undue delay. It may be necessary, in bush country especially, for the surveyor to go off the line for this purpose. The courses of the rivers, valleys, trails, etc., must be indicated approximately as well as the outlines of the lakes or ponds, the position of the hills, etc. The draughtsman who plots the plan must have this information for representing the topography in the interior of the sections. It is not sufficient to show the crossings on the line; sketching as shown in the specimen field notes is required for plotting the plan.

The following definitions, used in the publications of the Chemical Division of the Dominion Experimental Farms, will assist surveyors in describing the nature of the soil.

Drift soils are of glacial origin and consequently of variable composition. They consist usually, however, of loose material—chiefly fine and coarse sand and gravel with more or less rounded small stones and boulders. As a class, these soils are “light” and frequently poor, not necessarily from lack of the mineral constituents of plant food but from unsuitable physical condition and deficiency in vegetable matter and its concomitant nitrogen.

Alluvial soils are those which have been transported and deposited by water, fresh or salt. There are many classes or varieties, both as to texture and composition, according to the character of the country furnishing the detritus and the velocity of the current; usually the particles are fine or moderately fine. Many of the most fertile soils are of alluvial origin, e.g. deltaic and valley soils, their productiveness being due largely to the intimate association of an ample supply of organic matter with the rock debris forming the mineral basis of the soil.

Gravelly soils are those consisting essentially of gravel or small water-worn fragments of rock with more or less coarse sand. The amount of fine material will not usually exceed twenty-five per cent. and the humus content is never large. As a class, they are among the poorest of arable soils.

Sandy soils contain 80 per cent. or more of sand principally finely comminuted quartz, with not infrequently fine material from the disintegration of crystalline rocks in general. The amount of clay present is less than 10 per cent. They may contain notable percentages of oxide of iron, carbonate of lime, &c.

Clay soils contain at least 60 per cent. of clay, the remainder being chiefly made up of sand and vegetable matter.

Loams are essentially mixtures of clay and sand and are classified according to the degree of preponderance of one or other of the constituents, as follows:

Heavy Clay Loam: containing from 75 to 90 per cent. of clay.

Clay Loam: containing from 60 to 75 per cent. of clay.

Loam: containing approximately equal amounts of clay and sand.

Sandy Loam: containing from 60 to 75 per cent. of sand.

Light Sandy Loam: containing from 75 to 90 per cent. of sand.

N. B. Organic matter (humus forming material) and carbonate of lime, are present to a greater or less extent in all productive loams.

Marl is a calcareous clay, containing from 10 to 20 per cent. of carbonate of lime. (Shell marl is essentially carbonate of lime. It occurs as an earthy deposit at the bottom of lakes and ponds and is composed largely of the disintegrated shells of fresh water mollusca. When dried it has a chalky appearance).

Lime or Calcareous soils contain carbonate of lime as a characteristic or distinguishing feature.

Alkali soils occur in arid and semi-arid districts and are characterized by the presence of considerable amounts of certain soluble salts, chiefly the sulphate, chloride and carbonate of sodium. These salts may appear on the surface of the soil as an efflorescence, usually white, in seasons of scanty precipitation. "Black" alkali, due to carbonate of sodium, is the most injurious form and may be recognized by the incrustation being dark brown or black, from the presence of organic matter dissolved from the soil by the alkali.

Peaty and Muck soils have resulted from the gradual accumulation in the presence of water of plant remains and hence consist largely of organic matter.

In peat the structure is essentially fibrous, clearly indicating the origin from sphagnum and other aquatic plants. In muck (swamp muck), further decay has destroyed or broken down the fibrous structure, resulting in a black or dark brown material, which is usually of a more or less cheesy consistency when wet.

Humus soils are those rich in semi-decomposed vegetable matter but which have not been formed under water, as in the case of peats and mucks.

Surface soil, generally spoken of as the soil or as the arable soil, is the upper or surface stratum used in cultivation and which in addition to disintegrated rock material contains as a rule more or less humus—the decaying remains of plants.

Subsoil is the unweathered, naturally undisturbed stratum immediately underlying the surface soil and may consist of sand, clay, gravel, etc., or mixtures of these. It is practically destitute of organic matter.

Hardpan, the name applied to the subsoil when such has become converted, by chemical and physical agencies, into a hard, tenacious rock-like stratum.

The following definitions of certain topographical features of common occurrence in the West are for the guidance of surveyors in preparing returns:

Swamp,—Soft, low ground saturated with water but not necessarily covered with it. A swamp differs from a bog or a marsh in producing trees and shrubs whereas a bog or a marsh produces only herbage, plants and mosses.

Marsh,—A tract of soft wet land commonly covered partially or wholly with water.

Muskeg,—A rocky basin filled by successive deposits of unstable materials, such as leaves, muck and moss, and incapable of sustaining much weight.

Bog,—Wet and spongy ground usually covered with coarse grass and often containing peat and other organic substances. It is too soft to bear the weight of any heavy body on its surface.

Pond,—A body of still water smaller than a lake.

Slough,—Differs from a pond or lake in that it is usually of shallow depth and is liable to dry up at certain seasons of the year.

207. The surveyor who is making the original survey of a township is to obtain from every bona fide settler a statutory declaration on the form supplied, and to see that all the questions on the form are answered, and the answers entered.

A bona fide settler is a person already residing on the quarter section or lot at the time of its survey, or who has made substantial improvements on the said piece of land, proving his prior occupation. No other persons should

be permitted to make declarations, nor should declarations be accepted in which any answer is clearly untrue or in opposition to the facts.

The object of the declaration is to show the persons who squatted on the land before the survey. A declaration taken from a person locating after the survey would mislead the Department as it would be inferred from the declaration being made before the surveyor that the person was found on the ground or that improvements were in existence.

All declarations from squatters who reside on the land or have made improvements are to be accepted, no matter how many there may be on a quarter section or lot.

A statutory declaration does not give any right or legal status to the declarant: it is simply for the information of the Department.

Surveyors are strictly forbidden to make any charge to squatters for receiving their declarations, and it is no part of their duty to explain the law or to give directions to intending or actual settlers for securing land. Surveyors in the employment of the Department are requested to abstain from giving such advice.

Every declaration must be mailed to the Department at the first opportunity after it has been taken.

No statutory declarations are to be taken on resurveys, retracements or restoration surveys.

CHAPTER III.

RETURNS OF SURVEY.

PROGRESS REPORTS.

208. Surveyors must report at least once a month the progress of their work, and forward the report at the first available opportunity.

209. Each progress report is accompanied by sketches on the forms supplied showing the work done up to date. The sketches must give the bearings and lengths of all section lines surveyed and the jogs on correction lines when measured. Traversed lines are marked red. A quarter section made fractional by a traversed body of water, is designated by the letter "F". It must also show the quarter quarter section lines selected as boundaries of bodies of water in accordance with clause 142 of the Manual.

The sketches must also show the main topographical features, that is to say, the rivers, lakes, trails, hills, etc.; they may be drawn with pencils of different colours. No scale is needed for plotting; a rough estimate of distances is all that is required. It should be understood that it is not necessary to indicate every little swamp, pond or rise that may be found.

The bearings and distances entered on the sketches may be those recorded in the field; they are subject to any corrections which the surveyor finds necessary when making his final returns.

TOWNSHIP PLANS.

210. Plans of townships are made in the Department from the surveyor's field notes. They are plotted on a scale of thirty chains to one inch, and reduced for publication to forty chains to one inch. Every fractional township, however small, is shown on a separate plan.

211. The township plans exhibit the bearings and lengths as ascertained and measured on the ground, of all surveyed lines, the monuments erected to define the boundaries of the lands, and the main topographical features of the ground.

212. The township plans show the area of all full quarter sections computed to the nearest acre. Fractional quarter sections are divided into quarter quarter sections, and the area of each is computed and shown to the nearest tenth of an acre. A quarter section is fractional when it is broken by lakes or streams which have been traversed or by parcels of land previously laid out.

In a quarter quarter section divided into two or more parts by a traversed lake or stream, the separate area of each part is given.

PLANS OTHER THAN TOWNSHIP PLANS.

213. Plans other than township plans are made on the following scales:—

Settlements, not less than one inch to twenty chains.

Group lots, not less than one inch to five chains.

Town sites, not less than one inch to four chains.

Highways, not less than one inch to ten chains.

214. The plan of a settlement exhibits the bearings and lengths of all boundary lines, the bearings and lengths of all roads surveyed, the corner and witness monuments and their descriptions, the numbers of the lots and their areas, the settlers' improvements, and the main topographical features. The boundaries are marked by solid lines; the base lines by broken lines.

215. The title of the plan of a settlement gives the name of the settlement, the district, province or territory, the name of the surveyor, the date of survey and the scale.

216. The plan of a group lot exhibits the same information as a settlement plan. It must also show the connection with a monument of the nearest Dominion lands survey, and with adjoining lots or claims, if any. When the connection is made by a traverse of more than one course, the traverse lines are not shown on the plan; the connection is indicated by its latitude and departure in dotted lines with distances written on the lines.

When the connection is too long, it is plotted separately on a smaller scale, but on the same sheet of paper. The plan must also show the nearest corners and portions of the boundaries of the adjoining lots or mineral claims, if any. The area is given to the nearest tenth of an acre. The limits of the lot are made more distinct by an edging of colour applied with a brush.

217. The title of the plan of a group lot must state the number of the lot, the number of the group, a concise designation of the locality, the district, province or territory, the name of the surveyor, the date of survey and the scale. The designation of the locality must be that which is in general use among the public in referring to the place.

218. The plan of a town site must show a sufficient number of the exterior boundaries together with the ties thereto, also the bearings for one side of all streets and avenues and sufficient other bearings to enable the length and bearing of every lot line to be deduced, the bearings of the external boundaries, the monuments and their nature, the numbers of the blocks, town lots, avenues and streets, the depth and width of all lots, the width of the streets, avenues and lanes, and the houses and improvements. In the case of curved streets, the plan must indicate the radius, point of curvature and point of tangency. Every block and every lot in the block must have a distinct number or symbol. When all the lots in a block have the same depth it is sufficient to show the depth of the end lots. Only the essential topographical features are indicated.

219. The title of the plan of a town site must state the name of the town site, the number of the section, township, range and meridian, or settlement or other lot, in which the town site is situated, the province, district or territory, the name of the surveyor, the date of the survey and the scale.

220. Plans of highways must show the bearings and lengths of the courses, the monuments, their descriptions, and the bearings and lengths thereto, the main topographical features and the area of the highway, computed to the nearest hundredth of an acre, in every separate parcel crossed by it.

221. The title of the plan of a highway must give the name or description of the highway, its beginning and end, the province, district, or territory, the name of the surveyor, the date of survey and the scale.

222. The following rules are applicable to all plans other than township plans, and must appear in the form of a note:—

(a) Surveyed lines and measured lengths are in vermillion.

- (b) Unsurveyed lines, calculated distances or bearings, and previous surveys are in black.
- (c) Bearings are in degrees and minutes (or degrees and hundredths). Observed bearings are in blue.
- (d) Distances are in chains and links (or in feet and tenths).
- (e) Monuments found on the ground are indicated by square black marks.
- (f) Wooden posts planted are indicated by square vermilion marks.
- (g) Iron posts planted are indicated by square blue marks.

223. The origin of the bearings must be stated on the plan.

224. A retraced or restored line is shown in vermilion, but the boundary marks found upon it are represented by square black marks.

225. An obliterated boundary mark restored by the surveyor is indicated on his plan by a square black mark.

226. A bearing is written in blue, as observed, when the surveyor has measured the course of the line, although his bearings may be derived from the bearing of an adjoining survey.

227. Distances to water boundaries are given only when they are necessary for the description of the parcels.

228. Boundaries are represented by full lines; lines which are not boundaries are shown broken.

229. The descriptions of the monuments are given by means of the same abbreviations as in the field notes.

230. Unless otherwise directed, areas over one hundred acres are given to the nearest acre; under one hundred acres and over ten acres, to the nearest tenth of an acre; under ten acres to the nearest hundredth of an acre.

231. All the bearings of a plan must be referred to a single meridian, so that the angle of any two lines may be given by the difference of their bearings. When the survey is of such an extent in longitude that several meridians have to be used, there must be a separate plan for each meridian upon which shall be shown all the courses of which the bearings are referred to that meridian.

232. The date of a survey is the date on which measurement was completed on the ground. The dates of beginning and ending of the survey which are entered on the

title page of the field notes should include all traverse or other surveys within the field book.

233. The surveyor must not lose sight of the fact that the main object of his plan is to identify the boundaries of the parcels laid out; the plan must not be obscured by irrelevant details. Only the main topographical features are to be represented, and in so far only as they may assist in locating the boundaries. Traverse lines of rivers or lakes, generally are of doubtful utility; they are not boundaries, and as the feature which they define is liable to change, any measurements required may, if the traverse has been accurately plotted, be scaled off the plan with sufficient accuracy.

234. Plans must be plotted carefully and accurately, and must be fair specimens of draughtsmanship. If incomplete, faulty, or not up to the standard of professional work, they will not be accepted.

FIELD NOTES, REPORTS AND OTHER RETURNS.

235. The field notes sent in to be placed on record in the Department of the Interior are to be a fair and exact copy of the original notes taken in the field, after applying to the bearings the corrections deduced from the astronomical observations and the deflections from true lines; evident errors in the original notes may, however, be corrected in the copy. The field notes for record must be written in the books furnished for that purpose; the forms supplied for field use are not accepted as office copies.

When portions of different townships are surveyed, it is preferable to have the notes of as many townships as possible copied into one book, but if it can be avoided the notes for one township should not be copied partly in one book and partly in another.

236. The first page gives the title, the nature of the survey, the name of the surveyor, and the dates of commencement and completion of the work. The second page contains a skeleton diagram, with each section line numbered to correspond with a page of the notes. The third page contains the names and duties of all members of the party. Whenever a new member is employed or any one changed, an appropriate entry thereof with the reasons therefor is made previous to entering any notes under the changed arrangements.

237. The field notes must be distinctly and neatly made out in language precise and clear, and their figures, letters, words and meaning are always to be unmistakable.

238. The road allowances must be ruled in proper position. The regular width is stated at the beginning of the book; other widths are entered in the notes. Corner monuments are properly described and marked in true position. When a boundary monument is found, the fact must be stated, also whether it was in good condition or obliterated, and whether it has been restored.

239. Traverses are plotted on a scale of not less than one inch to twenty chains and large enough to show all the details of the survey. They are on tracing linen, one piece of linen being used for each township if convenient. If a traverse extends into two or more townships a separate traverse plot is required for each township. The lines of the traverse are in red and the shore lines as well as the the section lines are in black. The numbers of the stations should be indicated on the plot. Areas are not entered upon these plots; they are calculated at the head office. The plot must not be pasted in the field book. Connecting traverses are dealt with in the same manner. Field notes of the traverses are to be entered in the blank pages in the field book. (See specimen pages 88, 89 and 90).

240. Where islands occur in a stream, or where there are several channels the traversed line to which areas are calculated is shown on the traverse plot by a fine blue line.

241. The astronomical observations for azimuth together with the calculations thereof, are entered in the blank forms at the end of the book. If the field book does not contain sufficient forms on which to enter all the returns of the astronomical observations taken, they may be entered on some of the blank pages at the end of the book. Blank forms for astronomical observations are furnished on request and if the surveyor prefers, the returns may be entered on these forms and attached to the book.

242. The surveyor subdividing a township must make in the field book a report upon the following subjects:—

Route for reaching the place and its condition.

Nature of soil and what it is suitable for.

Description of the surface, whether prairie, timbered or scrubby, with the location and proportions of each kind.

Size, kind, and quantity of timber and where located.

Hay.—Location, quantity, and quality.

Water.—Whether fresh or alkaline. Is supply sufficient and permanent? Description of streams, depth, width, rate of current, and volume of water. Is land liable to be flooded, and if so, to what depth?

Water-powers.—Heights of falls, or rapids, and horse-power available. Whether such power can be developed by the construction of dams.

Climate.—General indications. Any summer frosts?

Fuel.—What kind of fuel is most readily available, and where can it be procured? Description of any coal or lignite veins in the township.

Stone quarries.—Where located. Kind and quality of stone.

Minerals.—Description and location of any minerals of economic value in the township.

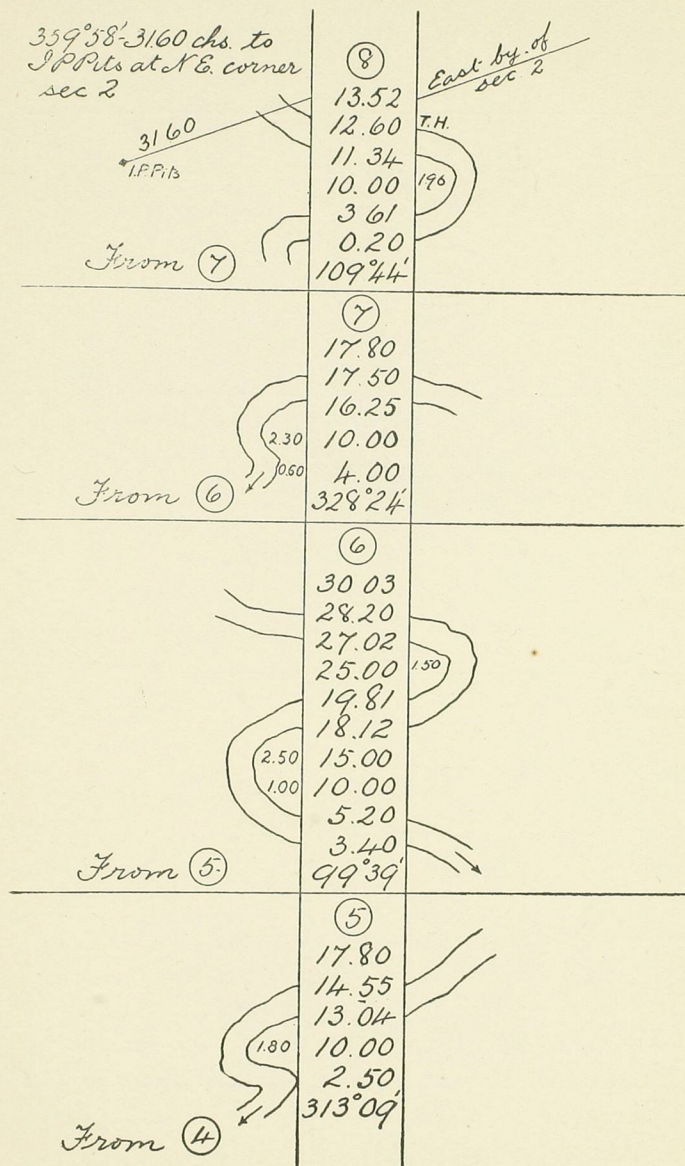
Game.—Kinds of game to be found.

Also any other subject of interest in connection with the township.

243. Every subject mentioned above must be dealt with in the report. For instance, if there is no timber in the township it must be so stated and not left to be inferred from the absence of any reference to timber in the report.

244. At the end of the field book of a township subdivided under contract, there must be an account of the cost of the survey. This account must give in miles and decimals of a mile the length of the section and traverse lines surveyed, of the lines opened in the woods, of the lines measured over rough ground, and of the meridian outlines surveyed, together with the rate per mile and the amount claimed in each case; also the number of pits, and the number of statutory declarations with the rate per unit and the amount claimed in each case, and the total amount for the township.

245. The surveyor performing the original subdivision of a township must make a separate report upon the timber to be found within the township. In his report, the surveyor states whether, in his judgment, from the knowledge gained on the ground, it would be desirable to reserve the timber for the needs of settlers or whether it would be advisable to set apart the same as a timber berth or as a



SPECIMEN OF FIELD NOTES OF CHAINED TRAVERSE SURVEY—Continued.

timber reserve for the conservation of water supply. Should a timber berth be suggested, he is to give a general statement of the quality and extent of the timber over ten inches in diameter suitable for lumbering purposes. If reporting on several timbered townships, he must make a statement of their relative value, taking into account the extent, quality and facilities afforded by streams, etc., for getting out the timber. When there is no wood in the township, the fact must be stated. The report for each township must be on a separate sheet of foolscap or on forms supplied by the Department.

246. Following the field notes, the surveyor will make the following affidavit:—

I, A.B., of in the province of Dominion Land Surveyor, make oath and say that I have, in my own proper person, according to law and the instructions of the Surveyor General, faithfully and correctly executed the survey shown by the foregoing field notes and accompanying plan, and that the said field notes and plan are correct and true to the best of my knowledge and belief. So help me God.

The reference to the plan is left out when there is no plan.

The affidavit must be made before filing the plan or the field notes: the examination is not commenced nor is anything else done before the affidavit is made.

247. The statement that the surveyor has made the survey in his own proper person means that the survey operations have been carried out under his personal supervision and direction in such a manner that he is certain of their correct execution. It involves the presence of the surveyor on the ground. He may assign to his assistants such parts of the work as he may see fit.

248. A survey has been made according to law and the instructions of the Surveyor General, when the directions of the law and of the Surveyor General have been carried out as far as practicable. Cases may occur where it is impossible or manifestly inexpedient to comply with some clause of the instructions; in such cases, the surveyor is expected to use his own discretion. On the other hand, a departure from the instructions is not justified when they can be carried out without causing any harm.

249. A surveyor employed on the survey of base lines or meridians must furnish a general report upon his operations and the resources of the district in which his work lies, for publication in the annual report of the Department of the Interior; also, for each township adjoining the outline, a description of the surface, nature of the soil, timber, minerals, etc.

As base line surveys lie in practically unexplored portions of the country, an explorer is attached to the survey party for the purpose of exploring the adjoining country.

It is his duty to explore for twelve miles on each side of the surveyed line and to cover the ground sufficiently to enable him to furnish the surveyor with a detailed description of the country. Among the particulars to be noted by him are the following:—

(a) General character of the country, whether level, rolling, broken, hilly or mountainous. Average height of hills.

(b) Description of the surface whether prairie, wooded or scrubby with location and proportion of each.

(c) Nature of soil whether clay, sand, stony or rocky, suitability for farming. Where land remote from known settlements has been occupied or cultivated, the circumstances should be reported and the success or failure of the operations determined when possible.

(d) Liability of land to be flooded. Frequency of swamps and marshes. Location and extent of marshes and other lands growing hay.

(e) Description of timber met with, giving dimensions and what it is suitable for. If suitable for lumber or pulp wood, the quantity should be estimated.

(f) Average width and depth of the rivers and creeks, direction and rate of current. Note the waterfalls and rapids and estimate the height of fall. Observe whether power can be developed by building dams.

(g) Average depth and width of valleys; whether slopes are easy or steep.

(h) Description of coal or lignite veins, or other minerals found, with samples of the same.

(i) Description and location of stone suitable for lime or building.

(j) General indications of the climate; occurrence of frosts.

(k) Game and fish.

(l) Any other information of scientific or practical interest.

The explorer is to keep a diary in which to enter notes as he travels from place to place and in no case should he trust to memory to record observations of previous days. Owing to the nature of his work he may have to be absent from camp several days at a time, but he should report at every available opportunity so that the surveyor may have a check on his work.

Such of the information thus obtained as is of sufficient importance, is embodied in the general report of the surveyor after the completion of the survey.

From the data collected by the explorer, the surveyor compiles a sketch map on tracing linen of the country showing the various lakes, rivers and other topographical features of the ground together with full topographical notes giving all, or as much as possible, of the information gathered. The map is drawn on a scale suitable to the amount of information contained. It is intended merely for office use, and provided the information is plain and unmistakable, fine draughtsmanship is not required.

Attention is particularly drawn to the necessity of devoting care and attention to the preparation of general reports. The object is not merely to give an account of the surveyor's operations and of the quality of the land, but to describe comprehensively the resources of the country visited and its industries, whether farming, stock-raising, lumbering, mining, etc., furnishing such details as may enable the prospective emigrant to choose judiciously the locality in which to settle according to his calling, and to form an idea of the expectations which he may reasonably entertain.

A general report is also required from all other surveyors employed by the day, such report to contain all the information concerning the season's operations of value to the Department of the Interior or to the public, but which does not appear in the surveyor's plans or field notes.

250. The final returns of survey are as follows:—

For a survey of township outlines:

(a) Field notes.

(b) General report.

(c) Oaths of chainmen.

(d) Accounts in duplicate on the forms supplied.

For the subdivision of townships:

- (a) Field notes.
- (b) Oaths of chainmen.
- (c) Statutory declarations of settlers, if any.
- (d) Timber report.

For other surveys:

- (a) Field notes.
- (b) Plan.
- (c) Oaths of chainmen.
- (d) Statutory declarations of settlers, if any.
- (e) Accounts in duplicate on the forms supplied.

251. Immediate preparation of returns after the surveyor has completed his field work will be insisted upon.

INSPECTION AND EXAMINATION OF SURVEYS.

252. The responsibility for the accuracy of a survey and of the plans and field notes of the same, rests with the surveyor. He must not look to the Department for assistance in discovering the errors or deficiencies of the survey in the field or for help in completing or correcting the returns.

253. Should the field inspection of a few miles of the survey lines disclose work below the standard required by the instructions, the surveyor will be invited to correct the whole survey, and no further payment will be made until a new inspection has shown the survey to be satisfactory.

254. The field notes and plans must, before being filed, be carefully checked by the surveyor. It is no part of the duties of the office staff to help a surveyor in correcting his returns; that must be done by the surveyor himself. A few errors may escape his attention, and if such as not to require a change in the survey, he will be allowed to file supplementary field notes correcting the previous ones and to be attached to them. Clerical mistakes may, at the request of the surveyor, be corrected in red ink. Should the examination of a few pages of field notes disclose more errors or discrepancies than should exist, had the notes been carefully prepared and checked, the examination will not be continued and the notes will be returned to the surveyor who will be requested to send correct ones.

255. In case the notes show that a part of the survey on the ground is incorrect, deficient or incomplete, the sur-

veyor will have to correct the survey on the ground and to file supplementary returns embodying the corrections.

256. After being fully examined by the office staff, neither plans nor field notes are returned to the surveyor. Any corrections necessary are made by supplementary returns, duly sworn to, or are, at the request of the surveyor, entered in red ink on the original returns when the mistakes are evidently clerical.

CHAPTER IV.

BLOCK AND BASE LINE SURVEYS.

GENERAL DIRECTIONS.

257. The first operation in laying out a given portion of country, is the survey of the outlines of the blocks.

The eastern and western exterior boundaries of the blocks in the third system of survey are broken lines each consisting of two meridians separated by the "jog" at the correction line. The northern and southern limits (base lines) are parts of a polygon described on a parallel of latitude, by laying off, as chords thereto, the successive township sides, forming, as the case may be, the northern or southern outline of the block.

If time does not permit the survey of whole blocks, the base lines are established first.

The road allowances along meridians are in all cases of the prescribed theoretic width, one chain. That the distribution of excess or defect is among the sections, and is not applied to the roads, does not materially affect the azimuth of those north and south lines involved; the displacement at the extremes—but two-thirds of a link on each mile—being less than ordinary chaining is at all accurate enough to indicate.

258. Except in the case of the blocks south of the second base, where the meridians are surveyed from the second base to the first correction line, and after laying off the theoretical jog, south to the first base, leaving all the north and south closing error at the first base, the surveyor invariably closes his block on the correction line, projecting first the part on one side of the correction line and then the other half of the block. The north and south error in closing is divided equally between the two quarter sections north and south of and adjoining the correction line. The jog on the correction line is left as found, unless it should show an error of more than one chain and fifty links in the lines of the last block in which case they have to be resurveyed. The limit allowed for the north and south closing error on the correction line is also one chain and fifty links.

The block surveyor marks, on the correction lines, only the township corners; all other posts are planted by the subdivider.

259. When it becomes necessary to deflect a base line to place it in proper latitude, such deflection, unless instructions to the contrary be received from the head office, is not to exceed two minutes, and must be carried to such a distance as to effect the required correction, except in closing on an initial meridian, where the last township corner is connected with the post on the meridian by a trial line, the deviation never extending beyond the range or fraction of a range adjoining the meridian.

260. The method of establishing the lengths and directions of the lines of the survey is the following:

All lines are measured twice. This is effected by having two sets of chainmen, using the continuous steel band chain. The leading one is of the length of a standard Gunter's chain; by it all topographical notes are kept and posts planted. The following band, used as a control, is 100 feet or more in length.

With a steel tape several hundred feet in length, the inequalities of the ground would frequently prevent the rear chainman from seeing the front chainman if the tape were used to the full length. The method of chaining in such a case is to have the zero of the tape in front, the rear chainman holding whatever "ten" links or feet happens to be nearest over the last pin, while the front chainman always drops his pin from zero.

As the front chainman advances, unless the ground is exceptionally level, he generally encounters a small rise which if the full chain were used would obstruct his view of the rear chainman. To pull the chain out to its full length, and then come back to the summit of the rise, and put in a pin or to read the clinometer for the chain on each side of the rise is very laborious and complicated. Instead of this the front chainman, when he reaches the summit, estimates if he can get to the next summit and see the rear chainman. If not he stops at the top. The rear chainman comes up to the last pin, picks up the chain beside it, takes the nearest "ten" and holding this mark exactly over the pin he gets the front chainman to tighten the chain and set his pin in the usual way at the zero always. The mark read on the chain is entered in

the book, the clinometer is read and the front chainman advances again either to the full length of the chain or to the top of the next rise as the ground may dictate. It is best to use only the "tens" as a means of avoiding errors in reading. It seldom happens that odd feet or links between tens must be used.

At the last distance, the front chainman holds the zero exactly over the post put in by the first chainage, and the rear chainman coming up to the last pin, pulls the chain back tight from the front chainman who is holding the zero over the post. The rear chainman then reads the odd feet or links and tenths.

When, at a section or quarter section corner, the distances registered by the respective chainings for the length of the quarter section side, differ, in prairie country, more than two links, or, in woods or brush, more than three links, the two sets of chainmen return to the last post and measure over again, repeating their measurements until accordance within the limit prescribed is attained.

When the surface is so broken or uneven that it would be unreasonable to expect such accordance, and therefore, in a still greater measure, to look for any proper approximation to the absolute length of the interval chained, the surveyor, while continuing to establish the direction and carry on the production of his line, in the usual manner, has recourse to such application of trigonometric methods, for obtaining the distances along it, as his judgment and the necessities of the case may lead him to employ.

261. The field bands must be frequently compared with the standard measure.

In using the standard for comparison, it should be stretched with a proper tension measured by means of a spring balance.

As every increase or decrease in temperature of ten degrees Fahrenheit would give to measurements a corresponding increment or decrement of somewhat more than half a link in a mile, and since in the western provinces a season of field work, extending from summer to winter may include variations of temperature covering a range as high as 130°, a base line chained in summer across four ranges, might, from this cause alone, differ from the adjoining base lines north or south, chained across the same ranges in midwinter, by more than one chain and a half.

262. In ordinary summer weather, although the correction for temperature would, compared with the order of precision of the work generally, be inappreciable, yet it must not be entirely neglected. The temperature error might, in any given case, happen to have the same sign as other uncorrected constants, or accidental errors, whose effect it would then go to aggravate. That in another case, further on, it might tend to counteract these, would not lessen the inaccuracy of position of the boundary monument planted under the first condition.

The surveyor will, therefore, apply this correction for all variations of 10° and over, from the temperature for which the chains are compared or adjusted to standard. This he can conveniently do, by allowing half a link to the mile for each ten degrees Fahr., not attempting to note or estimate the temperature of his chain to less than ten degrees. This will keep his corrections in the convenient form of multiples of half links, and render tables unnecessary.

A thermometer attached to the end of a chain near the hand, fails to give the temperature of the rest of the chain; fastened to the middle and allowed to drag on the ground, it is liable to derangement and injury, it is therefore extremely difficult for the surveyor to obtain even a rough approximation of the temperature of his chain. By repeating at convenient times, and under varied conditions, the experiment of placing a pocket thermometer on, or in, the grass or brushwood, as nearly as possible similarly to the average position of the chain during the trial, and comparing the temperature attained by the thermometer so placed with that of the air, or indicated by a thermometer attached to the leading end of the chain, a rough idea may be got of the allowances that should, in practice, be made in taking the indications of the latter, or in rudely estimating the temperature of the chain from that of the air at the time.

Attention is to be paid to the condition of the chain during measurement, whether wet or dry; a wet chain will have its temperature lowered to a great extent, especially in dry weather. The colour of the chain also has some influence; a black or dark blue chain will absorb more heat than a bright one.

263. Besides the small plummet line that should be carried by the chainmen to enable them to get correctly past minor irregularities of surface, the assistant should

carry an Abney or Locke pocket clinometer, by which he can obtain the inclination and thus permit the chainmen to use the more accurate method of chaining on the inclined surface, instead of the one requiring them to hold their chain level and entailing a continuous repetition of plumbing down from the high end to the pin in the ground.

In using his clinometer, the assistant stands at one end of the slope, one of the chainmen standing at the other end, and he sights through the instrument to some part of the chainman's body, the height of which has been previously ascertained to be the same as the height of his own eye. Such point is easily found by using the clinometer at zero, the assistant and chainman standing close together and on the same level.

264. Table XIX, "Corrections in links to slope measurements," is intended for the subdivision of townships; it is not sufficiently precise for block surveys. A more accurate table is pasted inside the cover of the field book for block surveys. This book contains a form for applying the correction to the chainage. (See specimen, page 102). The first number entered in this form is the length, in links of the chain used, of the quarter section to be laid out. When the chain can be adjusted for length, it is adjusted so as to be standard at some given temperature; the number to be entered is then the theoretic length of the quarter section, forty chains or forty-one chains as the case may be. When it cannot be adjusted the surveyor ascertains its length at the given temperature by comparison with the standard, and computes the number of links of *his chain* required to give, at the above temperature, the proper length to the quarter section. With a chain too long, the number of links is less than the true length and vice versa. This number being entered in the field book form, the corrections for slope are written underneath; they are in all cases to be added. The correction for temperature, one quarter of a link to the quarter section for every ten degrees Fahr., is entered next; it is added when the thermometer is below the standard temperature and subtracted when above the same.

At the end of the quarter section, the algebraic sum of the quantities entered shows the number of chains and links to be actually measured on the ground in order to give to the said line its exact length, forty or forty-one

chains. The same process is followed to find the distance to be measured for the section corner.

An alternative method, more convenient and probably better when using a long tape for the check chainage, is to reverse the method and reduce the slope measurements to the horizontal. The temperature correction in this case is of course reversed in sign, the correction over standard being additive and under standard negative.

This method gives the correct distance between the monuments previously established by the first chainage while the first method gives the number of chains to be laid out in order that the monuments may be at the correct distance. When using the second method with a long tape, it is convenient to use a separate field book, which may be of very small size, for entering the measurements.

The distance for the topography, being entered as found in the field, is in error by the amount of the correction to the chainage. This quantity being generally small, may be neglected for the topography, but the posts should be entered at their true distances.

The method of chaining along the slopes and correcting for inclination is applied both with the Gunter's chain and with the longer chain used for control.

265. When the distance across an obstacle is determined by a triangle, the surveyor must be careful to check it by another independent operation, either another triangle, or, in exceptional cases, a micrometer measurement, so as to conform to the principle of double independent chainage.

If a second triangle be adopted, having the side to be calculated common with the first triangle, it is sufficient to set up the instrument at both ends of this side; any error in the angles is shown by the calculation. In all triangles, calling the angle opposite to the base B, the angle opposite to the side to be calculated C and the third one A, the calculation is made according to the form given on page 102. The distance to the nearer side of the obstruction being entered at the proper place, it is only necessary to fill the form to have the distance to the farther side. From this last point the chainmen start with the number of tallies and pins and the fraction of a chain found by the calculation.

266. Should the extension of a block line be hindered by a very large lake or marsh, the surveyor may pass around the same, projecting for the purpose the adjacent township

$\frac{1}{4}$ Sec. 40.140	TRIANGLE No. 43	b = 9.442
Slope. 3	Observed angles	Corrected angles
13	A = 64° 43'	64° 44'
7	B = 55 56	55 57
24	C = 59 18	59 19
	179 57	180 00
		log. b = 0.97506
		cosec. B = 0.08168
		sin. C = 9.93450
		log. c = 0.99124
		c = 9800
	Distance to near side of obstruction =	0.050
	Distance to far side " =	9.550
	TRIANGLE No. 44	b = 5.287
	Observed angles	Corrected angles
	A = 58° 03'	58° 02'
	B = 52 51	52 50
	C = 69 09	69 08
	180 03	180 00
		log. b = 0.72321
		cosec. B = 0.09861
		sin. C = 9.97054
		log. c = 0.79236
		c = 6.200
Th. cor. -5	Distance to near side of obstruction =	37.000
$\frac{1}{4}$ Sec. 40.182	Distance to far side " =	43.200
Sec. 41.140		
Slope 11		
6		
18		
23		
2		
1		
1		
	Temperature 80°	
Th. cor. -5		
S ₉₂ 81.379		

SPECIMEN OF PART OF FIELD NOTES OF BLOCK SURVEY.

lines. In working around in this way to arrive at and take up the continuation of the block line on the opposite side of the obstruction, the surveyor regularly posts off all township, section and quarter section corners on the several lines, reporting the circumstance fully and sending all the field notes of such additional work forward with the returns of survey.

INSTRUMENTS.

267. The instrument used for the survey of block outlines is a six-inch reiterating theodolite of which the horizontal circle is read by two microscopes. A four-inch vertical circle read by a vernier serves as a finder for stars in daytime.

The telescope has an objective of one and seven-eighths inches diameter and twelve and three-quarters inches focus.

A small magnetic needle attached to the instrument is useful in finding stars in daytime when the surveyor happens to be elsewhere than on a line of known bearing.

268. The surveyor must also have a repeating transit having a four or five inch horizontal circle reading to minutes, which may be used for doing generally whatever may be done with sufficient accuracy, and more conveniently than with the larger instrument used in the production of the line.

For astronomical work the surveyor must be provided with a sidereal pocket chronometer.

DIRECTION OF LINES.

269. The reference of lines to an astronomic meridian, in order to obtain their direction, or to check the accuracy of their production, is most readily made by observations on Polaris.

The telescope used being amply powerful to show stars of the second magnitude within a few hours from noon, and stars of the third magnitude in twilight when it is still clear enough to read the graduation, the observation should be taken in daylight whenever practicable.

Besides avoiding the errors peculiar to all artificial illumination, and likely to be specially developed in the case of field work in unsheltered positions, daylight observations

have the advantage that they are conveniently made with the instrument at one of the stations for the ordinary production of the line, and during its progress, without materially interfering therewith. Day observations also give the surveyor more time in evening in camp for their reduction, and for checking his own and his assistant's work generally.

270. In making these observations, as in angular measurements generally, care should be taken when turning the instrument in azimuth by hand, to use the same forward or backward motion throughout for every pair of pointings in same position, the angle between which is intended to be read on the horizontal circle. This tends to obviate the effect of any yield in the instrument stand to that part of the impulse of revolution that passes down through the foot screws to the stand head. A source of similar error is looseness of foot screws in their nuts. The pinch screws closing these last should always be screwed up so tightly as to have the levelling screw turning stiffly in the nut. Even though this may entail more rapid wear of the screws, and be less convenient to the observer in bringing quickly, and with nicety, his level bubbles to their desired position, the certainty that it ensures warrants it.

The tangent and micrometer screws should always be turned so as to push against the counteracting spring; because in turning in the opposite direction, the spring might fail to bring back the plate at once and do so only during the interval between the observation and the reading of the drum.

271. The reference object for azimuth work should be, if possible, at such a distance that the telescope is at solar focus when the pointing is made on the reference object.

272. In observing for azimuth the following programme may generally be adopted:

1. Level the instrument very carefully using the striding level for this purpose, so that the level correction may be small.
2. Point on the reference object and read the microscopes three times each on forward and backward graduations.
3. Point approximately on Polaris and place the striding level in position (zero of graduation to the right or east). Point accurately on Polaris not-

ing the time by sidereal chronometer. Read the striding level, reverse it, read it again and *remove* it. Read the microscopes three times each on forward and backward graduations.

The direction to remove the striding level is most important and must not be overlooked. If forgotten the striding level would be knocked off and broken in reversing the telescope.

4. Reverse the telescope in altitude, turn the instrument 180° in azimuth, and repeat as in No. 3.
5. Same as No. 2.

A complete observation as above should, under favourable conditions, give a result correct to within a few seconds.

In the special cases where the reference object is on or near the meridian, the observation for azimuth can be arranged so as to be independent of the readings of the graduation which need not be taken, the difference in azimuth between the star and the reference object being measured by means of the eyepiece micrometer. This measurement is more accurate than an angle read on the graduated circle.

On base lines the reference object being usually east or west of the instrument, an angle of about 90° has to be measured. In cases where the greatest accuracy on a base line is desired, a reference object may be placed on or near the meridian and its azimuth determined entirely by means of the movable wire. The angle between the reference object and the base line may then be measured by the usual method of reiteration, shifting the horizontal circle several times.

It is necessary that the reference object be at such a distance that the telescope is at solar focus when the pointings are made.

The programme is as follows:

1. Level the instrument very carefully using the striding level for this purpose, so that the level correction may be small.
2. Point approximately on Polaris and place striding level in position (zero graduation to the right or east).

Bisect the star with the movable thread, noting the time by sidereal chronometer. Read the striding level and reverse it. Bisect the star

again with the movable thread noting the chronometer time. Read the striding level and remove it.

3. Lower the telescope and bisect the reference object twice with the movable thread.
4. Set the movable thread in the symmetrical position on the opposite side of the middle thread, reverse the telescope and turn the instrument around in azimuth until the movable thread is on the reference object. Fasten the clamping screw, and bisect the reference object twice with the movable thread.
5. Same as No. 2.

Under favourable conditions, the result by this method should be accurate within three or four seconds. It is important that the telescope be set to solar focus very accurately. An error of one thousandth part of the focal length in the adjustment causes a corresponding error in any angle measured with the eyepiece micrometer. If the angle is, for instance, fifty minutes, the error is one-thousandth part of fifty minutes or three seconds. It is therefore, advisable to use a magnifying glass in extending the telescope to the focal mark.

Whatever programme be adopted it will be found convenient in order to prevent mistakes to always begin the observation with same position of the instrument.

273. The chronometer error is required for the reduction of the observations. In observing Polaris near upper or lower transit an error of one second of time corresponds in the latitude of the western provinces to an error in azimuth of half a second of arc more or less. The error of the watch should therefore be known with some precision. An observation for time should be taken either shortly before or shortly after every azimuth observation. The instrument should be carefully levelled with the striding level and the observed transit corrected for level and azimuth errors according to the methods prescribed in any of the standard text books on astronomy.

If Polaris is sufficiently close to the meridian, a convenient way of setting the instrument in the meridian is by the eyepiece micrometer. Set the azimuth of Polaris off from the collimation (correcting for altitude by dividing by the secant of the altitude) with the movable wire and by turn-

ing the tangent screw bisect the star with the movable wire. Observe the times of transit of some time star across the fixed wires.

Another method of getting the time is by observing the transit of a star across the vertical of Polaris and following the directions given in the explanation of "Table XIV."

The result of the observations for time must always be entered in the form at the beginning of the book of record of astronomical observations.

274. The striding level is graduated from zero at one end, continuously upwards to the other end. Representing by w and e the readings of the west or left and east or right extremities of the bubble respectively when the zero of the graduation is at the east or right end and by w^1 and e^1 , the corresponding west and east readings after the level is reversed, that is to say, when the zero of the graduation is at the west or left end, d being the value of one division in seconds of arc, the level correction

$$= \frac{d}{4} \left\{ (w-w^1) + (e-e^1) \right\} \tan h$$

$\tan h$, the inclination factor for Polaris, is tabulated in the azimuth observation book.

If the observation is taken according to the first programme the level correction is applied to the horizontal circle readings according to sign; but if taken by the micrometric method the level correction is applied to the angle "Polaris from collimation" according to sign if Polaris is east of collimation, opposite to sign if west.

The determination of the value of one division of the level is ordinarily made at the Surveys laboratory. If however, the surveyor has no knowledge of his level value and wishes to determine it in the field, he may adopt the following method:—

The level is placed on the upper plate parallel to the plane of revolution of the telescope, and a mark set up at a distance such that the the telescope may be in solar focus and in the direction of one of the foot screws. The bubble is, by turning this foot screw, brought close to one end of its run, the telescope is pointed on the mark and firmly clamped. A careful pointing is now made on the mark with the movable thread of the eyepiece micrometer and the read-

ings of the micrometer and level noted. The foot screw is then turned until the bubble is close to the other end of its run, the drum of the eyepiece micrometer turned until the movable thread again bisects the mark and the micrometer and level readings noted. The difference of micrometer readings gives the angular displacement from which the value of one division of the level may be derived. The operation should be repeated several times. The level may be reversed end for end during the course of the determination if desired.

Instead of a distant point, the pointings may be made upon the telescope of a transit or level used as a collimator.

275. In the reduction of an observation taken according to the second programme, "circle east" and "circle west" are reduced independently, the mean of the micrometer readings on the reference object and star and of the chronometer times being taken in each case. The correction for curvature of the path of Polaris, being in extreme cases only a fraction of a second, may be neglected.

The angle measured by the micrometer between the star and the line of collimation and, when the reference object has any appreciable altitude, between the reference object and the line of collimation, must be multiplied by the secant of the altitude to reduce it to the horizontal. When Polaris is sufficiently close to the meridian to allow it, it will be better to make the pointing with the movable thread on Polaris not far from the centre of the field. In this way the factor for the reduction to the horizontal of the angle "Polaris from collimation" affects only a small angle while the factor for the reduction of the large angle "Reference object from collimation" is nearly unity. The altitude of Polaris may be taken from the Astronomical Field Tables for the mean of the times of the two observations, "circle right" and "circle left," without appreciable error. At or near elongation when the altitude is changing rapidly and when the angle "Polaris from collimation" is necessarily large, the altitude is better read off the vertical circle, each half of the observation being reduced with its own altitude.

To reduce the micrometer readings to arc, the value of one turn is required. This is ordinarily determined at the Surveys laboratory. But if the surveyor is without this value, he may find it by any of the methods described in standard text books on astronomy.

The following method will be found convenient:—

Set the movable wire of the micrometer close to one end of its run and move the upper part of the instrument with the tangent screw until the movable wire bisects some distant object (solar focus) at the same level as the transit; read the micrometer once and the horizontal circle microscopes three times. Now bring the movable wire close to the other end of its run and bisect again the same point with the movable wire by means of the tangent screw, reading the micrometer and circle microscopes as before. The horizontal angle as shown by the microscope readings divided by the difference of micrometer turns gives the value of one turn of the micrometer.

The operation should be repeated a number of times and, in order to eliminate as much as possible periodic errors of the circle graduation, the instrument should be revolved by means of the shifting head on the stand to give readings on different parts of the circle.

The uniformity of the micrometer screw may be tested by measuring the value of one turn over different parts of the screw.

Another transit or a level may be used as a collimator and gives a better reference object than a distant point. Set up the collimator a few feet from the transit to be tested and with the telescope at the same level. Adjust both to solar focus and point on the object glass of the transit. Now looking at the collimator through the telescope of the transit, the cross wires or points of the collimator telescope will be seen as at an infinite distance. These cross wires or points make an excellent reference object.

276. Surveyors are at liberty to use any formula or process for reducing their observations, but, as forms and tables could not be prepared for every method, the following formula has been adopted; for convenience, with regard to future reference, it is desirable that all surveyors should adopt it:—

$$\tan Z = -\frac{\tan P \sec L \sin t}{1 - \tan P \tan L \cos t}$$

where Z , P , L , t , are azimuth, polar distance, latitude and hour angle respectively.

Writing m for $\tan P \tan L \cos t$ the formula may be written

$$\tan Z = -\frac{1}{1-m} \tan P \sec L \sin t$$

FIRST

Place *Sta. 68 - 61.52 W. of NE cor. sec 34. Tp 84. R. W. 5th Mer.*
 R. O. *Sta. 70 - 60.80* 33
 Date. *12-7-11* Observer *J. S. Smith D.L.S.*

Position	Pointing Number	HORIZONTAL CIRCLE READINGS			
		Reference Object		Polaris	
		Microscope A	Micr. B	Microscope A	Micr. B
Circle Right Drum Right	1	359° 21' ^F 39 ^B 36	22' ^F 55 ^B 58	87° 25' ^F 07 ^B 07	26' ^F 28 ^B 30
	2	36 37	56 58	08 07	26 32
	3	38 35	54 59	09 07	27 32
	4				
	5				
Mean		359° 21' 37.1	22' 56.9	87° 25' 08.0	26' 28.2
Circle Left Drum Left	1	179° 22' 45 48	24 11 05	267° 23' 55 60	25 17 21
	2	45 48	09 08	58 61	19 21
	3	46 48	11 06	59 60	18 22
	4				
	5				
Mean		179° 22' 46.8	24' 07.0	267° 23' 59.7	25' 18.2
Mean H.C.R. of Pol.	Circle Right	87° 25' 48	Circle Left	267° 24' 39	Mean chron. time
Level correction ...	+5	+9	Chron. error ...		
Corrected H.C.R. of Pol.	87 25 53	267 24 48	Sidereal time ...		
" H.C.R. of R.O.	359 22 17	179 23 27	R. A. Polaris ...		
Angle Pol. to R.O.	88 03 36W	88 01 21W	t in time ...		
Pol. from collimation ... log.			t in arc ...		
One turn micrometer ... log.			Log. tan P.		
Altitude Pol. ... log. sec.			Log. tan & Sec. L		
log. sum			Log. cos. & sin. t		
Pol. fr. coll. reduced to horiz'al			Log. sum ...		
Level Correction ...			Log. $\frac{1}{1-m}$...		
Microm. angle Pol. fr. coll.			Log. tan Z.		
R. O. from collimation ... log.			Log. T.		
One turn micrometer ... log.			Log. a (in sec.)		
Altitude R.O. ... log. sec.			Azimuth Pol.		
log. sum			Angle Pol. to R.O.		
Microm. angle R.O. from coll.			Azimuth R. O. ...		
Angle Pol. to R.O.			Mean ...		
			Convergence ...		
			Bearing R. O. ...		

SPECIMEN OF RECORD

QUADRANT

Instrument. # 112
 One turn of micrometer. *166.36*
 One division of striding level. *4"0*

Chron. Time	Micrometer Readings		Level		
	Polaris	R. O.	W.	E.	Corrn.
5 ^h 34 ^m 16 ^s			25.7 6.4	8.1 24.0	+3.4 x 1.0 x 1.54 = +5"
5 ^h 43 ^m 46 ^s			26.8 6.0	9.0 23.8	+6.0 x 1.0 x 1.54 = +9"
			+19.3	-15.9	
			+20.8	-14.8	
	Circle Right 5 ^h 34 ^m 16 ^s + 6 12	Circle Left 5 ^h 43 ^m 46 ^s + 6 12			
	5 40 28 1 27 08	5 49 58 1 27 08			
	4 13 20 63° 20' 00"	4 22 50 65° 42' 30"			
	2.31083 0.17649 T.66205	2.31083 0.25622 T.95116	2.31083 0.17649 T.61425	2.31083 0.25622 T.95974	
	2.13937	2.51821 +0.0603 _N	2.10157	2.52679 +0.0652 _N	
		2.52424 _N 5.31427		2.53231 _N 5.31426	
		3.83851 _N 358° 05' 05" 88 03 36W		3.84657 _N 358° 02' 56" 88 01 21W	
		270 01 29		270 01 35	
				270 01 32	
				19	
				270° 01' 13"	

OF AZIMUTH OBSERVATION.

SECOND

Place ^{chs} Sta 21-35 7ⁿ of N.E. cor. sec. 13 T⁹ R. 14ⁿ Mer.
 R. O. ^{chs} Sta 22-32 10ⁿ of 2A
 Date 18-7-11 Observer Geo Norton DLS

Position	Pointing Number	HORIZONTAL CIRCLE READINGS			
		Reference Object		Polaris	
		Microscope A	Micr. B	Microscope A	Micr. B
Circle Right Drum Right	1				
	2				
	3				
	4				
	5				
	Mean				
Circle Left Drum Left	1				
	2				
	3				
	4				
	5				
	Mean				
Mean H.C.R. of Pol.....	Circle Right	Circle Left	Mean chron. time		
Level correction.....			Chron. error.....		
Corrected H.C.R. of Pol.....			Sidereal time.....		
" H.C.R. of R.O.....			R. A. Polaris.....		
Angle Pol. to R.O.....			t in time.....		
			t in arc.....		
Pol. from collimation.....log.	T. 63347	T. 70157	Log. tan P.....		
One turn micrometer.....log.	2.21696	2.21696	Log. tan & Sec. L		
Altitude Pol. 56° 25' log. sec.	0.25716	0.25716	Log. cos. & sin. t		
log. sum	2.10759	2.17569	Log. sum.....		
Pol. fr. coll. reduced to horiz'al	0 02 08	0 02 30	Log. $\frac{1}{1-m}$		
Level Correction.....	+ 02	- 05	Log. tan Z.....		
Microm. angle Pol. fr. coll....	0 02 10 ^m	0 02 25 ^m	Log. T.....		
R. O. from collimation.....log.	1.09127	1.05603	Log. a (in sec.)		
One turn micrometer.....log.	2.21696	2.21696	Azimuth R. O...		
Altitude R.O. 4° 36' log. sec.	0.00140	0.00140	Angle Pol. to R.O		
log. sum	3.30963	3.27439	Azimuth Pol. ...		
Microm. angle R.O. from coll.	0 34 00E	0 31 21E	Mean		
Angle Pol. to R.O.....	0 36 10E	0 33 46E	Convergence.....		
			Bearing R. O....		

SPECIMEN OF RECORD

QUADRANT

Instrument... # 113
 One turn of micrometer... 164" 80
 One division of striding level... 3" 6

Chron. Time	Micrometer Readings		Level		
	Polaris	R. O.	W.	E.	Corrn.
12 ^h 15 ^m 01 ^s 40	20.471 .389	7.658 .666	22.8 7.3	7.0 24.0	-15x9 x1.52 = -2"
12 15 20	20.430	7.662	+15.5	-17.0	
12 ^h 19 ^m 37 ^s 20 13	19.459 .535	31.375 .380	23.1 5.8	7.5 21.4	+3.4x9 x1.52 = +5"
12 19 55	19.497	31.377	+17.3	-13.9	
	Circle Right 12 ^h 15 ^m 20 ^s + 5 10		Circle Left 12 ^h 19 ^m 55 ^s + 5 10		
	12 20 30		12 25 05		
	1 27 14		1 27 14		
	10 53 16		10 57 51		
	163 19' 00"		164 27' 45"		
2.31079	2.31079	2.31079	2.31079	2.31079	
0.19614	0.27001	0.19614	0.27001	0.27001	
T. 98132 _N	T. 45801	T. 98383 _N	T. 42793	T. 42793	
2.48825 _N	2.03881 T. 98684 _N	2.49076 _N	2.00873 T. 98676 _N	2.00873 T. 98676 _N	
	2.02565 _N		3.97549 _N	3.97549 _N	
	5.31442		5.31442	5.31442	
	3.34007 _N		3.30991 _N	3.30991 _N	
	359 23 32		359 25 59	359 25 59	
	36 10E		33 46E	33 46E	
	359 59 42		359 59 45	359 59 45	
			359 59 44	359 59 44	

OF AZIMUTH OBSERVATION.

FOURTH

Place Sta 30-3978 N. of N.E. cor. sec 1 T. 99 R. W. 4th Mer
 R. O. Sta 32-4232
 Date 22-7-11 Observer Geo. Norton D.L.S.

Position	Pointing Number	HORIZONTAL CIRCLE READINGS			
		Reference Object		Polaris	
		Microscope A	Micr. B	Microscope A	Micr. B
Circle Right Drum Right	1				
	2				
	3				
	4				
	5				
	Mean				
Circle Left Drum Left	1				
	2				
	3				
	4				
	5				
	Mean				

Mean H.C.R. of Pol.	Circle Right	Circle Left	Mean chron. time
Level correction			Chron. error
Corrected H.C.R. of Pol.			Sidereal time
H.C.R. of R.O.			R. A. Polaris
Angle Pol. to R.O.			t in time
			t in arc
Pol. from collimation.....log.	T. 61909	T. 75587	Log. tan P.
One turn micrometer.....log.	2. 21696	2. 21696	Log. tan & Sec. L
Altitude Pol. $58^{\circ}44'$log. sec.	0. 28482	0. 28482	Log. cos. & sin. t
log. sum	2. 12087	2. 25765	Log. sum
Pol. fr. coll. reduced to horiz'al	0 02 12E	0 03 01E	Log. $-\frac{1}{1-m}$
Level Correction	+ 8	+ 9	Log. tan Z.
Microm. angle Pol. fr. coll.	0 02 20E	0 03 10E	Log. T.
R. O. from collimation.....log.	0. 95593	0. 89332	Log. a (in sec.)
One turn micrometer.....log.	2. 21696	2. 21696	Azimuth Pol.
Altitude R.O. $2^{\circ}14'$log. sec.	0. 00033	0. 00033	Angle Pol. to R.O.
log. sum	3. 17322	3. 11061	Azimuth R. O.
Microm. angle R.O. from coll.	0 24 50W	0 21 30W	Mean
Angle Pol. to R.O.	0 27 10W	0 24 40W	Convergence.....
			Bearing R. O.

SPECIMEN OF RECORD

QUADRANT

Instrument #113
 One turn of micrometer 164.80
 One division of striding level 3.6

Chron. Time	Micrometer Readings		Level		
	Polaris	R. O	W.	E.	Corrn.
$0^{\circ} 43^m 11^s$	19.541	29.031	26.5	69	
53	.627	.039	5.2	22.8	+5.4 x 9 x 1.65 = +8"
0 43 32	19.584	29.035	+213	-159	
$0^{\circ} 47^m 42^s$	20.611	12.175	28.0	10.2	
48 21	.529	.181	7.2	25.0	+6.0 x 9 x 1.65 = +9"
0 48 02	20.570	12.178	+208	-14.8	
	Circle Right		Circle Left		
	$0^{\circ} 43^m 32^s$		$0^{\circ} 48^m 02^s$		
	- 3 32		- 3 32		
	0 40 00		0 44 30		
	1 27 18		1 27 18		
	23 12 42		23 17 12		
	$348^{\circ} 10' 30''$		$349^{\circ} 18' 00''$		
$\bar{2}.31074$	$\bar{2}.31074$	$\bar{2}.31074$	$\bar{2}.31074$	$\bar{2}.31074$	
0.19712	0.27071	0.19712	0.27071	0.27071	
T. 99069	T. 31159 _n	T. 99238	T. 26873 _n	T. 26873 _n	
$\bar{2}.49855$	$\bar{3}.89304_{n}$ + 01391 _n	$\bar{2}.50024$	$\bar{3}.86018_{n}$ + 01396 _n	$\bar{3}.86018_{n}$ + 01396 _n	
	3.90695		$\bar{3}.86414$	$\bar{3}.86414$	
	5.31442		5.31442	5.31442	
	3.22137		3.17856	3.17856	
	0 27 45		0 25 09	0 25 09	
	27 10W		24 40W	24 40W	
	360 00 35		360 00 29	360 00 29	
			$360^{\circ} 00' 32''$	$360^{\circ} 00' 32''$	

OF AZIMUTH OBSERVATION.

Table XVII gives the values of $\log \frac{1}{1-m}$ tabulated with $\log m$ as argument; in using these tables attention must be paid to the sign of m which is the same as that of $\cos t$. When t lies between 0^h and 6^h , or 18^h and 24^h , m is positive and the first half of the table must be used; when t lies between 6^h and 18^h , m is negative and the second half of the table must be used.

Since m is always less than unity, $\frac{1}{1-m}$ is always positive, and therefore $\tan Z$ is of opposite sign to $\tan P \sec L \sin t$. Hence when t is between 0^h and 12^h , $\tan Z$ is negative indicating that Polaris is west of the meridian; and when t is between 12^h and 24^h , $\tan Z$ is positive indicating that Polaris is east of the meridian. In the specimen observations, the suffix 'n' has been added to $\log \frac{1}{1-m}$ thus representing $\log -\left(\frac{1}{1-m}\right)$ in the above formula.

Denoting by a the angle which Polaris makes with the meridian east or west from north, then $\log a$ (in seconds) is obtained directly from $\log \tan Z$ by the use of table XVI and Polaris is east or west of the meridian according as a is positive or negative.

The logarithms of secant and tangent L are given in tables IX and X for the north side of every section.

277. The observations on pages 110, 111, 112, 113, 114, 115, 116 and 117, one in each quadrant, show the form of record and method of computation.

278. In the form, R.O. is for reference object; H.C.R. for horizontal circle reading; coll. for collimation; R.A. for right ascension; and F. and B. for forward and backward readings of the microscopes.

The observations in the first and third quadrants are taken according to the first programme; those in the second and fourth quadrants according to the micrometric method of the second programme.

In the first and third quadrant observations, the correction for run of the microscopes in each case is deduced from the mean of the forward and backward readings and applied to the forward readings.

In the second and fourth quadrant observations, as the angle between Polaris and the R.O. is less than one half the run of the screw, the pointing on Polaris is made in the approximate line of collimation.

It is not necessary that the collimation be correctly known. An approximate value may be taken; the bearings of the R.O. deduced from the two sets "circle right" and "circle left," will then differ by twice the error of collimation, but the mean of the two will be correct. In the observations the collimation is taken as 20.000 turns of the drum, which is only approximately correct.

In the position "drum right," the micrometer readings increase as the star travels from right to left, or as the horizontal circle readings decrease. And in the position "drum left," the micrometer readings increase as the star travels from left to right, or as the horizontal circle readings increase. Hence in the second quadrant observation Polaris is west of collimation and the level correction is reversed in sign, while in the fourth quadrant observation Polaris is east of collimation and the sign of the level correction remains unchanged.

The observations in the first and third quadrants being taken on a base line, the convergence must be applied to the mean azimuth to reduce it to bearing. The observations in the second and fourth quadrants being taken along a meridian, the results are for convenience sake left as azimuths.

279. The correction to the line found from the observation for azimuth may be laid off with the eyepiece micrometer by setting the movable wire the required correction from the middle fixed wire (allowing for the change in value of one turn of the micrometer due to the change of focus of objective from solar focus) and correcting accordingly.

If a surveyor should happen to survey a block line with a transit lacking the eyepiece micrometer, he can correct the direction of the line by placing the instrument a certain number of inches from its former position, at right angles to the line. This offset is found by multiplying the distance of the back picket by the tangent of the correction.

280. Surveyors are expected to observe for azimuth every four miles or thereabouts. With proper care in transporting the instrument, the levels will seldom get

much out of adjustment, and then the complete observation for azimuth, as above, does not take much time. It is hoped that with the forms and tables supplied, the work has been made so short and easy that no objection to the frequency of observation should fairly exist.

281. The observations are entered in the note book of astronomical observations at the time they are taken, the calculations made either in pencil or in ink, and the book sent in as part of the returns of survey. No copy is accepted.

PRODUCTION OF LINES.

282. In producing the line the surveyor employs but one flagman, a forward picket man; a back flagman is not necessary, as the surveyor, when about to leave an instrument station, can set a picket there himself.

283. Perfectly straight pickets are not indispensable; a part of the picket, exactly in the line, may be indicated by some visible mark and only this part used in the production of the line.

284. The following method for the production of the line has been found to give good results. The flagman carries an ordinary surveying picket, about nine feet long, and terminated at the lower end by a heavy iron point. When the flagman comes to the place where a new station is to be established, the surveyor gives him roughly the direction of the line. A wooden slab, held to the ground by two small wooden pins or by stones on the ends, is then placed at right angles to the line at the point determined as above, and in all subsequent operations the picket is held on the slab, and its position marked with a pencil.

In setting a point forward on his line, the surveyor is careful never to do it in one position only of his instrument; in all cases, first making his back and forward sights "circle right," then reversing his instrument, repeating them "circle left" and having his flagman instructed to make in each case a separate and independent setting of his picket. If there be any difference between the settings, the middle point is carefully determined and marked. Then the process is once repeated, so that there are two pointings in each position of the instrument on the back and forward pickets respectively, or eight pointings in all.

The same rule as to the reversion and number of pointings is observed in offsetting the line to get past long reaches unfavourable to chaining or triangulation.

The slab ought to be of such a length as to allow play for collimation.

Other methods are sometimes adopted with satisfactory results.

285. The deflection angle at a township corner on the base line is most readily turned off with the eyepiece micrometer, if the instrument is set up at the corner. Otherwise, it may be laid off by using the "deflection offset" given in Tables V and VI of the Supplement. This deflection offset is the length, at the distance of one chain, of the tangent of the deflection angle, or the angle between the chord forming a township side and the next chord. When the surveyor comes to a township corner, the last picket before the corner is placed south of the line, at a distance equal to the deflection offset, as given by the table, multiplied by the distance from the corner, and the instrument, instead of being set up over the forward point previously ascertained, is placed north of the line, at a distance equal to the deflection offset multiplied by the number of chains between the instrument and the corner. The line is then produced from the back picket in the ordinary manner.

Supposing, for instance, that it should be required to turn off the angle at a township corner on the seventh base line, the back picket being 12 chains behind the corner and the instrument 15 chains beyond the same corner, the back picket will be planted at 12×1.501 , or 18.01 inches south of the line, and the instrument set up at 15×1.501 , or 22.51 inches to the north.

286. At the corners of the block, the surveyor turns the required angle approximately, and the flagman holds his picket at the point so determined, while the surveyor measures accurately the angle thus turned off. If the angle is not what it should be, the direction of the line is corrected either by means of the eyepiece micrometer or by offsetting the instrument at the next station.

Should the corner fall in such a place that the angle cannot be measured correctly, as for instance at B (Fig. 47), one of the stations, C, being too near the corner,

the surveyor has the angle at B approximately turned off by his assistant with the small transit, and measures the angle EAC. He then sets up his instrument at C, determines approximately the next station D, and measures ACD. The sum of the two angles EAC and ACD, should be equal to 180° plus the angle to be turned off at B. The error, if any, is corrected by offsetting the instrument at D.

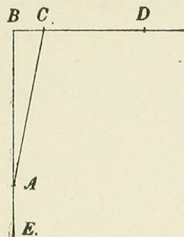


Fig. 47.

MARKING THE SURVEY.

287. The attention of surveyors is directed to the necessity of making sure that the posts planted for township, section and quarter section corners are placed in their correct positions as indicated by the chainage and *exactly on the line*.

Neglect of precautions in this behalf inevitably leads to errors in the subsidiary subdivision work.

CHAPTER V.

REGULATIONS FOR THE EMPLOYMENT OF SURVEYORS.

SURVEYORS EMPLOYED BY THE DAY.

288. For surveys, other than township subdivision surveys, Dominion land surveyors may be employed at a daily salary.

289. To be eligible for employment, a surveyor must own, in addition to the standard measure required by section 35 of the Dominion Lands Surveys Act, a transit theodolite with a telescope of not less than one and one half inches aperture, a sidereal watch, a surveying aneroid barometer, a clinometer and a sixty-six foot steel band chain.

These instruments must be of approved patterns and in good order.

A spare transit theodolite is recommended.

The aneroid barometer must be compared with a standard barometer at every convenient opportunity.

290. A block surveyor must have in addition thereto a six-inch transit of approved pattern and a steel band chain not less than one hundred feet in length.

291. When the services of a surveyor are of a temporary character, his salary is at the rate of eight dollars a day for ordinary surveys, but for surveys of block outlines and for services requiring special qualifications, the rate is twelve dollars and fifty cents a day.

292. A surveyor is paid for every day of service in the field, including Sundays. The number of days is computed from the day on which he leaves his home until the day of his return, both days inclusive.

293. The final returns of the season's surveys must be prepared immediately after the close of operations in the field. The surveyor must state in his account for personal services and allowances (Form A) the actual days, including intervening Sundays and statutory holidays, spent on the preparation of his returns. For this time he is paid at the same rate as for field services but payment is not allowed

for a greater number of days than is deemed sufficient by the Surveyor General.

294. If a surveyor employed at a daily salary or a member of the party meets with an accident while engaged on the work of the survey, the Minister may pay to the injured surveyor or member of the party such portion of his salary while incapacitated from work, and such portion of his reasonable surgical expenses, as he may see fit.

295. The surveyor is allowed the actual cost of hire of men, provided their number and rate of pay is not in excess of what is permitted by his instructions.

296. For the transport of himself and party, and miscellaneous expenditure (not including meals, board, hotel expenses, camp equipage and stationery), the surveyor is allowed actual expenses supported by vouchers, provided they do not exceed what is allowed by his instructions. Requisitions for railway tickets are furnished to him, and he is expected to obtain transportation at the lowest rate after inquiry from the ticket agents. Return tickets or excursion tickets must be used whenever practicable, or limited tickets when they answer the purpose as well as unlimited tickets.

297. The items chargeable to transport account are: horses, horseshoes, horseshoe nails, horseshoeing tools, horse medicine, oil for flies, buckboard, buckboard cover, castor oil, carts or wagons, covers, cart wrench, bolts, screws, nails, wire, sets of harness, saddles, saddle cloth, nose bags, hobbles, tethering ropes or chains, logging chain, horse bells, pail for watering horses, oats and horse keeping, leather, rivets and burrs, buckles, snaps, hemp and wax for harness repairs, harness oil, axle grease, pack saddles, pack blankets, pack boxes with sling ropes and binding ropes (when required), pack straps (when required), also all material and charges for repairing transport. Horse-shoeing tools include hammer, rasp and crooked knife.

298. The surveyor in charge of a survey party is allowed a special ration allowance of one dollar a day for the party, such allowance to be paid as long as the surveyor remains in the field. He is further allowed an ordinary ration allowance of fifty-five cents a day for himself and every member of his party while in the field.

299. For meals, board and hotel expenses of himself and party, the surveyor is allowed, in addition to the ration

allowance, a sum of forty cents a day for himself and four cents a day for every other member of his party while in the field.

300. Camp equipage must be owned and furnished by the surveyor. For its use, he is allowed while in the field forty cents a day for himself and six cents a day for every other member of the party.

301. Camp equipage comprises the following articles:—Tents, cooking utensils, dishes, plates, forks, knives, candles, lanterns, lamp oil, soap, bags, towelling, stoves, blankets, robes, axes, brush hooks, spades, picks, scribing irons, grindstones, whetstones, scythes, chain pins, surveying pickets, boxes for instruments and other purposes except pack boxes for pack horse equipment, and all tools required to keep the outfit in repair excepting horseshoeing tools.

Medicines and medical expenses, otherwise than provided by clause 294, are not allowed.

302. When an assistant is regularly appointed as such by the Minister of the Interior, the board and camp equipage allowance for him are twenty-five cents and ten cents a day, respectively.

303. A sum of ten dollars is allowed for stationery.

304. While engaged at office work preparing returns, the surveyor is allowed one dollar a day for living expenses, in addition to his daily salary.

305. In special cases, when it is considered that any of the regulations respecting rations, board, camp equipage or stationery is not suitable, the surveyor may be allowed actual expenses supported by vouchers.

306. The surveyor receives with his instructions such an advance on account of his survey as appears necessary for procuring his outfit and supplies. Subsequent advances are made on receipt of a certified statement on the proper form (form G), exhibiting in detail the payments made out of former advances and those which are to be made out of the amount applied for. Twenty per cent. of his salary is retained until his accounts are finally closed.

307. In closing operations for the season, the surveyor must observe the following rules:—

(a) The horses and transport outfit must be disposed of in accordance with instructions previously obtained from the Department.

When a surveyor is instructed to winter his horses, and the name of the person or persons with whom they are to be wintered is not specified, the surveyor is expected to select some responsible person who is willing and has the proper facilities to perform the service. Nothing is to be paid for any horse that dies before being handed over to the Department in the spring. This condition is to be embodied in the contract, together with such other provisions as may seem necessary for ensuring that the horses will be properly cared for. Should a horse not be fit for another season's work or be in such a condition that the contractor will not run the risk of taking charge of it, such horse is to be sold. If a surveyor winters a horse which cannot reasonably be expected to give another full season's work, the cost of wintering such horse will be charged to the surveyor.

A statement of disposal of outfit on the form supplied and the agreement for wintering the horses and outfit must be furnished at the end of the season.

(b) When a surveyor is instructed to store his outfit he is expected to store all articles in one place as far as practicable. The storing of articles at various points throughout the country gives considerable trouble to the Department. Articles not serviceable for another season's operations are to be sold.

(c) In addition to the statement of disposal of transport outfit, a statement must be furnished on the form supplied showing the number of iron posts of each kind received and used during the year and the disposal of unused posts.

(d) In order to facilitate work in the Department in making preparation for the following season's surveys, the surveyor must, as soon as possible after closing operations, send in a statement of all work for which he had instructions during the season and which remains unfinished. Sketches and other information sent to the surveyor in connection with uncompleted surveys are to be returned to the Department.

308. The accounts and vouchers must be rendered in duplicate. The original and duplicate must be exactly alike in all respects and must be made up in separate bundles. Each bundle consists of:—

Form A.—Account of personal services and allowances.

Form B.—Pay-list of party showing the date of engagement and discharge of each man, his occupation and rate of pay, and the number of rations for the party. It must be signed by each payee or his receipt attached.

Asking a member of a survey party to sign the pay-list or any person to sign a voucher or receipt, with the amount paid left blank to be filled in later, is a grave irregularity, and will under no circumstances be tolerated. No change must be made nor anything inserted on a receipt, beyond the serial number, after it has been signed by the payee and witness. If the pay-list is not available when wages are being paid or if for any other reason it is not convenient to fill in the blanks of the pay-list, an ordinary receipt may be taken from the payee and attached to the pay-list. Any person signing the pay-list or a receipt as a witness must be present and see that the amount entered is actually being paid. This rule will be strictly enforced.

Form C.—Transport expense account with vouchers duly numbered, accompanied by a separate and detailed statement of travelling expenses.

Form D.—Miscellaneous expense account.

Form E.—Statement of disposal of outfit showing the articles received and the disposal made thereof.

Form F.—Balance sheet showing on the credit side the gross amounts of personal services, pay-list, transport and miscellaneous accounts and stationery allowance, and on the debit side the payments received on account of the survey.

Each account must have its vouchers attached and statements of sales, if any, attested by the auctioneer or purchasers.

The vouchers must give the details of the articles purchased with the price of each.

The item of stationery, for which a specific amount is allowed, is charged in one lump sum, without details or vouchers.

309. The following statutory declaration is to be made to the accounts:—

I, A. B., Dominion Land Surveyor, do solemnly declare that this account is correct, and I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath, and by virtue of the Canada Evidence Act.

310. A diary showing the employment of every day in the field, is to be furnished.

CONTRACT SURVEYS.

311. The subdivision of townships is made according to law at certain rates per mile.

312. Section lines are paid for at the rate of three dollars and fifty cents a mile for each mile of line surveyed.

313. A further payment at the rate of fifty cents a chain up to ten chains in a section side, is made for opening, cutting and blazing the line through woods, windfalls, underbrush, or heavy scrub.

314. Any opening, cutting and blazing of the line in excess of ten chains in a section side is paid for at the rate of twenty-five cents a chain. If the mileage charged for by the contractor for opening, cutting and blazing of lines exceeds that reported by the Inspector of Surveys, the contractor's account is reduced accordingly, the deduction being applied over the whole contract. No deduction, however, is made if the contractor's charge does not differ from the Inspector's by more than five per cent.

315. For the interpretation of Clauses 313 and 314, a section line means the distance between two monuments at section corners or the places assigned to such corners, and this distance may include a road allowance.

316. No payment is made under the provisions of Clauses 313 and 314, where the line could have been measured without opening and cutting. A strict interpretation is given to this clause, and the field notes must show every opening of half a chain or more where no cutting was necessary in order to measure the line.

317. The part of a line chained across a marsh or other body of water, except on the ice, or measured across water by means of a triangulation, is up to half a mile, paid for as opening through woods when the body of water is surrounded by continuous woods. When such measurement exceeds a mile in length, one half the distance is paid for as opening through woods. Distances measured by means of improper triangles are not paid for.

318. When the side of a section, exclusive of road allowance, is longer than ninety chains or shorter than seventy chains, the number of chains of opening or cutting which

may be paid for at the rate of fifty cents a chain, is increased or reduced in proportion to the length of the section side.

319. Only the lines actually run and marked in the field are paid for. Nothing is allowed for random and trial lines, bases of triangles and offsets. A single payment only is made for the north and south boundaries of townships, although they must always be run twice under the provisions of the Manual of Survey.

320. A further payment at the rate of three dollars a mile is made for section lines surveyed over rough or hilly country. A section side is classed as rough or hilly when the field notes show that it crosses a ravine not less than one hundred feet deep or two ravines not less than fifty feet deep, or that the difference of level between two points of the line not more than a half mile apart exceeds two hundred feet, the depths or heights being measured by aneroid barometer. In case the corner of a section falls in the ravine or on the side of a hill, payment is made for either of the adjoining sections, but not for both.

321. A further payment at the rate of four dollars a mile may be made upon a report of the Inspector of Surveys, concurred in by the Surveyor General, stating that the survey presented unusual difficulties on account of large rivers flowing through deep valleys with the surrounding country broken by gullies; or on account of exceptionally extensive and deep marshes. This payment is not made for difficulties other than those mentioned or for marshes which have been crossed on the ice. Payment, if made, is for the number of miles recommended in the Inspector's report.

322. A further payment at the rate of four dollars a mile is made for surveying the outlines of a township when such outlines are included in a subdivision survey contract, but such payment is not made for resurveying or retracing lines previously surveyed.

323. Section lines resurveyed or retraced by direction of the Surveyor General, or under the provisions of the Manual of Survey, are paid for at the same rate as original section lines in the subdivision of a township, but no payment is made for the part of an outline chained under the provisions of the Manual of Survey for testing the chainage. Lines resurveyed or retraced without authority are not paid for. The fact that a line is obliterated or

that a monument cannot be found is not to be deemed sufficient authority to resurvey or retrace the line.

324. A further payment at the rate of forty cents a pit in prairie, and sixty cents a pit in woods, is made for erecting a boundary monument, such payment to cover the cost of planting and marking the post, building the mound and otherwise completing the monument. A witness trench is paid for as four pits. A stone mound is paid for as four pits in woods. A long quarter section post planted in a marsh is paid for as two prairie pits.

325. Traverses of lakes and rivers and connecting traverses are paid for at the rate of twelve dollars a mile. For traverses of lakes and rivers, the distance paid for is measured along the bank of the lake or river from every point fixed by the survey in a straight line to the next point. When both banks of a river are located from a single traverse line the full traverse rate of twelve dollars a mile is paid for one bank only and the additional work for locating the other bank is paid for at the rate of four dollars a mile.

Nothing is paid for offsets, but one dollar is deducted for every offset short of the number required by the Manual of Survey.

One dollar is paid for every statutory declaration of a settler.

326. A payment at such rate as the Surveyor General may allow, but not exceeding two dollars a mile of township outline or section line surveyed, may be made for the determination of the bearings of the lines of the survey.

327. The above allowances are to cover the cost of preparing the returns of the survey.

328. A surveyor requiring iron posts for use on the surveys of Dominion lands must obtain from the Surveyor General an order for the delivery of the posts. They are supplied free of cost at Winnipeg and at every other place where they are kept in stock. Posts not used, if not returned to stores, are charged to the surveyor at forty cents each.

329. A deduction at the rate of six cents a cubic foot for deficiency in the size of the pits in excess of one and one-half cubic feet in a pit is made from the payments to survey contractors. This deduction is averaged on the monuments examined by the Inspector and is applied to the whole contract. When the deduction, calculated as above,

exceeds thirty per cent. of the amount allowed for erecting the monuments, or when the Inspector reports that the monuments are too deficient to be accepted, the contractor is required to repair and correct them according to the standard required by the Manual of Survey.

330. The lines embraced in any survey under contract must be surveyed by the surveyor in person; no payment is made on such contract work if otherwise performed.

331. To be eligible for employment as a survey contractor, a surveyor must own, in addition to the standard measure required by section 35 of the Dominion Lands Surveys Act, a transit theodolite with a telescope of not less than one and one-half inches aperture, a sidereal watch, a surveying aneroid barometer, a clinometer and a sixty-six foot steel band chain.

These instruments must be of approved patterns and in good order.

A spare transit theodolite is recommended.

The aneroid barometer must be compared with a standard barometer at every convenient opportunity.

The instruments of a contractor are subject to inspection by the Inspector of Surveys at any time.

332. Upon receiving a contract, a surveyor is required to enter into a bond jointly with two sureties each in a sum equal to the estimated amount of the contract, for the due and faithful fulfilment thereof.

333. On receipt of the bond properly executed, an advance not exceeding fifteen hundred dollars on account of the contract is made to the surveyor, and the advance is made in such a manner as the Surveyor General considers advisable.

334. Seventy-five per cent. on account of the work performed is, after deducting advances, paid to the contractor or placed to his credit as he may direct. Such payments are made on receipt of progress accounts accompanied by sketches of the work.

335. A rigid inspection of the work is made. On receipt of a report from the Inspector of Surveys, that the survey is being improperly executed, payments on account of the contract are stopped, and steps are taken to recover the advances from the contractor and from his sureties, but when the deficiencies are of such a nature that they can be remedied by the contractor, he may be warned to

correct them, and payments on account may be continued for a reasonable time.

GENERAL DIRECTIONS.

336. All payments are made by cheques issued in favour of the payee or in favour of a bank to be placed to his credit. It is useless to ask bank bills or post-office orders; they cannot be sent.

A payment may be divided into several cheques, if desired.

An application for a payment must contain explicit directions as to whether a credit or a cheque is wanted, and where it is to be sent.

No money is placed to the credit of a third party without a power of attorney. Powers of attorney must be made on the official forms, supplied on application, and must conform to the regulations of the Treasury Board.

337. It is of the utmost importance that the Department should be kept well informed of the surveyor's address. Particular attention is called to the matter as the most vexatious delays, due to this cause, are continually occurring and the surveyor is the first to suffer therefrom. A surveyor is requested when writing to the head office to enter on the first page of his letter in the spaces provided for the purpose on the official form, his Post Office address, his Telegraph address and his Express Office address, and also the file number quoted in previous official correspondence relative to the same subject, if any.

338. No draft on the Department is accepted. Powers of attorney must be made on the official forms, supplied on application, and must conform to the regulations of the Treasury Board. No money is placed to the credit of third parties without such power of attorney.

Credits may be telegraphed through banks having agencies in Ottawa, but only after receipt of the sketches.

The banks with branches in Ottawa are:—

Bank of British North America,
Bank of Montreal,
Bank of Nova Scotia,
Bank of Ottawa,
Bank of Toronto,
Canadian Bank of Commerce,

Dominion Bank,
Imperial Bank of Canada,
La Banque Nationale,
La Banque Provinciale,
Merchants Bank of Canada,
Molsons Bank,
Northern Crown Bank,
Quebec Bank,
Royal Bank of Canada,
Standard Bank of Canada,
Union Bank of Canada,

339. Iron posts are stored at Winnipeg, Saskatoon and Edmonton. A small stock is kept in British Columbia for local needs.

In preparing a surveyor's instructions, an estimate is made of the number of iron posts required for the surveys covered by the instructions. When the surveyor can reach the storekeeper readily, either by mail or by telegraph, an order for the posts is enclosed with the instructions and the surveyor is requested to forward it to the storekeeper together with shipping directions. If there is a probability that this method may involve too much delay in the delivery of the posts, an order is sent direct from the head office to the storekeeper to deliver or ship the posts on receipt of shipping directions from the surveyor, and the latter is notified to that effect. He must then communicate with the storekeeper and give him shipping directions.

If more posts than are covered by the order are wanted, the surveyor must apply to the head office stating the additional number wanted and whether the order is to be sent to himself or to the storekeeper direct. When the request does not state where the order is to be sent, it is sent to the surveyor or to the storekeeper, as is considered best under the circumstances.

Unless in exceptional cases, shipping directions will not be transmitted by the head office to the storekeeper as there is a risk of mistakes in transmission and nothing is gained by the surveyor in sending his directions to the head office instead of to the storekeeper.

340. The following forms are supplied free of cost upon a requisition stating the number of each kind wanted:—

Township progress sketch, 1st and 2nd systems of survey, 80 chains to one inch.

Township progress sketch, 3rd system of survey, 80 chains to one inch.

Field book for field use, 56 section lines.

Field book for field use, 72 section lines.

Field book for final returns, 54 section lines.

Field book for final returns, 72 section lines.

Field book for miscellaneous surveys.

Field book for block surveys.

Record of chronometer errors and rates.

Statutory declaration of occupation.

Oath of chain bearer.

Articles of agreement for the engagement of members of party.

Letter pad with official letter head.

Letter pad without official letter head.

Progress account for subdivision survey contract.

Timber reports.

Astronomical Field Tables.

Azimuth observation forms.

Table XIX, printed on cardboard for the pocket.

Table XX, printed on cardboard for the pocket.

Accounts for surveys paid by the day:

Form A.—Personal services and allowances.

Form B.—Pay-list.

Form C.—Transport expense.

Form D.—Miscellaneous expense.

Form E.—Statement of disposal of outfit.

Form F.—Balance sheet.

Form G.—Estimate of cost of survey.

Official diary.

341. In his requisition the surveyor must state what forms he wants and how many. Giving this information entails no work on his part beyond writing it, while the office staff cannot find it without a long search through the records. A surveyor cannot reasonably expect that the officers of the Department will undertake this unnecessary work for no other purpose than to save him the trouble of writing a few lines. Any surveyor making a requisition in indefinite terms, such as "the forms which I require for preparing my returns" or some such expression will receive no other reply than a reference to this paragraph of the Manual of Survey. The same remarks apply to requisitions for iron posts and to other requests addressed to officers of the Department. Every request should always state fully and explicitly what is wanted.

APPENDICES.

APPENDIX A.

7-8 EDWARD VII.

CHAP. 21.

An Act respecting the Surveys of the Public Lands of the Dominion and the Surveyors entitled to make such surveys.

(Assented to 17th March, 1908.)

His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

SHORT TITLE.

1. This Act may be cited as *The Dominion Lands Surveys Act*.

INTERPRETATION.

2. In this Act, unless the context otherwise requires,—

(a) "Minister" means the Minister of the Interior;

(b) "Surveyor General" means the officer of the Department of the Interior who bears that designation and has, subject to the direction of the Minister, the management of surveys of Dominion lands, or the chief clerk performing his duties for the time being;

(c) "Board" means the Board of Examiners for Dominion Land Surveyors;

(d) "Dominion land surveyor" means a surveyor authorized to survey Dominion lands under the provisions of this Act;

(e) "Dominion lands" means any lands to which *The Dominion Lands Act* applies;

(f) "monument" means a post, stake, peg, mound, pit or trench, or anything used to mark a boundary corner.

APPLICATION OF ACT.

Application. **3.** This Act applies to the public lands of the Dominion to which *The Dominion Lands Act* applies.

POWERS OF THE GOVERNOR IN COUNCIL.

Cases unprovided for, etc.

4. The Governor in Council may—

(a) make such orders as are deemed necessary to carry out the provisions of this Act, according to their true intent, or to meet any cases which arise, and for which no provision is made in this Act; and further make and declare any regulations which are considered necessary to give the provisions in this section full effect;

(b) impose penalties not exceeding two hundred dollars, or not exceeding three months' imprisonment, for violation of any regulations under this Act;

(c) provide that any statement or return required to be made by such regulations shall be verified on oath.

Orders and regulations must be published.

5. Every order or regulation made by the Governor in Council by virtue of the provisions of this Act shall, unless herein otherwise specially provided, have force and effect only after it has been published for four successive weeks in *The Canada Gazette*; and all such orders or regulations shall be laid before both Houses of Parliament within the first fifteen days of the session next after the date thereof.

And laid before Parliament.

Fees.

6. The Governor in Council may establish a tariff of fees to be charged by the Minister for all copies of maps, township plans, field notes and other records; and all fees received under such tariff shall form part of the revenue from Dominion lands.

ADMINISTRATION.

7. The Minister shall have the administration, direction and control of the surveys of Dominion lands. Administration.

SURVEYORS.

8. No person shall act as surveyor of any lands to which this Act applies unless he has become qualified to do so under the provisions hereinafter set forth or was, before the fourteenth day of April, 1872, duly qualified by certificate, diploma or commission, to survey Crown lands in some one of the provinces of Canada. Qualified to survey.

9. There shall be a Board of Examiners for the examination of candidates for admission as articulated pupils, for commissions as Dominion land surveyors or for certificates as Dominion topographical surveyors, which shall consist of the Surveyor General and two Dominion topographical surveyors appointed from time to time by the Governor in Council. Board of examiners.

2. The Board shall meet annually for such examination on the second Monday in the month of February, and the Minister may require the Board to meet and to hold examinations at such other times and places as are necessary. Dates of examinations.

3. Notice of such annual and other meetings shall be given in the *The Canada Gazette*. Notice of meetings.

10. Every member of the Board shall take an oath of office, in the form A in the schedule to this Act, which may be administered by a judge of any court in Canada. Oath of office.

11. The Minister shall, from time to time, appoint a fit and proper person to be secretary of the Board who shall keep a record of its proceedings. Secretary.

12. The Minister may cause examinations of candidates for admission as articulated pupils or for commissions as Dominion land surveyors to be held at such times and places as he directs, by one of the members of the Board or by a special examiner who is a Dominion land surveyor, and is appointed thereto by the Governor in Council. Examinations.

Notice of. 2. Notice of any such examinations shall be given for four consecutive weeks in *The Canada Gazette*.

Rules for. 3. Such examinations shall be subject to any rules and regulations made by the Board in that behalf, and shall have no effect unless they are conducted in accordance with such rules and regulations, and are subsequently approved by the Board.

Filling vacancies on Board *pro tem*.

13. The Governor in Council may appoint one or more Dominion topographical surveyors for the purpose of filling the place of any member or members of the Board who may, through illness or other cause, be unable to attend any meeting of the Board.

Secretary to be notified by candidate for examination.

14. Every person who desires to be examined by the Board shall notify the secretary in writing at least one month previous to the meeting of the Board at which the examination is to take place, and shall, with such notice, transmit the fee hereinafter prescribed.

Examination for admission as articled pupil.

15. No person shall be admitted as an articled pupil with any Dominion land surveyor unless he has previously passed an examination before the Board, or before one of the members thereof, or before a special examiner as hereinbefore provided, as to his knowledge of arithmetic, algebra, including quadratic equations, plane geometry, plane trigonometry, spherical trigonometry as far as the solution of triangles, the mensuration of superficies, and the use of logarithms, and in penmanship and orthography, and has obtained from the Board a certificate of having passed such examination.

Conditions precedent to examination for commission.

16. Except as hereinafter provided, no pupil shall be entitled to be examined for a commission as a Dominion land surveyor unless he has previously served regularly and faithfully for and during the period of three years, under articles in form B in the schedule to this Act, as pupil of a Dominion land surveyor, and unless he produces an affidavit from such surveyor in form C in the schedule to this Act, together with his own affida-

vit in form D in the schedule to this Act, that he has so served; or, if for some good and valid reason the surveyor's affidavit cannot be produced, unless he produces such evidence of service as the Board requires: Provided that such three years' service shall include at least twelve months' actual practice in the field.

17. Any Dominion land surveyor may, by an instrument in writing, in form E in the schedule to this Act, transfer a pupil with his own consent, to any other Dominion land surveyor, with whom such pupil may serve the remainder of his term; but such pupil shall not be entitled to examination unless he produces the affidavits of both surveyors in form C in the schedule to this Act, together with his own affidavit in form D in the schedule to this Act, that he has so served: Provided that, if such pupil is unable to obtain the surveyors' affidavits, or either of them, as aforesaid, the Board may accept evidence of service, in such form as it sees fit.

Transfer of pupil.

18. If an articled pupil is, at the time of his entering into articles or of his transfer, of the full age of twenty-one years, form B or E may be so varied as to provide for the articles being entered into or the transfer made on the responsibility of such articled pupil himself without reference to the consent and approbation of his father or of any other person.

Variation of form when pupil is of age.

19. If any Dominion land surveyor dies, or leaves Canada, or is suspended, or has had his commission as a surveyor cancelled, his pupil may complete his term under articles, as aforesaid, with any other Dominion land surveyor.

Completion of term with another surveyor.

20. Articled pupils shall transmit to the secretary of the Board, by registered letter, within three months of the date of their articles, a duplicate thereof, together with a fee of two dollars for filing such duplicate.

Duplicate of articles and of transfers to be transmitted to Board.

2. They shall also transmit to the secretary by registered letter, within three months of the transfer, if any, of their articles, a duplicate of such transfer.

3. The secretary shall acknowledge the receipt of such duplicates and shall file and keep them with the records of the Board.

4. In any case in which a duplicate of the articles of a pupil or of the transfer of his articles is not transmitted to the secretary of the Board within a period of three months, as aforesaid, the time of service of the pupil under the said articles or transfer shall count from the date of the receipt of the duplicate thereof by the secretary.

As to provincial surveyors.

21. Every person who upon or after the fourteenth day of April, 1872, became, or hereafter becomes, by certificate, diploma, or commission, qualified to survey lands in any province of Canada and who is still so qualified, and who, in order to become so qualified, has—

- (a) served a term under articles to a surveyor, similar to the term prescribed by this Act, and
- (b) passed examinations before the Board of Examiners of the province for which he is so qualified, in the subjects prescribed by this Act for the examination of candidates for admission as articulated pupils and for commissions as Dominion land surveyors,

shall be entitled to obtain a commission as a Dominion land surveyor without further service and without being subjected to any examination other than with respect to the system of survey of Dominion lands.

Further service and examination if necessary.

2. If, in the opinion of the Board,—

- (a) the service of any person so qualified who applies for a commission is not equivalent to that required by this Act for pupils of Dominion land surveyors, or—
- (b) the subjects of the examination passed by him for certificate, diploma, or commission as a surveyor, in the province for which he is qualified, are not sufficiently similar to those by this Act prescribed for qualification as a Dominion land surveyor

the Board may, in its discretion, require the candidate to complete such further term of service or practice in surveying and may examine him in such of the subjects prescribed by this Act as appear necessary.

22. Every graduate in surveying of the Royal Military College of Canada, and every person who has followed a regular course of study in all the branches of education required by this Act for admission as a Dominion land surveyor, for at least two years, in any college or university where a complete course of theoretical and practical instruction in surveying is organized, and who, after examination, has thereupon received from such college or university a diploma or certificate, shall be exempt from serving three years as aforesaid, and shall be entitled to examination for a commission after being admitted upon examination as aforesaid as an articulated pupil and serving one year under articles with a Dominion land surveyor, including six months' actual practice with him in the field, on producing an affidavit from the said surveyor in said form C, together with his own affidavit in said form D, that he has served for one year as herein provided; but it shall rest with the Board to decide whether the course of instruction in such college or university meets the requirements of this section.

As to graduates of Royal Military College and other graduates.

23. Except as in this Act otherwise provided, no person shall receive a commission from the Board authorizing him to practise as a Dominion land surveyor until he has complied with the general requirements of this Act in that behalf, nor until he has attained the full age of twenty-one years and has passed a satisfactory examination before the Board or before a member thereof, or before a special examiner as hereinbefore provided, in the following subjects:—

Examination for commission as a surveyor.

- (a) plane and solid geometry;
- (b) spherical trigonometry, as far as the solution of triangles;
- (c) the use of logarithms;

(d) the measurement of areas, including their calculation by latitude and departure;

(e) the dividing or laying off of land;

(f) the elements of astronomy and their practical application in the determination of latitude, longitude, time and azimuth:

Proviso.

Provided that no commission shall issue unless the Board is satisfied that the person is well informed as to the system of survey prescribed by this Act; that he is conversant with the Manual of instructions for the survey of Dominion lands issued from time to time, under the authority of the Minister, by the Surveyor General for the guidance of Dominion land surveyors; and that his practical knowledge is such that—

(a) he can properly conduct surveying operations and report thereon;

(b) he can correctly keep field notes and plot and represent them on plans of survey;

(c) he can describe land by metes and bounds for title;

(d) he can properly adjust and use ordinary surveying instruments.

Examine candidate on oath.

24. The Board may examine any candidate on oath, which oath may be administered by any one of the examiners, as to his actual practice in the field or as to any matter relating to his examination.

Issue of commission.

25. Every person who qualifies in the manner prescribed by this Act shall receive a commission from the Board in form F in the schedule to this Act, constituting him a Dominion land surveyor; Provided that he shall, jointly and severally with two sufficient securities to the satisfaction of the Board, enter into a bond to the Crown in the sum of one thousand dollars, conditioned for the due and faithful performance of his duties as a surveyor, and that he shall take and subscribe before a judge of any court in Canada, or before any member of the Board who is hereby authorized to administer it, the oath of allegiance and an oath in form G in the schedule to this Act.

Security and oath.

2. The commission shall be registered in the office of the Registrar General of Canada; the oaths shall be deposited in the office of the Surveyor General; and the bond shall be deposited and kept in the manner prescribed by, and shall be subject to the provisions of the Act respecting public officers, and shall enure to the benefit of any person who sustains damage by breach of any condition thereof.

Registering of commission.
Depositing of oath and bond and enuring of bond.

26. Any Dominion land surveyor, who has previously given the notice of examination required by this Act may present himself for examination as to his knowledge of the higher branches of surveying, qualifying him for the prosecution of extensive, governing, or topographical surveys, and geographic explorations; and a syllabus of the subjects of such examination shall be prepared from time to time by the Board and published in *The Canada Gazette* at least six months before the examination.

Examinations in higher branches.

27. Persons who pass the examinations provided for in the next preceding section shall receive a certificate to that effect from the Board, and shall be designated Dominion topographical surveyors.

Certificate as topographical surveyor.

28. The following fees shall be paid to the secretary of the Board:—

Fees.

(a) by each person, on giving notice of his desire for examination for admission as an articulated pupil, one dollar;

(b) by each candidate for such preliminary examination, ten dollars;

(c) for certificate of preliminary examination, two dollars;

(d) by each pupil, at the time of transmitting his indenture or articles, two dollars;

(e) by each applicant for examination for a commission as Dominion land surveyor or for a certificate as Dominion topographical surveyor, with his notice thereof, two dollars;

(f) by each applicant upon obtaining a commission, two dollars;

(g) for admission to practice after receiving a commission, twenty dollars;

(h) by each applicant who obtains a certificate as Dominion topographical surveyor, two dollars;

(i) for subsidiary standard of the Dominion measure of length, tested and stamped as hereinafter provided, eight dollars;

(j) for each subsequent testing of such subsidiary standard, two dollars;

Provided that the fees payable under paragraphs (b), (g) and (i) shall be deposited to the credit of the Receiver General on account of Dominion lands; and that the other fees payable under this section shall belong to the secretary.

Allowances to members of Board, secretary, and special examiners.

29. Every member of the Board who attends at the meetings thereof or who holds an examination, and every Dominion topographical surveyor who fills the place of an absent member shall receive seven dollars and fifty cents for each day's sitting; and every special examiner who holds an examination for admission as articled pupils or for commissions as Dominion land surveyors, and the secretary of the Board, shall receive five dollars for each day's sitting; and in addition to such per diem allowance, there shall be paid the actual travelling and living expenses incurred by such member, surveyor, special examiner or secretary, and consequent upon such attendance or examination.

Suspension or cancellation of commissions.

30. The Board may suspend for such period as it deems meet, or may cancel, the commission or certificate of any Dominion land or topographical surveyor, or debar from surveying under this Act any provincial land surveyor authorized to act as a Dominion land surveyor under the provisions of this Act, whom it finds guilty of—

(a) gross negligence or corruption in the performance of his duties as a surveyor;

(b) certifying to false returns of a survey;

(c) certifying as his own surveys not made by himself; or,

(d) making survey without being in possession of a standard measure, as required by this Act;

Provided that the Board shall not suspend or cancel the commission or certificate of such surveyor, or debar any surveyor from surveying under this Act, unless he has, at least thirty days in advance of action by the Board, been notified by the secretary by registered letter, mailed to his last known address, of the charges against him, and been summoned to appear before the Board to make his defence, nor before having heard the evidence offered both in support of the charges and by the surveyor himself, or, in the event of his failure to appear, by a person appointed by the Board to act on his behalf.

31. The Surveyor General shall require every Dominion land surveyor, in addition to the oath by this Act required to be administered to him on receiving his commission as such, to take and subscribe an oath or make and subscribe an affirmation, on the return of his surveys of Dominion lands, that he has faithfully and correctly, and in his own proper person, executed such surveys in accordance with the provisions of this Act and the instructions of the Surveyor General; and, if it is proved before any court of competent jurisdiction, that such surveys, or any part thereof, have not been so executed, the Attorney General of Canada shall, upon the application of the Surveyor General immediately institute a suit upon the bond of such surveyor; and the institution of such suit shall operate as a lien on any property owned or held by such surveyor, or his sureties, at the time the suit is instituted.

Affidavit of correct and personal work.

Proceedings to be taken if false statement.

32. Every Dominion land surveyor shall keep exact and regular journals and field notes of all his surveys of Dominion lands, and shall file them in the order of time in which the surveys have been performed, and he shall give copies thereof to all persons concerned, when required so to do; and for so doing he shall be paid the sum of one dollar for each copy, if the number of words therein does not exceed four hundred; but if the number of words therein exceeds four

Surveyors' records.

hundred, he shall be paid ten cents additional for every hundred words over and above four hundred words.

Allowance to surveyors as witnesses.

33. Every Dominion land surveyor summoned to attend any court, civil or criminal, for the purpose of giving evidence in his professional capacity as a surveyor, shall be allowed five dollars for each day he so attends, in addition to his reasonable travelling and living expenses, to be taxed and paid in the manner by law provided, with regard to the payment of witnesses attending such court.

CHAIN BEARERS.

Chain bearers to be sworn.

34. Every chain bearer employed in the survey of Dominion lands, shall, before he commences his chaining or measuring, take an oath or affirmation that he will discharge such duty with exactness, according to the best of his judgment and ability, and render a true account of his chaining or measuring to the surveyor by whom he is employed; and any Dominion land surveyor may administer such oath or take such affirmation.

STANDARD OF MEASURE.

Measure of length.

35. The measure of length used in the surveys of Dominion lands shall be the Dominion measure of length defined by *The Weights and Measures Act*, and every Dominion land surveyor shall be in possession of a subsidiary standard thereof, which subsidiary standard, tested by the secretary of the Board under the supervision of the Surveyor General, and stamped as correct by the Surveyor General, shall be furnished to him by the secretary of the Board on payment of the fee fixed therefor by this Act; and notwithstanding any thing to the contrary in *The Weights and Measures Act*, such subsidiary standard shall not require any test, stamp, inspection or verification other than is required

Subsidiary standard.

by this act; and all Dominion land surveyors shall, from time to time, regulate and verify by such standard, the length of their chains and other instruments for measuring lengths; and the said standard measure shall be returned to the secretary of the Board as often as it requires to be tested again.

Verification.

EVIDENCE BEFORE SURVEYORS.

36. Every Dominion land surveyor acting in that capacity may examine witnesses on oath with respect to all matters relating to the survey of lands, and for better ascertaining the original corners or limits of any township, section, quarter section, legal or other authorized subdivision, lot, parcel or tract of land, and may administer such oath to every person whom he examines in relation to such matters.

Surveyors may examine under oath.

37. Whenever any Dominion land surveyor is in doubt as to the true corner boundary or limit of any township, section, quarter section, legal or other authorized subdivision, lot, parcel or tract of land which he is employed to survey, and has reason to believe that any person is possessed of any important information touching such corner, boundary or limit, or of any writing, plan or document tending to establish the true position of such corner, boundary or limit, and if such person does not willingly appear before, and be examined by, such surveyor, or does not willingly produce to him such writing, plan or document, such surveyor may apply to any justice of the peace for an ordinary subpoena *ad testificandum*, or a subpoena *duces tecum*, as the case requires, accompanying such application by an affidavit or solemn declaration made before the justice of the peace, as to the facts on which the application is founded; and such justice may issue a subpoena accordingly, commanding such person to appear before the surveyor at a time and place mentioned in the subpoena, and, if the case requires it, to bring with him any writing, plan or document mentioned or referred to therein.

Procedure for compelling attendance of persons who have information as to boundaries.

meridian, drawn northerly from the forty-ninth parallel of latitude at a point ten miles, or thereabouts, westerly from Pembina; and elsewhere in ranges numbered from such other initial meridians as the Minister orders to be established, which meridians shall be styled the second, the third, the fourth meridian, and so on, according to their order in number westward from the principal meridian.

Width of townships on base line.
Meridians.

44. Townships shall be given their prescribed width on the base line hereinafter mentioned; and the meridians between townships shall be drawn across such bases, northward and southward to the depth of two townships therefrom, that is to say, to the correction lines hereinafter mentioned.

Base lines.

45. The said forty-ninth parallel, or international boundary, shall be the first base line, or that for townships numbered one; the second base line, shall be between townships four and five; the third between townships eight and nine; the fourth between townships twelve and thirteen; the fifth between townships sixteen and seventeen; and so on northerly, in regular succession.

Correction lines.

46. The correction lines, or those upon which the jog resulting from the convergence of meridians shall be allowed, shall be those lines running east and west between townships and midway between the bases, which lines are, the line between townships two and three, that between townships six and seven, and between townships ten and eleven, and so on.

Division of sections.

47. Each section shall be divided into quarter sections of one hundred and sixty acres, more or less, subject to the provisions hereinafter contained.

Error.

48. The north and south error in closing on the correction lines from the north and south shall be allowed in the ranges of quarter sections adjoining, and north or south respectively of the said correction lines; except in the case of the north and south error in those townships

between the first and second base lines, which error is to be left in the last quarter section adjoining the said first base line.

49. In the survey of a township, the east and west deficiency or surplus shall be allowed in the range of quarter sections adjoining the west boundary of the township; but the Governor in Council may order such deficiency or surplus to be equally distributed among all the quarter sections involved.

Deficiency or surplus.

50. The dimensions and area of irregular quarter sections or other parcels of land shall, in all cases, be returned by the surveyor at their actual measurements and contents: Provided that in cases in which road allowances are not between but through sections the area reserved for such road allowances shall not be included in the area returned for a quarter section, or other parcel of land.

Irregular quarter sections.

51. Except as hereinafter provided, only a single row of monuments to indicate the corners of townships, sections or quarter sections, shall be placed on any survey line thereof; such monuments shall, on north and south lines, be placed in the west limit of the road allowances, and on the east and west lines, in the south limit of road allowances, and in all cases shall fix and govern the position of the boundary corner between the adjoining townships, sections, or quarter sections, on the opposite side of the road allowance.

Monuments to indicate corners.

52. In the case of township, section and quarter section corners on correction lines, monuments shall, in all cases, be placed and marked independently for the townships on each side; and when a road allowance is laid out along such a line, the monuments shall be placed in the limit of the road lying alongside the lands which they are intended to define.

Corners in correction line.

53. The township subdivision surveys of Dominion lands, according to the system above described, shall be performed under contract, either at a rate per township, per mile, or per

Surveying to be by contract or tender.

Exception.

acre, to be fixed, from time to time, by the Governor in Council, or by competitive tender, as the Governor in Council may, from time to time, direct; Provided that in special cases, where circumstances render it advisable, the Governor in Council may order the survey of a township or townships to be otherwise performed.

Legal subdivisions.

54. To facilitate the description for letters patent of less than a quarter section, every section shall be taken to be divided into quarter quarter sections, each of forty acres more or less, which shall be styled legal subdivisions, and shall be numbered as shown in the following diagram:—

				N.								
				13	14	15	16					
				12	11	10	9					
W.					5	6	7	8	E.			
				4	3	2	1					
				S.								

Special provisions as to survey of certain lands.

55. Notwithstanding anything in this Act contained, the Minister may direct—

(a) That lands bordering on any river, water course or lake, or on a public road, be surveyed, laid out and divided into lots of any certain frontage or depth, in such manner and with such roads as appears desirable;

(b) That lands be surveyed, laid out and divided into town or village lots, with such streets, lanes, places, squares and commons as are considered necessary;

(c) That roads, not exceeding sixty-six feet in width, be surveyed and laid out where such roads appear to be required;

(d) That lands in the Yukon Territory and in remote parts of the unorganized portions of the provinces of Manitoba, Saskatchewan and

Alberta and the Northwest Territories, be surveyed, laid out and divided into lots of such size and shape as may be found advisable;

(e) That lands in mountainous regions where the ordinary mode of survey is impracticable, be laid out into townships, sections, quarter sections and legal or other authorized subdivisions by fixing the corners of such townships, sections, quarter sections, and legal or other authorized subdivisions by reference to points determined by astronomical observations, or by triangulation or other geodetic process;

(f) That townships, sections, quarter sections, legal or other authorized subdivisions, settlement or river lots, town or village lots, or other lots or parcels of land, surveyed or laid out under the authority of this section, be described for patent by numbers according to plans of record, or by metes and bounds, or by both, as seems expedient.

OFFICIAL PLANS OF DOMINION LANDS.

56. Plans of Dominion lands surveyed or resurveyed under the provisions of this Act shall be plotted from the surveyors' field notes under the direction of the Surveyor General; and such plans shall show the direction and length of the boundaries, the nature and position of the boundary monuments and the areas of the quarter sections or other parcels of land laid out.

2. The confirmation of any such plan by the Surveyor General shall be held to be a confirmation of the survey or resurvey as the case may be, and the confirmed plan shall be the official plan; but no survey or resurvey of Dominion lands shall be confirmed unless made in conformity with the provisions of this Act.

3. No land shall be held to be surveyed, or resurveyed, until the official plan of the survey or resurvey has been confirmed by the Surveyor General.

Description of plans.

Confirmation of plans.

When lands are deemed surveyed.

Correction
of plans.

4. Where any plan of Dominion lands of record in the Department of the Interior is found to have been improperly or incorrectly plotted from the field notes of the survey, or where any omissions or clerical error or other defect is found in the plan, the Surveyor General may cause a new plan to be plotted from the field notes of the survey or a new plan to be made showing such omissions or error or defect corrected, and such new plan shall, after confirmation by the Surveyor General, become the official plan of the survey and shall be used for all purposes instead of the old plan: Provided that nothing in this section shall affect any rights claimed or set up under the old plan prior to the date of the confirmation of the new plan, and that all transactions prior to that date shall remain in force as if the new plan did not exist.

RESURVEYS.

Resurvey of
land disposed
of.

57. Wherever through an error in the survey, a boundary monument is not at the place where it should have been erected, the Minister may order that such monument be removed and that a new monument be erected at the proper place; but no monument defining the boundary of land for which letters patent have issued shall be displaced without the consent in writing of the owner thereof; nor shall a monument defining the boundary of land held as a homestead or under lease, license or agreement of sale be displaced without the consent in writing of the holder thereof, unless the error in the position of the monument is at least five chains, in which event the Minister may, without the consent of the holder, authorize the correction of the error, but the person or persons acquiring through such correction any improvements on the land shall be required to pay the owner of such improvements therefor such an amount as may be fixed by the Minister, or, in case either party is dissatisfied with the finding of the Minister,

Arbitration
proceedings.

such an amount as is determined by the award of a single arbitrator if the parties concur in his appointment, or, if not, by the award of three arbitrators, one to be named by each of the parties, and the third by the two so named: Provided, in the latter case, that, if either party refuses or neglects to name an arbitrator within one month after being notified so to do, an arbitrator may be named on his behalf by the agent of Dominion lands of the district.

2. The award of the single arbitrator or of a majority of the three arbitrators shall be final, and the proceedings upon the arbitration shall be governed by the laws in force in the province in that behalf.

58. The Minister may order a resurvey on receipt of a petition from owners of lands or from persons holding lands as homesteads or under lease, licence or agreement of sale, representing that part or the whole of the monuments of the original survey have disappeared and cannot be found.

2. Before commencing any such resurvey, public notice thereof shall be given once a week for a period of four weeks in *The Canada Gazette* and in some newspaper circulating in the neighbourhood of the lands to be resurveyed.

3. Any person who claims to know the position of one or more of the survey monuments defining the lands to be resurveyed, or to be in possession of information whereby the position of such monument or monuments can be established, may give notice thereof by registered letter addressed to the Minister before the commencement of the resurvey.

4. Before reestablishing any monument with respect to which notice has been given, the surveyor shall, by registered letter, request the person who has given such notice to appear before him at a time and place specified and to show the position of the said monument or to produce the evidence in his possession with regard thereto.

Finding of original monument after resurvey.

5. Notwithstanding anything in this Act contained, any monument reestablished under the provisions of this section to replace a lost monument shall define the boundary line which such monument is intended to mark, even though the monument of the original survey be subsequently found or its position be proved by other evidence.

Resurvey of land undisposed of.

Resurvey to have effect of original.

59. Undisposed of Dominion lands may be resurveyed when necessary.

60. Any resurvey of lands authorized by the Minister under the provisions of this Act, whether for the purpose of removing a monument wrongly placed through an error in a previous survey and erecting a new monument at the proper place, or for the purpose of reestablishing the lines of a previous survey, shall, when confirmed by the Surveyor General, become, and it is hereby declared to be, the original survey of the said lands, and upon such confirmation the boundaries established by the previous survey shall cease to have any force or effect, and any confirmed plan or plans plotted from the field notes of the previous survey shall cease to be the official plan or plans of the said lands.

SURVEY OF AUTHORIZED SUBDIVISIONS.

Establishing line between sections.

61. When it is necessary for a Dominion land surveyor to establish the division line between two sections, he shall effect this by connecting, by a straight line, the opposite original section corners, if they exist, and if not, by similarly connecting points established in renewal thereof, in accordance with the provisions of this Act relating to lost corners, giving, in either case, the quarter sections involved an equal breadth.

Laying out half or quarter sections.

2. In laying out a half section or a quarter section he shall connect the opposite quarter section corners by straight lines, but when the quarter section corner in any of the limits of the section has not been marked by a monument in the original survey, then such corner shall be

established by giving to each half section its proportionate share of such limit according to the official plan of the township, and the half sections shall then be laid out by connecting the corner so established to the opposite corner.

3. In laying out other authorized subdivisions he shall give to every such subdivision its proportionate share of the frontage and interior breadth, according to the official plan of the survey, and connect the resulting terminal points by a straight line.

Other subdivisions.

4. The lines or limits so drawn on the ground in the manner above described shall, in the respective cases, be the true lines or limits of such section, half section, quarter section, legal or authorized subdivision, whether they correspond or do not correspond with the area expressed in the respective official plans or letters patent for such lands.

Lines in ground to be true limits.

ORIGINAL BOUNDARY LINES.

62. All boundary lines of townships, sections or other authorized subdivisions, and of towns or villages, and all boundary lines of blocks, gores or commons, all section lines, and all limits of lots or parcels of land surveyed, or resurveyed, as defined by monuments placed at the corners of any such townships, sections or other authorized subdivisions, towns or villages, or of any blocks, gores, commons, lots or parcels of land under the authority of this Act or of the Governor in Council, shall, after confirmation of the survey or resurvey by the Surveyor General and subject to the provisions herein contained, be the true boundaries of such townships, sections, or other authorized subdivisions, towns or villages, blocks, gores, commons, lots or parcels of land respectively, whether the same, upon admeasurement, are or are not found to contain the exact area or dimensions mentioned or expressed in any official plan or in any letters patent, grant or other instrument of or affecting any such township, town, village, section or other author-

Boundaries as defined by monuments shall be deemed the true boundaries.

ized subdivision, town, village, block, gore, common, lot or parcel of land.

Every division to comprise the area within its boundaries.

63. Every township, section or other authorized subdivision, town, village, block, gore, common, lot or parcel of land, shall consist of the whole width included between the several monuments placed as aforesaid, at the several corners thereof, and no more or less, notwithstanding any quantity or measure expressed in the official plan, letters patent, grant, or other instrument.

Aliquot part.

64. Any letters patent, grant or instrument purporting to convey any right or interest in any aliquot part of any section, or other authorized subdivision, block, gore, common, lot or parcel of land, shall be construed to affect such aliquot part of the quantity it contains on the ground, whether such quantity is more or less than that expressed in such letters patent, grant or instrument.

Road allowances in towns and villages to be public highways.

65. In every town or village surveyed or laid out under the provisions of this Act, all allowances for roads, streets, lanes, or commons, laid out in the original survey of such town or village, shall be public highways and commons; and boundary lines defined by monuments placed or planted in the original survey or resurvey of such town or village, to designate or define any allowance for a road, street, lane, lot or common, shall be the true boundaries of such road, street, lane, lot or common; and all Dominion land surveyors employed to make surveys in such town or village shall follow and pursue the same rules and regulations in respect of such surveys as are, by law, required of them when employed to make surveys in townships, as far as such rules and regulations are applicable.

REESTABLISHMENT OF LOST CORNERS.

When original monument is lost.

66. Whenever a Dominion land surveyor is employed to run any dividing line or limit between sections or other authorized subdivisions and any monument erected in the original survey

to define a corner of any section or other authorized subdivision cannot be found, he shall obtain the best evidence that the nature of the case admits of, respecting such monument; but if its position cannot be satisfactorily so ascertained he shall proceed as follows:—

(a) If the lost monument is that defining a township corner he shall report the circumstances of the case to the Surveyor General, who shall instruct him how to proceed;

If a township corner.

(b) If the lost monument is on one of the outlines of a township, or on one of the interior meridian section lines of a township, he shall connect by a straight line the nearest section or quarter section corners found on such outline or such interior meridian section line, and divide such straight line into such number of quarter sections as it contained in the original survey, giving to each a breadth proportional to the breadth shown on the official plan of the township;

If on the outlines.

(c) If the lost monument is on the outline of a township and all the monuments between it and the corner of the township, together with the monument defining the said corner, are also lost, the township corner shall be reestablished as provided in paragraph (a), previously to reestablishing the outline of the township;

If on the outline, and other monuments are lost.

(d) When the lost corner is that of a quarter section on a section line running east and west in the interior of a township, the surveyor shall connect by a straight line the opposite section corners on the meridian boundaries of the section and give to each quarter section a breadth proportional to the breadth shown on the official plan of the township;

If in the interior.

(e) When a corner on either of the meridian boundaries of the section is also lost, such meridian shall be reestablished previously to reestablishing the east and west line.

If on meridian boundary.

2. Whenever a surveyor places a monument, as aforesaid, to reestablish a lost corner, he shall duly take into account any allowance for a road

Road allowance to be taken into account.

or roads; and the corner, or division or limit so established, shall be the true corner, or division or limit of such township, section or quarter section.

Exception.

3. Notwithstanding anything in this section provided, resurveys of Dominion lands may be made, on the order of the Minister, in such manner, not inconsistent with the other provisions of this Act, as he may direct.

Transmission of plans to local registrar.

67. The Minister shall cause to be transmitted to the registrar of every registration district or division or land titles district in the provinces of Manitoba, Saskatchewan, Alberta and British Columbia and in the Northwest Territories and in the Yukon Territory, as soon as possible after the confirmation thereof, to be lodged or filed with him, a copy of the official plan of the survey or resurvey of each township, settlement, town or village site, lot, plot or other survey or resurvey made under the authority of this Act, and of each plan amended or corrected under the authority of this Act, of Dominion lands in such registration district, or division or land titles district.

EVIDENCE.

Copies as evidence.

68. Copies of any records, documents, plans, books or papers, belonging to or deposited in the Surveyor General's office, attested under the signature of the Minister or of the Surveyor General, or of any chief clerk or officer authorized thereto, shall be competent evidence in all cases in which the original records, documents, books, plans or papers would be evidence.

Plans as evidence.

69. Lithographed or other copies of maps or plans purporting to be issued or published by the Department of the Interior, and to have a lithographed or copied signature of the Minister of the Interior or of the Surveyor General thereto attached, shall be received in all courts and proceedings as *prima facie* evidence of the original and of the contents thereof.

70. All affidavits, oaths, solemn declarations or affirmations required to be taken or made under this Act, except as herein otherwise provided, may be taken before the judge or clerk of any county or circuit court, or any justice of the peace, or any commissioner for taking affidavits, or any notary public, or any Dominion land surveyor, or any person specially authorized to take such affidavits by this Act or by the Minister.

Before whom affidavits, etc. may be made.

71. The Minister may require any statement in relation to any land to which any Act relating to Dominion lands applies to be verified by oath, affirmation, declaration or affidavit.

Minister may require sworn statement as to lands.

GENERAL.

72. The Minister, with the approval of the Governor in Council, may, whenever he deems it necessary so to do, vary any of the forms in the schedule to this Act, or to any Act amending it, or he may from time to time, with the like approval, cause to be adopted such other forms to the like effect or such new forms as he considers applicable to or necessary in or for the purposes of any special case or class of cases.

Forms in schedule may be varied by Minister.

OFFENCES AND PENALTIES.

73. Every person who, in any part of the Dominion lands, interrupts, molests or hinders any Dominion land surveyor while in the discharge of his duty as a surveyor, is guilty of an indictable offence, and liable on conviction thereof, either summarily or upon indictment, to a penalty not exceeding twenty dollars or to imprisonment for a term not exceeding two months, or to both, in the discretion of the court.

Molesting a surveyor.

74. Every person who, knowingly and wilfully, pulls down, defaces, alters, or removes any monument erected, planted or placed in any original survey or resurvey, is guilty of an indictable offence, and shall be liable on conviction thereof, to a penalty not exceeding twenty dollars or to imprisonment for a term not exceeding two months, or to both, in the discretion of the court.

Destroying marks of original survey.

tion thereof, either summary or upon indictment, to imprisonment for any term not exceeding seven years.

Destroying
other marks.

2. Every person who, knowingly and wilfully, defaces, alters or removes any other monument placed by any Dominion land surveyor to mark any limit, boundary or angle of any township, section or other legal subdivision, lot or parcel of land is guilty of an indictable offence, and liable on conviction thereof either summary or upon indictment, to a penalty not exceeding one hundred dollars or to imprisonment for a term not exceeding three months, or to both, in the discretion of the court.

Unlawful
possession of
monuments.

3. Every person who, not being a Dominion land surveyor, knowingly and wilfully has in his possession and custody, not for any lawful purpose in connection with a survey of Dominion lands, any such monument, or any post or monument intended, or apparently intended to be used for the purposes of any such survey, or to mark any such limit, boundary or angle, is guilty of an indictable offence and is liable on summary conviction or upon indictment to imprisonment for a term not exceeding six months, or to a penalty not exceeding one hundred dollars, or to both, in the discretion of the court.

Surveyors'
privilege as to
displacing
monuments.

75. Nothing in this Act shall be held to prevent Dominion land surveyors, in their operations, from displacing any monuments or other boundary marks when necessary, after which they shall carefully replace them as they were before; or from removing a monument and erecting a new one when making a resurvey under the authority of this Act.

Repeal.

76. Sections 16 to 80 inclusive, 206, 212, and 221 to 224 inclusive, of *The Dominion Lands Act*, chapter 55 of the Revised Statutes, 1906, are repealed.

SCHEDULE.

FORM A.

(Section 10.)

OATH OF MEMBER OF BOARD OF EXAMINERS.

I, A. B., do solemnly swear [or affirm, as the case may be] that I will faithfully discharge the duty of an examiner of candidates for admission as articulated pupils, for commissions as Dominion land surveyors or for certificates as Dominion topographical surveyors, according to law, without favour, affection or partiality.

Subscribed and sworn to
before me at , this }
 day of , }
19 , }

FORM B.

(Section 16.)

ARTICLES OF PUPIL TO A DOMINION LAND SURVEYOR. (PUPIL OF AGE.)

These articles of agreement, made this day of one thousand nine hundred and , between A. B., of Dominion Land Surveyor, hereinafter called the surveyor, and C. D., of , hereinafter called the pupil, witness as follows:

The pupil doth hereby bind himself pupil to the surveyor to serve him as such from the date hereof during and until the full end of such period from thence next ensuing and not exceeding three years as shall entitle the pupil under the provisions of the Dominion Lands Surveys Act to present himself before the Board of Examiners for examination for a Commission as a Dominion land surveyor;

And the pupil doth covenant with the surveyor that the pupil shall faithfully and diligently serve the surveyor as his pupil in the practice of a Dominion land surveyor and shall continue with him as such during the said period, and that if the surveyor shall suffer any loss or damage through the neglect or improper conduct of the pupil the pupil will indemnify the surveyor, his executors, administrators and assigns;

And further that the pupil shall at all times be true and just to the surveyor, and shall readily obey the lawful and reasonable commands of the surveyor, and shall not absent himself from the service of the surveyor at any time during the said period without his consent and shall at all times during the said period conduct himself with all due diligence and with honesty and sobriety.

In consideration whereof and of of lawful money by the pupil paid at or before the sealing and delivery of these presents, (the receipt whereof is hereby acknowledged), the surveyor doth covenant with the pupil that the surveyor will accept the pupil as his pupil, and that he, the surveyor, will by the best ways and means within his power, and to the utmost of his skill and knowledge, instruct, or cause to be instructed, the pupil in the course of study prescribed by the Dominion Lands Surveys Act, and generally in the art, practice and profession of a Dominion land surveyor; that he will provide the pupil with all necessary and reasonable expenses incurred in transacting the business of the surveyor; and that at the end of the said period he will make the affidavit of service required by the Act provided the pupil shall have faithfully and diligently served his said intended pupilage.

And for the true performance of all and every the covenants and agreements aforesaid, according to the true intent and meaning thereof, each of them, the surveyor and the pupil, doth

bind himself, his heirs, executors and administrators unto the other, his heirs, executors, administrators and assigns, in the penal sum of five hundred dollars, firmly by these presents.

In witness whereof, the parties aforesaid have hereunto set their hands and seals the day and year first above written.

A.B. (seal)

C.D. (seal)

Signed, sealed and delivered in the presence of

.....
witness to signature of A.B.

.....
witness to signature of C.D.

FORM B.

(Section 16.)

ARTICLES OF PUPIL TO A DOMINION LAND SURVEYOR. (PUPIL A MINOR).

These articles of agreement made this day of one thousand nine hundred and , between A.B., of Dominion Land Surveyor, hereinafter called the surveyor, C. D., of hereinafter called the pupil, and E.F., of father or guardian of the said C. D., hereinafter called the guardian, witness as follows:

The pupil, with the consent of the guardian, doth hereby bind himself pupil to the surveyor to serve him as such from the date hereof during and until the full end of such period from thence next ensuing and not exceeding three years as shall entitle the pupil under the provisions of the Dominion Lands Surveys Act to present himself before the Board of Examiners for examination for a Commission as a Dominion land surveyor;

And the guardian doth covenant with the surveyor that the pupil shall faithfully and

diligently serve the surveyor as his pupil in the practice of a Dominion land surveyor and shall continue with him as such during the said period, and that if the surveyor shall suffer any loss or damage through the neglect or improper conduct of the pupil, the guardian will indemnify the surveyor, his executors, administrators and assigns;

And further that the pupil shall at all times be true and just to the surveyor, and shall readily obey the lawful and reasonable commands of the surveyor, and shall not absent himself from the service of the surveyor at any time during the said period without his consent, and shall at all times during the said period conduct himself with all due diligence and with honesty and sobriety.

And the pupil doth hereby for himself covenant with the surveyor that he, the pupil, will honestly and diligently serve the surveyor at all times during the said period as a faithful pupil ought to do in all things whatsoever.

In consideration whereof and of of lawful money by the guardian paid at or before the sealing and delivery of these presents, (the receipt whereof is hereby acknowledged), the surveyor doth covenant with the pupil that the surveyor will accept the pupil as his pupil and that he, the surveyor, will by the best ways and means within his power, and to the utmost of his skill and knowledge, instruct, or cause to be instructed, the pupil in the course of study prescribed by the Dominion Lands Surveys Act, and generally in the art, practice and profession of a Dominion land surveyor; that he will provide the pupil with all necessary and reasonable expenses incurred in transacting the business of the surveyor; and that at the end of the said period he will make the affidavit of service required by the Act provided the pupil shall have faithfully and diligently served his said intended pupilage.

And for the true performance of all and every the covenants and agreements aforesaid according to the true intent and meaning thereof, each of them, the surveyor and the guardian, doth bind himself, his heirs, executors and administrators unto the other, his heirs, executors, administrators and assigns, in the penal sum of five hundred dollars, firmly by these presents.

In witness whereof, the parties aforesaid have hereunto set their hands and seals the day and year first above written.

..... A. B. (Seal.)
..... C. D. (Seal.)
..... E. F. (Seal.)

Signed, sealed and delivered in the presence of

.....
Witness to signature of A. B.

.....
Witness to signature of C. D.

.....
Witness to signature of E. F.

FORM C.

AFFIDAVIT BY THE SURVEYOR.

I, A. B., of _____, Dominion land surveyor, do solemnly swear that E. F. has served regularly and faithfully as my pupil from the day of _____, 19____, to the day of _____, 19____; that he has been engaged with me in the field on the following surveys, that is to say: from the _____ day of _____ to the _____ day of _____ on the survey of _____ at _____; from the _____ day of _____ to the _____ day of _____, on the survey of _____ at _____, (and so on); and that the said E. F. has always conducted himself with all due diligence, honesty and sobriety on the said service.

Subscribed and sworn to }
before me at _____, }
this _____ day of _____, }
19____ . }

FORM D.

AFFIDAVIT BY THE PUPIL.

I, E. F., of _____, do solemnly swear that I have attained the full age of twenty-one years; that I have served regularly and faithfully with A. B., Dominion land surveyor, as his pupil, from the _____ day of _____, 19____, to the _____ day of _____ 19____; and that I have been engaged with him in the field between the following dates on the following surveys, that is to say from the _____ day of _____ to the _____ day of _____, on the survey of _____ at _____; from the _____ day of _____ to the _____ day of _____, on the survey of _____
(and so on.)

Subscribed and sworn to }
before me at _____, }
this _____ day of _____, }
19____.

FORM E.

(SECTION 17.)

TRANSFER OF ARTICLES OF A PUPIL FROM ONE
DOMINION LAND SURVEYOR TO ANOTHER.
(PUPIL OF AGE.)

This indenture made this _____ day of _____ one thousand nine hundred and _____, between A.B. of _____, Dominion Land Surveyor, hereinafter called the first surveyor; C.D. of _____, Dominion Land Surveyor, hereinafter called the second surveyor; and E.F. hereinafter called the pupil:

Whereas by articles of agreement bearing date the _____ day of _____, one thousand nine hundred and _____, made between the first surveyor and the pupil, the

pupil did bind himself pupil to the first surveyor to serve him as such from the date thereof during and until the full end of such period from thence next ensuing and not exceeding three years, as should entitle him under the provisions of the Dominion Lands Surveys Act, to present himself before the Board of Examiners for examination for a commission as a Dominion land surveyor;

And whereas the pupil has served the first surveyor from the date of the said articles of agreement to the date of these presents;

And whereas it has been agreed that the first surveyor shall assign to the second surveyor all benefit and advantage of him the first surveyor or under the said articles of agreement for all the residue now to come and unexpired of the said period of service as pupil, and it has been further agreed that the pupil shall bind himself pupil to the second surveyor from the date of these presents for the remainder of the said period.

Now this indenture witnesseth that in pursuance of the said agreement the first surveyor at the request, and with the consent of the pupil testified by his being a party to these presents, hath assigned, transferred and set over, and by these presents doth assign, transfer and set over unto the second surveyor all benefit and advantage, interest, claim and demand whatsoever of the first surveyor under the aforesaid articles of agreement and the service of the pupil under the same.

And this indenture further witnesseth that the pupil of his own free will testified as aforesaid, hath bound himself and by these presents doth bind himself pupil to the second surveyor to serve him from the date of these presents for and during the remainder of the said period of service.

And the pupil doth hereby covenant with the second surveyor, his executors, administrators and assigns, that he, the pupil shall

And this indenture further witnesseth that the pupil of his own free will testified as aforesaid, and with the consent and approbation of the guardian hath bound himself and by these presents doth bind himself pupil to the second surveyor to serve him from the date of these presents for and during the remainder of the said period of service.

And the pupil and the guardian do hereby respectively covenant with the second surveyor, his executors, administrators and assigns, that he, the pupil, shall and will well, faithfully and diligently serve the second surveyor as his pupil in the practice and profession of a Dominion land surveyor from the date hereof for the remainder of the said period according to the terms and conditions of the said articles of agreement.

In consideration whereof, the second surveyor for himself his heirs, executors and administrators, doth hereby covenant with each of the first surveyor, the pupil, and the guardian, their executors, administrators and assigns, that he, the second surveyor will accept and take the pupil as his pupil and will observe and be bound by the terms and conditions of the said hereinbefore mentioned articles of agreement, in so far as the same were binding upon the first surveyor.

In witness whereof the said parties have hereunto set their hands and seals.

A.B. (Seal.)
 C.D. (Seal.)
 E.F. (Seal.)
 G.H. (Seal.)

Signed, sealed and delivered in the presence of

.....
 Witness to signature of A.B.

 Witness to signature of C.D.

 Witness to signature of E.F.

 Witness to signature of G. H.

FORM F.

COMMISSION AS DOMINION LAND SURVEYOR.

This is to certify, to all whom it may concern, that A.B., of _____, hath duly passed his examination before the Board of Examiners, and hath been found duly qualified to perform the duties of a Dominion land surveyor he having complied with all the requirements of the law in that behalf: Wherefore, he, the said A.B., is hereby duly commissioned to practise as a surveyor of Dominion lands, under the provisions of *The Dominion Lands Surveys Act*.

In witness whereof, we, the president and secretary of the said Board, have signed this commission, at _____, on this day of _____, one thousand nine hundred and _____.

Surveyor General, President of Board.

Secretary.

FORM G.

SURVEYOR'S OATH.

I, _____ do solemnly swear (or affirm as the case may be) that I will faithfully discharge the duties of a Dominion land surveyor according to law, without favour, affection or partiality.

Subscribed and sworn to }
 before me at _____ }
 this _____ day of _____ }
 19 _____ }

APPENDIX B.

THE DETERMINATION OF THE ASTRONOMICAL MERIDIAN.

The plan of a land survey is the record of the boundaries of the parcels of land laid out. With an accurate survey and a plan properly made, the precise location of the boundaries, if lost, may be defined on the ground by means of the data furnished by the plan, provided some of the monuments are found. It is not contended that boundaries reestablished in this way will, in every case, hold good in law, but they are material evidence and the kind of evidence which it is the purpose of the plan to furnish. When the plan gives angles only, but no bearings, two at least of the original monuments must be found in order that the lines may be located; with a plan giving the bearings of the boundaries a single monument is sufficient. The reference of the lines to the astronomical meridian thus adds one element to the value of the plan as a record.

It is an error to consider a survey as worthless when the direction of its meridian is incorrect. Should the survey be otherwise accurate, the angle of any two lines is correctly given by the difference of their bearings. The survey has, therefore, the same value as an angular survey. The above considerations, and the fact that the lines of the system of Dominion land surveys have to be run north and south or east and west, make the determination of the astronomical meridian an operation of paramount importance for the surveyor of Dominion lands.

On block surveys, where great precision is required, the azimuth is ascertained as explained in Chapter IV. The following remarks apply to subdivision surveys:—

What seems to be the most convenient method is the observation of Polaris: it should be made in daytime. With modern instruments, there is no longer any necessity for night observations with all the discomforts attending the use of lanterns.

By means of the "Astronomical Field Tables," now supplied to surveyors, the observation has become very easy and simple; the tables are not absolutely accurate, but they are good enough for subdivision purposes.

INSTRUMENTS REQUIRED.

The instruments necessary are a watch keeping sidereal time, that is to say, gaining 3 m. 56 s. a day, and a four or five-inch transit theodolite of the so called "Canadian pattern" now listed by several manufacturers, or an instrument provided with a telescope of equal power.

A common watch of a reputable manufacture is good enough; the movement should be in a strong open face dust-proof screw case. The best grades keep the time for weeks with sufficient accuracy for subdivision purposes; the error is ascertained from time to time by a meridian observation of the sun or of a star. Inferior grades are equally serviceable, but they require more frequent determinations of the error.

STAR OBSERVATIONS IN DAYLIGHT.

In the western provinces and the Northwest Territories the air is in general exceedingly transparent, and a very bright star, like Sirius, may be seen at almost any time of the day; for smaller stars it is necessary to wait till the sun is low. In the eastern provinces, the stars cannot be seen as easily as in the West. The pole star is best seen about half an hour or an hour before dark, while there is still ample light for reading the graduation; it may also be observed in the morning.

It is essential that the telescope be very accurately focussed. This may be done as follows:—The high power eyepiece is first focussed upon the diaphragm. The telescope is now directed upon a star not too bright, the pole star for instance, and the tube of the telescope is racked in or out until the star appears as a fine point. A mark is made on the tube with a sharp knife to indicate this position. This must be done very accurately; for any other position the image of the star is more or less spread out and therefore not so bright.

For observing time stars close to the zenith, the high power eyepiece is inconvenient and it is necessary to use the long diagonal eyepiece.

To discover a star in the field in daytime requires a little patience and some practice, but once discovered, it is easy to follow it or to find it again. The telescope must be so

directed as to bring the star within the field; how this is to be done will be explained later. After clamping the telescope in the proper direction, the field is carefully scanned; it may be a minute or more before the star is perceived as a little speck of light in some corner of the field. A quick-moving star is more easily found than one which moves slowly. The motion of the pole star being almost imperceptible, a little movement to and fro given to the telescope by means of the tangent screw of the vernier plate helps in perceiving it. Once found, it appears so plain that it is always a subject of surprise that it was not seen before.

OBSERVATION OF THE POLE STAR FOR AZIMUTH.

For all astronomical observations, whether for time or azimuth, the instrument must be very carefully levelled. In subdividing a township, an observation for azimuth is made on a section line or at a station of a traverse. The section line or the course of the traverse is taken as reference line; in either case, the azimuth of the reference line is known with sufficient approximation for setting the instrument in the meridian. This is done as follows:—

Set the vernier of the horizontal circle to read the azimuth of the reference line, loosen the lower clamp and turn the instrument until the telescope is directed on the reference line; fasten the lower clamp and release the upper clamp. The instrument is now set to read azimuths. By setting the vernier at 360° , the telescope is in the meridian.

In example No. 1, the vernier is set to read $180^\circ 05'$, the lower clamp released and the telescope directed on the east boundary of section 18. In example No. 2, the vernier is set at $269^\circ 56'$ and the telescope directed on the north boundary of section 24.

The telescope must now be set for the altitude of the pole star. Take the latitude of the place from the diagram in the Astronomical Field Tables. For example No. 1, the diagram shows a latitude of $51^\circ 20'$ corresponding to township 27: for example No. 2, the latitude opposite township 35 is $52^\circ 03'$. Add or subtract the number of minutes in the first column of the "Table for finding the Pole Star, etc." (A.F.T.): the result is the altitude of the star. For example No. 1, the number in the first column is $52'$ which subtracted from the latitude $51^\circ 20'$ gives $50^\circ 28'$ for the

altitude. For example No. 2, the number in the first column is $60'$ which added to the latitude $52^\circ 03'$ gives $53^\circ 03'$ for the altitude of the star. The telescope is set at the altitude found.

The vernier is now set to read the azimuth of the star taken from the table for the time shown by the watch. For example No. 1, it is set at $1^\circ 15'$, and for example No. 2, at $359^\circ 01'$. With the instrument so set, the star is in the field and will be seen, provided the telescope is accurately focussed and the light not too strong. When found, it is brought under the vertical thread by means of the slow-motion screws of the vernier plate and vertical circle. The time by the watch is noted as well as the horizontal circle reading.

This is only one half of the observation. For all azimuth work, it is essential that the observation be made in two positions of the instrument, circle right and circle left. The position of the instrument is reversed by transiting the telescope and turning the vernier plate 180° . The first part of the observation is now repeated. The H.C.R. on the reference line is recorded, the telescope is set at the altitude of the star, the vernier at the azimuth, and the field is scanned for the star. When found, the time by the watch and horizontal circle reading are again recorded.

The examples and appended explanations show clearly how the observation is worked out.

It may be desired to observe at a place where no line of known azimuth exists. For instance, the surveyor may wish while in camp to ascertain the time by the meridian transit of a star: for doing so, he has to set his instrument in the meridian by means of the pole star. The method is the same as before, except that use is made of the compass for turning the instrument in the direction of the star. The compass box is set on the standard (not under the lower plate).

Having fixed the telescope at the proper altitude, as explained above, set the vernier of the horizontal plate to read the azimuth of magnetic north, taken from the small map accompanying the Astronomical Field Tables. Release the lower clamp and turn the instrument until the point of the needle is opposite the zero mark of its box. Fasten the lower clamp and release the upper one; the instrument is now set to read approximately astronomical

EXAMPLE No. 1
ASTRONOMICAL OBSERVATION.

Date *January, 19, 1909, 8.45 A.M. Mountain Time.*

Place *W. E. corner sec. 15, Tp. 27, R. 20, W. 3 Mer.*

Reference line *East boundary of sec. 15*

Face.	H.C.R. on Reference line	H.C.R. on Polaris	Watch Time.
1 Right	<i>180° 05'</i>	<i>1° 21.9</i>	<i>16^h 22^m 57^s</i>
2 Left	<i>180 03</i>	<i>1 23.0</i>	<i>16 25 07</i>
Mean	<i>180 04</i>	<i>1 22.45</i>	<i>16 24 02</i>
3 Watch correction			<i>- 42</i>
Sidereal time			<i>16 23 20</i>
4 Tabular Azimuth for <i>16 h. 20 m. & Tp. 20</i>			<i>1° 15.5</i>
5 Difference for <i>3 m. 20 s.</i>			<i>+ 1.1</i>
6 Difference for <i>7 townships</i>			<i>+ 1.0</i>
7 Convergence for <i>2 sections</i>			<i>+ 2.2</i>
8 Bearing of Polaris			<i>1 19.8</i>
9 H.C.R. on Polaris			<i>1 22.45</i>
10 Correction to H.C.R.			<i>- 2.65</i>
11 H.C.R. on Reference line			<i>180 04</i>
12 Bearing of Reference line			<i>180 01.35</i>

NOTE.—The Reference line must be a section line or a line between two stations of a lake or river traverse.

bearings. Set the vernier of the horizontal plate to read the azimuth of the pole star taken from the table: if the magnetic declination and setting of the compass box were correct, the star should now be in the field of the telescope. The needle being subject to large variations, the star may be out of the field. If not found after looking carefully, the instrument is turned slowly, a degree or two on each side, by means of the lower slow-motion screw. After finding the star, the vernier is again set to the azimuth from the Astronomical Field Tables for the time of the watch, and the star is brought under the vertical thread by means of the lower slow-motion screw. Setting now the vernier at 360°, the telescope is in position for observing meridian transits of stars.

Example No. 1. Explanatory Notes.

(1) The figures on this line are for the position of the instrument in which the vertical circle is at the right of the telescope. "H. C. R. on Reference line" is the reading of the horizontal circle when the telescope is pointed on the reference line. "H. C. R. on Polaris" is the reading of the horizontal circle when the telescope is pointed on the star. "Watch time" is the time shown by the watch when the star was under the middle thread of the diaphragm.

(2) The explanation of these figures is the same as above, but they are for the second position of the instrument, in which the vertical circle is at the left. The instrument is brought to this position by transiting the telescope and turning it 180° in azimuth.

(3) The watch correction is obtained as shown in the examples of observations for time.

(4) The tabular azimuth is taken from the table for finding the pole star and the astronomical meridian (A.F.T.). The sidereal time being 16h. 23m. 20s. and the number of the township 27, the bearing is taken for 16h. 20m. and township 20.

(5) This is the proportional part, taken from the table, for the difference, 3m. 20s., between the time of observation and the time of the table.

(6) This is the proportional part, taken from the table, for the difference 7, between 27, the number of the township in which the observation was made, and 20, the number of the township in the table.

(7) The convergence of the meridians is taken from the diagram in the Astronomical Field Tables. For township 27, the diagram shows a convergence of about 1'.11 to a section. The point of observation being two sections away from the central meridian, the convergence is 2'.22, say 2'.2.

The sign of the convergence is + in the western half of the township.

(8) This is the bearing of the star at the time of observation: it is the algebraic sum of the four numbers above it.

(9) This is the mean of the observed readings on Polaris.

(10) The correction to the horizontal circle readings is the difference between the bearing of Polaris and the H.C.R. on Polaris. Its sign is—when the bearing is less than the H.C.R. on Polaris. If the instrument was set in what was believed to be the meridian, this correction represents the error of orientation.

(11) This is the mean of the horizontal circle readings on the reference line.

(12) The correct bearing of the reference line is the algebraic sum of the H.C. R. on reference line and of the correction to H. C. R.

This bearing is generally found to differ from the bearing by account which was 180° 05' in this example. The difference represents the accumulated errors of the survey. It is distributed among the previous courses of the survey, according to the judgment of the surveyor.

Example No. 2. Explanatory Notes.

(1) The figures on this line are for the position of the instrument in which the vertical circle is at the right of the telescope. "H. C. R. on Reference line" is the reading of the horizontal circle when the telescope is pointed on the reference line. "H. C. R. on Polaris" is the reading of the horizontal circle when the telescope is pointed on the star. "Watch time" is the time shown by the watch when the star was under the middle thread of the diaphragm.

(2) The explanation of these figures is the same as above, but they are for the second position of the instrument, in which the vertical circle is at the left. The instrument is brought to this position by transiting the telescope and turning it 180° in azimuth.

(3) The watch correction is obtained as shown in the examples of observations for time.

EXAMPLE No. 2

ASTRONOMICAL OBSERVATION.

Date *March 1, 1909 5.10 P.M. Mountain Time*

Place *N. E. Corner Sec 24. Tp. 35. R. 13, W. 3 Mer.*

Reference line *North boundary of section 24*

Face.	H.C.R. on Reference line	H.C.R. on Polaris.	Watch Time.
1 Right	<i>269° 56'</i>	<i>358° 49'.5</i>	<i>3^h 34^m 35^s</i>
2 Left	<i>269 57</i>	<i>358 51.5</i>	<i>3 37 25</i>
Mean	<i>269 56.5</i>	<i>358 50.5</i>	<i>3 36 0</i>
3 Watch correction			<i>+ 39</i>
Sidereal time			<i>3 36 39</i>
4 Tabular Azimuth for <i>3 h. 30 m. & Tp. 20</i>			<i>359° 01'.3</i>
5 Difference for <i>6 m. 39 s.</i>			<i>- 2'.8</i>
6 Difference for <i>15 townships</i>			<i>- 1'.8</i>
7 Convergence for <i>3 sections</i>			<i>- 3.4</i>
8 Bearing of Polaris			<i>358 53.3</i>
9 H.C.R. on Polaris			<i>358 50.5</i>
10 Correction to H.C.R.			<i>+ 2'.8</i>
11 H.C.R. on Reference line			<i>269 56.5</i>
12 Bearing of Reference line			<i>269 59.3</i>

NOTE.—The Reference line must be a section line or a line between two stations of a lake or river traverse.

(4) The tabular azimuth is taken from the table for finding the pole star and the astronomical meridian (A.F.T.). The sidereal time being 3h. 36m. 39s., and the number of the township 35, the bearing is taken for 3h. 30 m. and township 20.

(5) This is the proportional part, taken from the table, for the difference 6m. 39s., between the time of observation and the time of the table.

(6) This is the proportional part, taken from the table, for the difference, 15, between 35, the number of the township in which the observation was made, and 20, the number of the township in the table.

(7) The convergence of the meridians is taken from the diagram in the Astronomical Field Tables. For township 35, the diagram shows a convergence of about $1' \cdot 135$ to a section and the point of observation being three sections away from the central meridian, the convergence is $3' \cdot 4$.

The sign of the convergence is—in the eastern half of the township.

(8) This is the bearing of the star at the time of observation; it is the algebraic sum of the four numbers above it.

(9) This is the mean of the observed readings on Polaris.

(10) The correction to the horizontal circle readings is the difference between the bearing of Polaris and the H. C. R. on Polaris. Its sign is + when the bearing is greater than the H. C. R. on Polaris. If the instrument was set in what was believed to be the meridian, this correction represents the error of orientation.

(11) This is the mean of the horizontal circle readings on the reference line.

(12) The correct bearing of the reference line is the algebraic sum of the H. C. R. on reference line and of the correction to H. C. R.

This bearing is generally found to differ from the bearing by account which was $269^{\circ} 56'$ in this example. The difference represents the accumulated errors of the survey. It is distributed among the previous courses of the survey, according to the judgment of the surveyor.

DETERMINATION OF THE ERROR OF THE WATCH.

In the observation for azimuth, the watch correction was assumed to be known within a minute. This correction has to be ascertained from time to time, more or less frequently according as the watch is of a better or an inferior grade.

The watch may first be set by means of the "sidereal time at noon, mountain time," given in the Astronomical Field Tables for the fifteenth of each month. For other dates, the time is calculated by interpolation, the variation being approximately four minutes a day. Mountain time is the time of the meridian of 105° west: in that longitude, the watch is set to the sidereal time of the table when it is noon, mountain time. Further west, four minutes must be subtracted from the sidereal time at noon for every degree of longitude from the meridian of 105° west.

The watch having been set approximately to sidereal time, its correction is ascertained by observing the meridian transit of a star or of the sun.

DETERMINATION OF THE TIME BY THE MERIDIAN TRANSIT OF A STAR.

The observation of the meridian transit of a star is best made while surveying section or traverse lines, because the telescope is readily placed in the meridian by turning the requisite angle from a line of known bearing. At other places, the instrument is placed in position by means of the compass and the pole star, as previously explained.

After placing the instrument in the meridian, the telescope is set at the altitude of the star, which is obtained by subtracting the polar distance from the supplement of the latitude. The stars in the Astronomical Field Tables pass the meridian south of the Zenith. The telescope being in position, the field is examined for the star a little before the time of transit. With the long diagonal eyepiece, the star enters the field on the left: with the inverting eyepiece, it enters on the right. The star moves through the field and when it crosses the vertical thread the time of the watch is noted.

In example No. 3, the latitude of the place from the diagram in the Astronomical Field Tables is 52° and its supplement 128° ; subtracting the polar distance of Pollux, $61^{\circ} 45'$ gives for the altitude $66^{\circ} 15'$, at which the telescope is set.

In example No. 4, the latitude of the place is $51^{\circ} 21'$ and its supplement $128^{\circ} 39'$; subtracting the polar distance of Regulus, $77^{\circ} 34'$, gives for the altitude $51^{\circ} 05'$. The calculation of the altitude is made roughly; a few minutes more or less does not matter.

The examples and explanations appended show how the watch correction is deduced.

EXAMPLE NO. 3.

TIME BY MERIDIAN TRANSIT OF A STAR.

DATE—October, 7, 1904,—6.45 a.m., Mountain time.

PLACE—Sec. 12, Tp. 35, R. 13, W. 3 Mer.

- | | |
|---|--|
| (1) Watch time of meridian transit of Pollux. | 7 ^h 38 ^m 31 ^s |
| (2) Sidereal time “ “ “ | 7 ^h 39 ^m 30 ^s |
| (3) Watch correction (slow)..... | + 39 ^s |

(1) This is the time shown by the watch when the star crosses the vertical thread of the diaphragm, the telescope having previously been set in the meridian.

(2) The sidereal time of meridian transit is taken from the table of time stars (A.F.T.).

(3) The watch correction is + when the watch is slow and — when it is fast.

EXAMPLE NO. 4.

TIME BY MERIDIAN TRANSIT OF A STAR.

DATE—November 2, 1904,—7.30 a.m., Mountain time.

PLACE—Sec. 30, Tp. 27, R. 20, W. 3 Mer.

- | | |
|---|---|
| (1) Watch time of meridian transit of Regulus | 10 ^h 03 ^m 59 ^s |
| (2) Sidereal time “ “ “ | 10 ^h 03 ^m 18 ^s |
| (3) Watch correction (fast)..... | —41 ^s |

(1) This is the time shown by the watch when the star crosses the vertical thread of the diaphragm, the telescope having previously been set in the meridian.

(2) The sidereal time of meridian transit is taken from the table of time stars (A.F.T.).

(3) The watch correction is + when the watch is slow and — when it is fast.

DETERMINATION OF THE TIME BY THE MERIDIAN TRANSIT OF THE SUN.

The determination of the watch correction by means of the meridian transit of the sun is a very convenient method. The observation is made at a time of the day

when the instrument is on the survey and therefore can readily be set in the meridian, there is no difficulty in finding the sun, and moreover it can be observed through light clouds or haze when stars are invisible.

The observation is exceedingly simple. The telescope is set in the meridian as explained for a star transit, and a note is made of the times shown by the watch when the first limb and the second limb cross the vertical thread of the diaphragm. The observation is, of course, made with the coloured glass. The Apparent Right Ascension of the sun at the time of observation must now be calculated; it is found by adding the variation for the longitude to the Right Ascension at Greenwich Apparent Noon given in the Astronomical Field Tables.

The longitude of the place of observation, which is required for calculating the variation of the Right Ascension, is taken from the diagram in the Astronomical Field Tables where it is given in hours and tenths. The variation in one hour is given in the table in the column next to the Right Ascension: the variation for the longitude is the product of the longitude expressed in hours and decimals by the variation in one hour.

The details of the calculation are shown in examples Nos. 5 and 6 and in the notes appended.

EXAMPLE NO. 5.

TIME BY MERIDIAN TRANSIT OF THE SUN.

DATE—March 18th, 1905.

PLACE—Tp. 28, R. 19, W. 2 Mer.

- | | |
|---|---|
| (1) Transit of first limb..... | 23 ^h 49 ^m 12.8 ^s |
| (2) “ second limb..... | 23 ^h 51 ^m 20.8 ^s |
| Mean..... | 23 ^h 50 ^m 16.8 ^s |
| (3) Sun's R.A. at App. Noon, | |
| Green..... | 23 ^h 49 ^m 51.3 ^s |
| (4) Var. in 6 ^h .98 = 9 ^s .1x6 .98. | 1 ^m 03.5 ^s |
| (5) Sun's R.A. at observation..... | 23 ^h 50 ^m 54.8 ^s |
| (6) Watch correction (slow)..... | + 38 ^s |

(1) This is the time shown by the watch when the first limb of the sun crosses the vertical thread of the diaphragm, the telescope having been previously set in the meridian.

(2) This is the time of the watch at the crossing of the other limb.

(3) The Apparent Right Ascension of the Sun at Apparent Noon is taken from the Astronomical Field Tables.

(4) The longitude $6^h \cdot 98$ is obtained from the diagram in the Astronomical Field Tables. The variation in one hour is given in the column next to the Apparent Right Ascension.

(5) The Sun's Right Ascension at the time of observation is the sum of the Right Ascension at Greenwich noon and the variation in $6^h \cdot 98$.

(6) The watch correction is obtained by subtracting the watch time from the Sun's Right Ascension at observation.

EXAMPLE No. 6.

TIME BY MERIDIAN TRANSIT OF THE SUN.

DATE—October 25th, 1904.

PLACE—Tp. 65, R. 15, W. 5 Mer.

(1) Transit of first limb.....	$13^h \ 58^m \ 27^s$
(2) " second limb.....	$14^h \ 00^m \ 39^s$
Mean.....	$13^h \ 59^m \ 33^s$
(3) Sun's R. A. at App. Noon, Green.....	$13^h \ 57^m \ 54^s$
(4) Var. in $7^h \cdot 75 = 9^s \cdot 56 \times 7 \cdot 75$	$1^m \ 14^s$
(5) Sun's Right Ascension at observation....	$13^h \ 59^m \ 08^s$
(5) Watch correction (fast).....	-25^s

(1) This is the time shown by the watch when the first limb of the sun crosses the vertical thread of the diaphragm, the telescope having previously been set in the meridian.

(2) This is the watch time of crossing of the other limb.

(3) The Apparent Right Ascension of the Sun at Apparent Noon is taken from the Astronomical Field Tables.

(4) The longitude $7^h \cdot 75$ is obtained from the diagram in the Astronomical Field Tables. The variation in one hour is given in the column next to the Apparent Right Ascension.

(5) The Sun's Right Ascension at the time of observation is the sum of the Right Ascension at Greenwich Noon and the variation in $7^h \cdot 75$.

(6) The watch correction is obtained by subtracting the watch time from the Sun's Right Ascension at observation.

OBSERVATION OF THE SUN FOR AZIMUTH.

Star observations require a clear sky: they may be prevented by smoke, haze or light clouds, while the sun is quite visible. It may therefore happen that the observation of the sun will be the only method available for the determination of the azimuth.

The method is not as accurate as with Polaris and as it involves considerable calculation it is more liable to errors. It is not recommended when Polaris can be observed.

The instrument must be provided with a dark coloured glass for looking at the sun through the telescope.

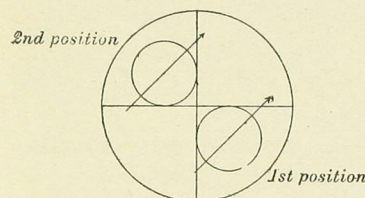


Fig. 48. Observation of the sun in the forenoon with an erecting eyepiece.

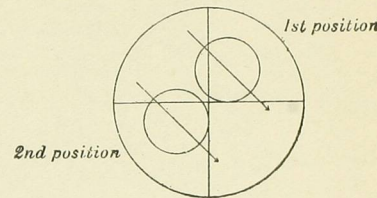


Fig. 49. Observation of the sun in the afternoon with an erecting eyepiece.

The observation is made first with the vertical circle in one position, to the right of the observer for instance, and next with the circle to the left, after reversing the telescope and turning the upper plate 180° . In the first position of the instrument, the image of the sun is brought in the angle formed by two of the threads in the telescope so as to be tangent to both at the same time. The same process is repeated with the instrument in the second position, but with the sun's image in the opposite angle (Figs. 48 and 49). In order to bring both threads tangent to the sun's limb at the same time, the sun's image must be so placed as to move towards one thread while going away from the other. The former thread is kept tangent to the limb by the proper slow-motion screw until both threads are tangent together. In the opposite angle of the threads, the same process is repeated with the other slow-motion screw. Fig. 48 shows how the sun's image appears in

the forenoon with an erecting eyepiece. In the upper left angle of the threads, the sun's image moves away from the horizontal thread and towards the vertical thread; the latter is kept tangent by the slow-motion screw of the upper plate. In the lower right angle of the threads, the sun's image moves away from the vertical thread and towards the horizontal thread, the latter being kept tangent by the slow-motion screw of the vertical circle. Fig. 49 shows how the discs would be placed in the afternoon.

An erecting eyepiece is not suitable for observing the sun; a diagonal eyepiece is more convenient. The explanations which follow are for the use of the long diagonal. Figs. 50 and 51 show how the images of the sun appear in the forenoon, and in the afternoon, with this eyepiece.

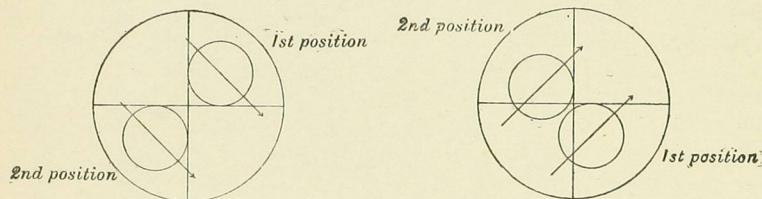


Fig. 50. Observation of the sun in the forenoon with a long diagonal eyepiece.

Fig. 51. Observation of the sun in the afternoon with a long diagonal eyepiece.

The observation is easy enough if made methodically, otherwise there is a risk of not placing the images in opposite angles which would entirely vitiate the result. The rules which follow, if learned by heart so as to be carried out without any hesitation, will prevent mistakes:—

1. Always commence with the sun on the right of the vertical thread and impinging upon it, above the horizontal thread in the forenoon and below in the afternoon.

2. Always commence by following the sun with the slow-motion screw of the vertical circle.

In the second position of the instrument, the rules are reversed.

3. Place the sun on the left of the vertical thread and impinging upon the horizontal thread, below it in the forenoon and above it in the afternoon.

4. Follow the sun with the slow-motion screw of the upper plate.

The reading of the horizontal circle on the reference object, generally one of the line pickets, must be taken in both positions of the instrument, and the approximate time of the observation noted.

The best time for observation is when the sun is near the prime vertical, that is to say, nearly due east or west.

The following formula may be used for the calculation:—

$$\cos \frac{a}{2} = \sqrt{\cos S \cos (S-P) \sec L \sec h}$$

$$\text{where } S = \frac{h + L + P}{2}$$

h being the true altitude of the sun, L the latitude, P the sun's polar distance, and a the angle the sun makes with the meridian east or west from north. Reducing this angle to Z , the azimuth, Z is the same as a in the forenoon and is equal to 360° minus a in the afternoon.

The latitude and its secant are given in Table X for the north side of every section.

On page 192 two examples are given, one in the afternoon and the other in the forenoon. H. C. R. is for horizontal circle reading.

DATE—21st November, 1881—3.18 p.m.
PLACE—50 chs. W. of N.E. corner section 31, Tp. 4, R. 14, W. of 3rd meridian.

Face.	Sun's Altitude.	H. C. R. on Sun.	H. C. R. on Line.
Right.	6° 25'	227° 35' 00"	90° 00' 00"
Left.	7 09	228 43 00	90 01 00
Mean.	6 47	228 09 00	90 00 30

Greenwich Time.	
Local time = Nov. 21	3h. 18m.
Longitude.....	+7 12
Greenwich time = Nov. 21.....	10 30

Correction of Altitude.		Sun's Polar Distance.	
Obs. altitude... = 6° 47' 00"	Decl. at 0h. = 20° 01' 35" S	Decl. at 0h.	= 20° 01' 35" S
Refraction..... = -7 38	Var. for 10h. 30m. = +5 42	Var. for 10h. 30m.	= +5 42
Difference..... = 6 39 22	Decl. at 10h. 30m. = 20 07 17	Decl. at 10h. 30m.	= 20 07 17
Parallax..... = +9	P = 110 07 17	P	= 110 07 17
h = 6 39 31			

sec. h	= 6° 39' 31"	sec. h	= 0.00294
sec. L	= 49 20 58	sec. L	= 0.18612
cos. S	= 110 07 17	cos. S	= 9.08188
cos. (S-P).....		cos. (S-P).....	= 9.94906
2S.....	= 166 07 46	cos. $\frac{a}{2}$	= 19.22060
S.....	= 83 03 53	cos. $\frac{a}{2}$	= 9.61030
S-P.....	= 27 03 24	$\frac{a}{2}$	= 65° 56' 30"
Convergence, $2\frac{1}{2}$ sec. (§68 & 69).....		Azinuth.....	= 131 53 00
Bearing.....			= 228 07 00
H. C. R. on sun.....			= +2 40
Correction.....			= 228 09 40
H. C. R. on line.....			= 228 09 00
Bearing of line.....			= +40
			= 90 00 30
			= 90 01 10

DATE—June 15th, 1881—7.20 a.m.
PLACE—25 chs. W. of N.E. corner section 36, Tp. 28, R. 17, W. of 2nd meridian.

Face.	Sun's Altitude.	H. C. R. or Sun.	H. C. R. on Line.
Right.	30° 09'	175° 43' 00"	176° 39' 00"
Left.	30 15	176 51 00	176 40 00
Mean.	30 12	176 17 00	176 39 30

Greenwich Time.	
Local time = June 14.....	19h. 20m.
Longitude.....	+6 57
Greenwich time = June 15.....	2 17

Correction of Altitude.		Sun's Polar Distance.	
Obs. altitude.... = 30° 12' 00"	Decl. at 0h. = 23° 20' 16" N.	Decl. at 0h.	= 23° 20' 16" N.
Refraction..... = -1 40	Var. for 2h. 17m. = + 14	Var. for 2h. 17m.	= + 14
Diff..... 30 10 20	Decl. at 2h. 17m. = 23 20 30	Decl. at 2h. 17m.	= 23 20 30
Parallax..... = +8	P = 66 39 30	P	= 66 39 30
h = 30 10 28			

sec. h	= 30° 10' 28"	sec. h	= 0.06324
sec. L	= 51 26 45	sec. L	= 0.20533
cos. S	= 66 39 30	cos. S	= 9.43664
cos. (S-P).....		cos. (S-P).....	= 9.99029
2S.....	= 148 16 43	cos. $\frac{a}{2}$	= 19.70150
S.....	= 74 08 21	cos. $\frac{a}{2}$	= 9.85075
S-P.....	= 7 28 51	$\frac{a}{2}$	= 44° 50' 00"
a or Z.....		Convergence, $2\frac{1}{2}$ sec. (§ 68 & 69).....	= 89 40 00
Bearing.....			= -3 00
H. C. R. on sun.....			= 89 37 00
Correction.....			= -86 40 00
H. C. R. on line.....			= 176 39 30
Bearing of line.....			= 89 59 30

APPENDIX C.

THE DETERMINATION OF THE MAGNETIC MERIDIAN.

Although the compass is not allowed for establishing lines of Dominion lands surveys, it is employed for other purposes and a knowledge of the direction of the magnetic meridian or of the magnetic declination is useful. For the determination of this direction, transit theodolites of the D. L. S. pattern are fitted with especially sensitive needles. As the observation can be made in a few minutes and with very little trouble, it is desired that all surveyors should observe when they can do so without inconvenience.

The observation and the recording for an are arranged for the determination of the azimuth of the magnetic needle instead of the magnetic declination. The arrangement is made for the sake of simplicity in observing and recording, the bearing in question being, subject to instrumental corrections, the angle read on the horizontal circle of the transit. Moreover, it is not liable to errors of sign, as in adding or subtracting the declination.

DIRECTIONS FOR OBSERVING.

1. Place the instrument on a section line, and after adjustment, set the vernier to read the bearing of the line.
2. Release the lower clamp, direct the telescope on the line, and fasten the lower clamp.
3. Release the vernier clamp, and turn the vernier plate until the north end of the magnetic needle observed with a magnifying glass, is seen exactly opposite the zero mark. Tap the trough *lightly with the pencil*, or preferably rit the milled part of one of the footscrews with the finger nail, to be sure that the needle has taken the position of rest. Note the reading of the horizontal circle. Take several readings by repeating the operation.
4. Repeat operation No. 3 for the south end of the needle.
5. Enter in the notes the place of observation, date, hour of the day, kind of time used, nature of the weather and any other remarks deemed necessary. *It is important to record auroras occurring within 24 hours of the time of observation.*

REMARKS OF OBSERVATION.

For saving trouble and calculations, it is suggested that observations be made on section lines; they may, however, be made on any line of which the azimuth is known.

The direction of the magnetic needle is subject to a daily fluctuation called the diurnal variation. During the greater part of the night the direction is not far from normal. In the early morning, the north end of the needle in Canada moves towards the east, reaching its maximum deflection about 7 or 8 a.m. The motion is now reversed, the north end travelling westwards, and crossing the normal direction about 10 or 11 a.m. The extreme western position is reached in the afternoon and then the needle comes back to its normal position at some time after 5 or 6 p.m. This march is subject to wide variations during magnetic storms. The magnitude of the diurnal variation is not constant. In the inhabited parts of Canada, it may exceed 20 minutes. Observations at both eastern and western elongations of the needle on the same day, that is between 7 and 8 a.m. and between 1 and 2 p.m., give the best results, and it is desirable that when convenient they may be taken then. This gives not only the best value for the declination, but also the diurnal variation which it is most useful to know. Failing this, however, the best time to observe is after 5 p.m., when the needle is about in its normal position. It is true that the normal position is crossed generally between 10 and 11 a.m., but the motion being very rapid and the time of crossing uncertain, the afternoon observation is preferable.

When an instrument is brought from England, it is usually found that the north end of the needle is depressed. To balance it without injuring the pivot point or cap, proceed as follows:

Raise the needle with the lifter, unscrew the end of the trough, withdraw the cover glass, take out the needle and shift the small brass counterweight. Then the lifter being still raised, place the needle upon it and lower the lifter gently. If the needle is not yet balanced, raise the lifter again and repeat the operation. The greatest care must be taken not to bend the needle in the slightest degree while shifting the counterweight, because the bending would change the direction of the magnetic axis.

In taking the needle out of the trough whether to rebalance the needle or to clean the agates, care should be taken to see that it is put back in its proper position. If replaced in the reverse position the index correction would be altered. For this reason, to safeguard against error, the position of the compass, whether "compass west" or "compass east" should be entered in the remarks after each observation when observing.

If the needle is sluggish, the observation cannot be accurate. The sluggishness is generally due to a dull pivot or a scratched cap. To keep both in proper condition, *the needle must always be lowered gently on its pivot and never be allowed to play, except when actually in use.*

There are instances of the polarity of the needle being reversed by transporting an instrument on an electric car. It is difficult to conceive that a needle may be brought into such an intense magnetic field as that of an electric car without its magnetism being affected in some way, therefore, it is preferable to avoid this mode of transportation.

The place of observation must be at least three or four hundred yards away from wires carrying direct electric current. There must be no iron near the instrument. The observer must scrutinize his clothing and make sure that he has no iron or nickel on his person. Iron is found in buttons, as wire in hat brims, in some forms of neckties, in watches, chains and other articles of jewellery. The pivot in folding reading glasses is frequently made of iron. In case of doubt, the object may be tried close to the compass, measuring the distance at which an appreciable deflection is first produced. If the object during the observation is not brought closer than fifteen or twenty times the above distance, the effect on the needle is negligible in observations of this kind.

The needle may be deflected by static electricity developed in cleaning the glass cover of the compass trough or the rubber frame of the reading glass: this electricity is dissipated by breathing on the glass or rubber frame.

When the telescope points to magnetic north, the needle should, if the instrument were accurately constructed, be exactly opposite its zero mark, but it seldom is. The deviation of the needle from the zero mark is the *magnetic index correction*; it is positive or + when the north end of

the needle is to the left or west of the zero mark; when on the right or east, it is negative or—.

With the needle opposite the zero mark, the telescope points in a direction which, in the following explanations, is called "compass north." To bring the telescope into the direction of the magnetic north, it must, if the index correction is positive, be turned to the right by an angle equal to the correction. Hence the rule that the index correction is to be algebraically added to the azimuth of compass north in order to obtain the azimuth of magnetic north (azimuth reckoned from 0° to 360°). Inversely, the index correction must be algebraically subtracted from the azimuth of magnetic north, such for instance as is taken from a magnetic map, in order to obtain the azimuth of compass north.

The index correction is ascertained by comparison with a standard unifilar magnetometer at the Magnetic Observatory. When possible, it is well to determine it both at the beginning and at the end of a survey.

EXPLANATION OF SPECIMEN OBSERVATION.

(a) H.C.R. of compass north.

This is the average of the mean north and south end readings. The transit was adjusted to read correctly the bearing of the section line, so that the horizontal circle reading of compass north is the bearing of compass north. If the transit had not been so adjusted a correction to this reading would have been required.

(b) Correction for convergence.

The correction for convergence is applied in order to reduce the bearing read on the horizontal circle to an azimuth. The value of the correction is taken from the diagram in the Astronomical Field Tables. It is added when the point of observation is in the east half of the township, and subtracted in the other half. The rule of clause 69 of the Manual is reversed, the object in this case being to refer the bearing to the meridian of the point of observation.

(c) Azimuth of compass north.

The bearing has now been reduced to an azimuth.

(d) Index correction.

In the example given, the index correction being negative is subtracted from the azimuth of compass north to obtain the azimuth of magnetic north. If the index cor-

rection were positive, it would be added to the azimuth of compass north. The index correction is furnished with each instrument after comparison with the unifilar magnetometer.

(e) Azimuth of magnetic north.

The azimuth of magnetic north is the angle formed by the astronomical and magnetic meridians.

SETTING A TRANSIT BY MEANS OF THE COMPASS.

In connection with surveys of Dominion lands, the most frequent use of the compass is for checking the courses of a traverse or for setting up the transit to read astronomical bearings.

In the first case, it is sufficient to make sure that there is no abnormal change in the reading of compass north: any sudden change indicates a probable mistake in some of the last courses.

The second case arises when it is desired to observe the pole star in day time at a place where there is no line of known azimuth. The problem consists in setting up the transit so that it shall read azimuths. If the surveyor has already ascertained the azimuth of compass north with his instrument, he merely sets his vernier to read this azimuth, releases the lower clamp, turns the whole instrument till the needle is exactly opposite the zero mark, fastens the lower clamp and releases the vernier clamp. With the instrument used for the specimen observation (No. 2216) and anywhere near the place where the observation was taken, the vernier would be set to read $27^{\circ} 11'.8$ or rather $27^{\circ} 12'$.

It may be, however, that the surveyor has not ascertained the azimuth of compass north with his own instrument and has to resort to the azimuth of magnetic north taken from a map or determined by another surveyor. Then the surveyor must, from the azimuth of magnetic north, deduce the azimuth of compass north by applying the index correction of his own instrument after changing the sign. Starting with $27^{\circ} 06'.0$ for azimuth of magnetic north in the case already cited, and the index correction being $-5'.8$, the surveyor would add $5'.8$ to $27^{\circ} 06'.0$, which would give him $27^{\circ} 11'.8$ for the azimuth of compass north. He would then proceed as already explained.

All these corrections, it may be observed, are generally small and in practice are frequently disregarded.

Form 16.-1-10.

OBSERVATION FOR MAGNETIC DECLINATION

Date 19th July 1908 Observer G. J. Lonergan D.I.S.
 Place 40 Chs. W of the N.E. Cor. of Sec. 33
 Tp. 49 Rge. 20 W. of 4^m Mer.
 Time 7.15 p.m. Instrument No. 2216
 Bearing of reference line 89°59'

H. C. R. FOR DIRECTION OF MAGNETIC NEEDLE

NORTH END		SOUTH END	
(1)	<u>27 15</u>	<u>27 17</u>	
(2)	<u>11</u>	<u>16</u>	
(3)	<u>12</u>	<u>10</u>	
(4)	<u>11</u>	<u>10</u>	
(5)	<u>10</u>	<u>12</u>	
Mean of North End <u>27 11.8</u>		Mean of South End <u>27 13.0</u>	
(a) H. C. R. of compass north.....		<u>27</u>	<u>12.4</u>
(b) Cor. for convergence.....			<u>- 00.6</u>
(c) Azimuth of compass north.....		<u>27</u>	<u>11.8</u>
(d) Index correction.....			<u>- 05.8</u>
(e) Azimuth of magnetic north.....		<u>27</u>	<u>06</u>

REMARKS

A few clouds — Windy.

No aurora.

Circle E — compass W.

Mean local time

APPENDIX D.

INSTRUMENTS.

The instruments most generally used by Dominion land surveyors are kept in stock at the head office. Some of these instruments are of a special type developed as the result of years of experience to meet the special requirements of Dominion lands surveys.

TRANSIT THEODOLITE FOR BLOCK SURVEYS.

The instrument for block surveys is a six-inch reiterating transit theodolite. The horizontal circle is graduated to five minutes and read by two microscopes to five seconds. A four-inch vertical circle read to minutes by a vernier, serves as a finder for stars and for measuring angles of elevation or depression.

The telescope has an object-glass of one and seven-eighths inches aperture and twelve and three-quarters inches focus. It has an eyepiece micrometer, the drum of which is divided into one hundred parts, each representing approximately one and two-thirds seconds. The diaphragm and micrometer can be revolved around the axis of the telescope so as to place the movable thread either horizontal or vertical. Precise level bubbles, electric lamps and special attachments are provided for astronomical observations.

The tripod is of the shifting head pattern for adjusting the instrument accurately over the station. Advantage can be taken of this feature for eliminating the effect of periodic errors of graduation in measuring angles, the instrument being shifted in azimuth so as to use different parts of the graduated circle.

This instrument was designed for the production of lines, the measurement of horizontal angles and the determination of latitudes and azimuths. These are the most important operations in a block surveyor's work and with this type of instrument great precision and convenience are obtained.

TRANSIT THEODOLITE FOR SUBDIVISION SURVEYS.

The instrument for subdivision surveys is a repeating four or five-inch transit theodolite, now listed by several firms as "D.L.S." or "Canadian" pattern.

The five-inch transit theodolite, the only kind now supplied, has a five-inch horizontal circle and a four-inch vertical circle. Both circles read to minutes by double opposite verniers. The telescope has a clear aperture of one and one-half inches and a focal length of ten inches. Three eyepieces are supplied; two ordinary inverting of high and medium powers, and one long diagonal. The diaphragm is the ordinary spider web with stadia threads. A spare diaphragm ruled on glass is supplied; it has the disadvantage in star observations of absorbing considerable light.

A trough compass is attached to the standards of the instrument; the needle is very sensitive and it can be adjusted with great precision. It serves for placing the instrument approximately in position for star observations in daylight, for checking the orientation in traverses and for the determination of the magnetic meridian.

A mahogany framed tripod is the regular equipment. Sliding tripods or other patterns can be supplied but they are not recommended.

The instrument fits in a leather covered case with shoulder straps, the outside dimensions being about $19\frac{1}{2}$ x $8\frac{1}{2}$ x 8 inches. The weight of the case with the instrument inside is about 27 lbs. The tripod weighs 9 lbs.

SIDEREAL WATCH FOR SUBDIVISION SURVEYS.

The sidereal watch is an 18 size 19 jewel movement in an open face nickel case. The dial is divided into twenty-four hours.

Before being accepted, each watch is tested at the Surveys Laboratory to ascertain if the adjustments have been made with the necessary accuracy. There may be slight changes by the time they reach the surveyors but their accuracy is ample for subdivision surveys.

No timepiece will give good service without reasonable care. Great changes of temperature must be avoided; this is accomplished by carrying it constantly in an inner pocket where it is maintained at an even tempera-

ture by the heat of the body. The pocket must be clean and reserved exclusively for the watch, which is placed in it always in the same position. It is a good plan, as a protection against dust, to keep it in a tight fitting case of chamois skin. If exposed to a very low temperature in winter, it may not only stop, but be injured permanently. It must be kept away from electric motors or dynamos, which might magnetize the balance. Winding every day as nearly as possible at the same hour is essential; this is to be done by turning the crown or the key and not by turning the watch. A watch must be cleaned and oiled every second year. A watch, particularly if of a higher grade, may easily be ruined by an incompetent workman; too much care cannot be exercised in selecting the man to whom it is entrusted. When any repairs are required, it is best to have them made through the head office.

ANEROID BAROMETER.

Formerly different grades of aneroids were kept in stock; but experience has shown that the cheaper grades are of little use and now only the best grade movement is stocked. The instruments are two and one-half inches in diameter and are put up in soft leather cases. They are graduated to 6,000, 8,000 and 12,000 feet. The divisions in the aneroids graduated to 6,000 and 8,000 feet are larger than in those graduated to 12,000 feet and the readings are consequently more accurate.

In requiring Dominion land surveyors to use aneroids, the object is to ascertain approximate elevations on the survey lines. If the index error is known, a fair idea of the elevations above sea-level may generally be obtained by comparison with the daily isobar maps of the Meteorological Service. As the instrument is very delicate and a slight jar is sufficient to alter the index error, no opportunity should be neglected of obtaining this error as frequently as possible, either by comparison with a standard barometer at any of the meteorological stations or by recording the aneroid reading, date and time of day, at all places of known elevation, such as railway stations. With these data, the index error can be calculated at the head office. A change in index error can often be deduced from readings

recorded at one place on different dates, even when the altitude of the place is unknown.

The aneroid is at best an unsatisfactory instrument. To get results upon which some degree of dependence can be placed it is necessary that the aneroid be handled with the greatest care. It is a good plan to have two, one being used to check the readings of the other.

STEEL TAPES.

The tapes kept in stock are flat wire tapes and quarter-inch steel bands. They are stocked in four, five, and eight-chain lengths. The wire tapes are one-eighth of an inch wide and very strong. Both kinds are divided into links throughout, the graduations being etched. Flat wire tapes with graduations on babbitt metal can also be supplied.

Steel tapes are very liable to break; this fact cannot be impressed too strongly upon the chainmen. In case an accident should happen, the surveyor ought to be provided with means of repair. Fairly good repairs can be made in the field with brass sleeves prepared with everything necessary for soldering. The broken ends of the tape are cleaned and inserted into the sleeve and a lighted match is held under it until the solder is melted, when the repair is completed. The central hole in the sleeve is to enable the user to see when the broken ends are in contact, and the other two holes are to indicate when the soldering material is melted, which takes place either when it bubbles in or runs away from these holes.

Prepared sleeves for flat wire tapes and for quarter-inch tapes are kept in stock.

STADIA RODS.

The stadia rods kept in stock are fourteen feet long and three inches wide. They fold in the middle. They are graduated in links and tenths. There are no figures on the rod, the colour scheme being so arranged that they are unnecessary. A folding circular level is attached to the back of the rod for holding it vertical.

The stadia wires of the transit theodolite are set by the makers in the supposed ratio of 1:100 between outside wires and 1:200 between middle and outer wires. As a matter of fact however they are never in this exact ratio.

The true ratios for each instrument are now determined at the Surveys laboratory and furnished to the surveyor along with the instrument. These ratios are used for calculating a table of the corrections to be applied to the distances read on the rod. If the surveyor should be without the true stadia constants, he can prepare his table of corrections by chaining a base on level ground and measuring with the stadia the distance of a number of points on the base; the difference between the two measurements gives the correction for each distance. The table is completed by interpolation. The measurement must be made when the air is quite steady and the conditions favourable.

CLINOMETER.

The clinometer usually kept in stock is of the pattern known as Abney Level. The angle of elevation or depression is read with a vernier and magnifying glass.

PACKING AND TRANSPORTATION.

Instruments must not be shipped without being packed in outside boxes: if shipped otherwise, there is great risk of injury in transit. For a surveyor's instrument enclosed in a single case, express companies charge three times the merchandise rate, but when the instrument is packed in its own case so that it cannot move and is covered with one or more additional boxes with proper packing or excelsior between, the charge is single merchandise rate. The triple rate will in no case be refunded by the Department to a surveyor who ships an instrument insufficiently packed and he will be held responsible for injuries in transit.

Aneroids and sidereal watches are too delicate to stand transportation by mail or express. These instruments are thoroughly tested at the Surveys laboratory before delivery to surveyors who should arrange to receive them at Ottawa. They will, however, if a surveyor so requests, be forwarded by express packed with the greatest care, but at the surveyor's risk and without any guarantee that they will be in good order when they reach him.

APPENDIX E.

FORM OF AGREEMENT FOR LABOURERS AND COOK.

ARTICLES OF AGREEMENT made and entered into at the city of Hamilton, in the province of Ontario, this sixteenth day of March, A.D., 1912,

Between *John Brown*, of the city of Hamilton, Dominion Land Surveyor, hereinafter called the employer, and *William Smith*, labourer, of the same city, hereinafter called the employee.

Witness that the employee hereby agrees to enter into the service and employment of the employer and to faithfully and diligently serve him and his assistant or assistants, or any person under whose charge the employee may for the time being be placed by order and direction of the said employer in the capacity of *labourer* for the period of *eight months* from the date upon which the party shall organize at the city of *Calgary*, in connection with the surveys to be performed in the province of *Alberta*, or such shorter period as shall prove sufficient for the completion of the said surveys.

And also to execute, do and perform with all due despatch and punctuality and according to his skill and ability, all such work as the employer or such assistant or assistants or other person as aforesaid shall require him to do in the said capacity.

And also at all times to conduct himself honestly, faithfully and properly in the course of such service; and also not to leave the service of the employer or enter into the service or employment of any other person during such period without the written consent of the employer.

And the employer in consideration of such service agrees to pay to the employee the wages of *ninety cents* per day for the first *three months* of such service, and *one dollar and five cents* per day thereafter, and to board him so long as the employee continues to serve under this agreement.

And if the employee shall complete such period of service hereunder, or if he shall sooner quit such service with the consent in writing of employer, and if he shall have conducted himself honestly, faithfully and properly in the course of such service and shall have otherwise in all respects observed the provisions of this agreement the employer agrees to pay

him a bonus, sufficient together with the wages already agreed upon, to make up the wages at the rate of *one dollar and fifty cents per day* from the date upon which the employee reports for duty at *the city of Calgary* until the completion of such service.

Provided that if the employee shall be guilty of any misconduct in his service or shall commit any breach of this agreement, he may at any time be discharged by the employer, and in such case shall forfeit all wages which may then be due him, and also the said bonus without prejudice to the employer's other remedies.

In Witness whereof the parties hereto have hereunto set their hands the day and year first above written.

Signed in the presence of } *John Brown,*
Robert Jones. } *William Smith.*

FORM OF AGREEMENT FOR ARTICLED PUPIL.

Articles of agreement made and entered into at *the city of Hamilton* in the *province of Ontario* this *sixteenth* day of *March, A.D. 1912,*

Between *John Brown* of *the city of Hamilton*, Dominion Land Surveyor, hereinafter called the employer, and *William Smith* of *the same city* hereinafter called the employee.

Witness that the employee hereby agrees to enter into the service and employment of the employer and to faithfully and diligently serve him and his assistant or assistants, or any person under whose charge the employee may for the time being be placed by order and direction of the said employer in the capacity of *articled pupil* for the period of *eight months* from the date upon which the party shall organize at *the city of Calgary* in connection with surveys to be performed in *the province of Alberta*, or such shorter period as shall prove sufficient for the completion of the said surveys.

And also to execute, do and perform with all due despatch and punctuality and according to his skill and ability, all such work as the employer or such assistant or assistants or other person as aforesaid shall require him to do in the said capacity.

And also at all times to conduct himself honestly, faithfully and properly in the course of such service; and also not to leave the service of the employer or enter into the service or employment of any other person during such period without the written consent of the employer.

And the employer in consideration of such service agrees to pay to the employee the wages of *one dollar* per day for the first *two months* of such service and *two dollars* per day thereafter, and to board him so long as the employee continues to serve under this agreement.

And if the employee shall complete such period of service hereunder, or if he shall sooner quit such service with the consent in writing of the employer, and if he shall have conducted himself honestly, faithfully and properly in the course of such service and shall have otherwise in all respects observed the provisions of this agreement, the employer agrees to pay him a bonus sufficient, together with the wages already agreed upon, to make up the wages at the rate of *three dollars* per day from the date upon which the employee *leaves the city of Hamilton* for *the city of Calgary*, until his discharge, and to pay his travel expenses.

Provided that if the employee shall be guilty of any misconduct in his service or shall commit any breach of this agreement, he may at any time be discharged by the employer, and in such case shall forfeit all wages which may then be due him, and also the said bonus and travel expenses without prejudice to the employer's other remedies.

In witness whereof the parties hereto have hereunto set their hands the day and year first above written.

Signed in the presence of } *John Brown.*
Robert Jones. } *William Smith.*

APPENDIX F.

RATION LIST.

Figures for 100 rations or subsistence for one man for 100 days.

Articles.	Alaskan Parties U. S. Geological Survey.	National Transcontinental Railway.	Canadian Militia.	C. P. R. Land Department.	Canadian Pacific Railway.	Grand Trunk Pacific Railway.
	(1)	(2)		(5)	(6)	(7)
Allspice..... lbs.		0-10			0-12	0-07
Apples, evap..... "		5-80		16-60	11-90	8-33
Apricots, evap..... "		4-16			5-95	
Bacon..... "	71-60	50-00	12-50	66-70	23-80	41-66
Bacon, long clear..... "						27-77
Baking Powder..... "	2-90	0-83		3-30	2-38	2-77
Barley..... "		1-66				(8)
Beans..... "	14-30	26-60	12-50	16-66	11-90	27-77
Beef, corned..... "		26-60				20-83
Beef, extract..... "		1-66				
Beef, dried..... "	2-70				5-95	(8)
Beef Tea Capsules..... "	0-20					
Biscuits..... "		20-00	(3)			
Bread..... "			100-00			
Butter..... "	14-00	15-80	12-50	20-80	14-28	16-66
Cabbage..... "						(8)
Candles..... "		6-66		3-33		
Celery Salt..... "	0-04					
Cereal..... "	17-90					
Cheese..... "		5-80	6-25	9-15	5-95	5-55
Cherries, canned..... "					9-60	
Chocolate..... "	1-80					
Cinnamon..... "	0-04				0-12	0-14
Coal Oil..... gal.					1-10	
Coffee..... lbs.	5-40	3-33	2-08	5-00	9-52	5-55
Codfish..... "		5-00			5-95	0-69
Corn, canned..... "		2-50			19-20	(8)
Corn Meal..... "		5-00		10-00	7-14	8-33
Corn Starch..... "		3-33			2-38	(8)
Cream, condensed..... "		5-83				
Currants..... "		3-33			2-38	2-77
Curry..... "	0-04					
Eggs, crystallized..... "	3-00					
Fish, dried..... "						8-33
Flour, wheat..... "	100-00	125-00		133-20	95-24	166-00
Flour, Buckwheat..... "					11-90	13-88
Fruit, evap..... "	22-30					
Ginger..... "	0-04	0-08			0-12	0-27
Ginger, essence..... "		0-08				
Ham..... "		33-30		28-30	23-80	
Hops..... "		0-20				(8)
Jam..... "		5-00	12-50			
Lard..... "		6-60			9-52	8-33
Lemon Extract..... "		0-08		0-31	0-21	0-13
Lime Juice..... "	0-08	2-10				
Lye..... "					0-48	0-27
Macaroni..... "		0-83			1-20	(8)
Marmalade..... "		1-66				(8)
Matches, small boxes..... lbs.		4-50	(4)	2-50	2 12-14	2 28-36
Meat..... "		6-60	100-00		6-24	6-05
Milk, condensed..... "		10-00				(8)
Molasses..... pts.						

RATION LIST—Continued.

Figures for 100 rations or subsistence for one man for 100 days.

Articles.	Alaskan Parties U. S. Geological Survey.	National Transcontinental Railway.	Canadian Militia.	C. P. R. Land Department.	Canadian Pacific Railway.	Grand Trunk Pacific Railway.
	(1)	(2)		(5)	(6)	(7)
Mustard..... lbs.	0-42	0-04		0-21		0-55
Nutmegs..... "	0-01	0-05			0-06	0-07
Oatmeal..... "	16-60			10-00	9-52	13-88
Onions..... "	0-54	6-60			4-62	
Peaches, canned..... "		6-60			24-00	(8)
Peaches, evap..... "					11-90	
Pears, canned..... "						(8)
Peas, split..... "			3-125		4-76	(8)
Peas, canned..... "		10-00				(8)
Pea Sausages..... "	3-20					
Pepper, black..... "	0-20	0-36	0-17	0-36	0-24	0-27
Pickles..... gals.		0-31		0-62	1-43	(8)
Potatoes..... lbs.			100-00		95-24	(8)
Potatoes, evap..... "	16-10	6-60				
Prunes, evap..... "	6-60				11-90	16-66
Pork..... "	43-30					
Raisins..... "	(8)	3-30				7-49
Rice..... "	8-50	5-83			5-95	16-66
Salt..... "	5-30	5-50	3-125	8-00	4-75	5-55
Sago..... "					2-38	
Sauce, Worcestershire..... bot.		1 20-30			1 19-21	1 20-30
Soap..... lbs.		5-00		6-66		5-55
Soap, toilet..... cakes		3-00				
Soda..... lbs.		0-20			0-71	
Soup, veg., evap..... "	1-80	0-26		1-20		
Soup, condensed..... "		1-66				
Strawberries..... "						(8)
Sugar..... "	25-10	33-33	12-50	31-60	35-71	41-65
Syrup..... gal.		0-40		1-25	1-19	
Tapioca..... lbs.		2-66			2-38	(8)
Tobacco, chewing..... "		2-50				
Tobacco, smoking..... "		5-00				
Tomatoes, canned..... "		8-30			36-00	(8)
Tea..... "	3-60	6-66	1-56	3-30	3-55	5-55
Vanilla Extract..... oz.		0-10			0-12	
Vegetables, fresh..... lbs.			3-75	5-00		(8)
Vinegar..... gal.	0-18	0-20		0-20	0-24	0-27
Yeast, cake..... lbs.	1-60	1-60		1-40	1-50	1-66

(1) The amounts of some articles will, of course, be reduced if fresh meat, eggs and vegetables can be bought in the country, and also if transportation permits the carrying of canned vegetables, fruit and milk.

(2) Calculated from the figures for one man for one month.

The following named articles may be selected by the District Engineer in quantities varying from the above

list, but retaining the same relative amount of meat and vegetable food as given in the list:

Bacon, Pork, Corned Beef, Ham, Peas, Rice, Oatmeal, Cornmeal, Buckwheat Flour, Condensed Soup, assorted Jam and Marmalade.

(3) When bread or biscuit is not available an equivalent in weight of wheat flour or oat or cornmeal, instead of the ration of bread or biscuit, may be issued.

(4) When fresh meat is not available salted or dried meat, as can best be obtained, may be issued instead.

(5) Calculated from the figures for one man for thirty days.

(6) Calculated from the figures for fourteen men for thirty days.

(7) Calculated from the figures for twelve men for thirty days. Eggs, fresh meat and vegetables may be supplied as required if they can be obtained from the farming community.

(8) The article may be supplied instead of similar articles opposite which weights or measures have been shown.

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