

MANUAL
OF INSTRUCTIONS FOR THE
SURVEY OF DOMINION LANDS

DEPARTMENT OF THE INTERIOR
OTTAWA

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DOMINION OF CANADA

Manual of Instructions

FOR THE

Survey of Dominion Lands

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

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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,
October, 1917.

MANUAL OF SURVEY

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CHAPTER I.

DOMINION LANDS SURVEYS ACT.

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.

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.

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.

9. There shall be a Board of Examiners for the examination of candidates for admission as articled 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.

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.

3. Notice of such annual and other meetings shall be given in *The Canada Gazette*.

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.

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.

**Examina-
tions.** 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.

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 articulated
pupil.** 15. No person shall be admitted as an articulated 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** 16. Except as hereinafter provided, no pupil shall be entitled to be examined for a commis-

sion 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 affidavit 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.

18. If an articulated 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 articulated pupil himself without reference to the consent and approbation of his father or of any other person.

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.

20. Articled pupils shall transmit to the secretary of the Board, by registered letter, within

examination
for commis-
sion.

Transfer of
pupil.

Variation of
form when
pupil is of age.

Completion of
term with
another
surveyor.

Duplicate of
articles and of
transfers to be

transmitted
to Board.

three months of the date of their articles, a duplicate thereof, together with a fee of two dollars for filing such duplicate.

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 ser-
vice 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 grad-
uates 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-

Examination
for commis-
sion as a
surveyor.

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:—

- (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

Security and oath.

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.

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 ensuring 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 examination 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:—

- (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 a 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 articulated 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

Surveyors' records.

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 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

Subsidiary standard.

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 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

Procedure for compelling attendance of persons who have information as to boundaries.

boundary, or forty-ninth parallel of latitude, and shall lie in ranges numbered, in the province of Manitoba, east and west from a certain meridian line run in the year one thousand eight hundred and sixty-nine, styled the principal 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 lines 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, that 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.

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.

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.

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.

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.

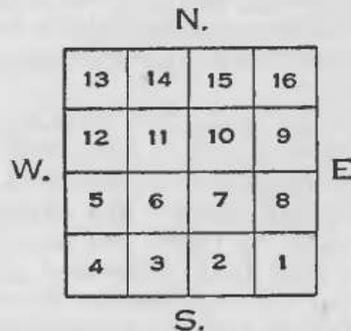
Surveying to be by contract or tender.

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 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.

Exception.

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:—



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 Description resurveyed under the provisions of this Act of plans 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 Confirmation Surveyor General shall be held to be a confirma- of plans.

tion 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.

When lands are deemed surveyed.

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.

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 filed 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 of 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, 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.

Arbitration proceedings.

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.

Award.

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, license or agreement of sale, representing that part or the whole of the monuments of the original survey have disappeared and cannot be found.

Resurvey on petition.

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.

Notice.

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.

Evidence of original survey.

Production of evidence.

4. Before re-establishing 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 re-established 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.

59. Undisposed of Dominion lands may be resurveyed when necessary.

Resurvey to have effect of original.

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 re-establishing 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.

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.

Laying out half or quarter-sections.

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 land.

Lines on 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 as defined by monuments shall be deemed the true boundaries.

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 authorized 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.

RE-ESTABLISHMENT OF LOST CORNERS.

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;

(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;

(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 re-established as provided in paragraph (a), previously to re-establishing the outline of the township;

(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 on meridian boundary.

(e) When a corner on either of the meridian boundaries of the section is also lost, such meridian shall be re-established previously to re-establishing the east and west line.

Road allowance to be taken into account.

2. Whenever a surveyor places a monument, as aforesaid, to re-establish a lost corner, he shall duly take into account any allowance for a road 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.

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.

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.

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.

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 offence.

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.

Destroying
marks of
original
survey.

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, 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.

76. Sections 16 to 80 inclusive, 206, 212, and ^{Repeal.} 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 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 re-

quired 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 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, 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 pur-
 suance of the said agreement the first 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 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 further been 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 and the guardian, testified by their being parties 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, 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 adminis-

trators, 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*.

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 .

SYSTEM OF SURVEY

AND

INSTRUCTIONS TO SURVEYORS

CHAPTER II.

SYSTEM OF SURVEY!

I. GENERAL DESCRIPTION.

1. The initial meridians, from which ranges are numbered, are:

The Principal meridian passing about twelve miles west of the city of Winnipeg. At the fourth base line its longitude is $97^{\circ}27'28''.4$.

The Second meridian in longitude 102° (very nearly).

The Third meridian in longitude 106° , and so on, each initial meridian after the second being four degrees west of the preceding one.

The Second meridian east, in longitude 94° . Ranges are numbered easterly from this meridian.

The Coast meridian of British Columbia to which are referred the townships of the Fifth System, hereinafter described.

2. Sections being laid out of the precise width of eighty chains on the base lines, and the meridians being drawn from the bases, north and south, it follows that the townships south of each base measure in an east and west direction more than 480 chains, exclusive of road allowances, while those north of the base measure less than this.

3. The number and the width of road allowances between sections 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," etc., systems of survey.

4. The instructions hereinafter are drawn up for the third system which is the most general; unless otherwise expressly provided, they apply also to the other systems.

5. Preliminary to the subdivision into sections of any given portion of country, the same is laid out into townships by projecting the base lines from the initial meridians and the central meridians from the base lines to the correction lines.

6. 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.

2. FIRST SYSTEM OF SURVEY.

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

8. 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 meridians.

9. 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.

10. 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 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. (See map.)

3. SECOND SYSTEM OF SURVEY.

11. 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 meridians which is distributed equally among all quarter-sections as in the third system.

12. The operation of the second system of survey is restricted to the following townships:—

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. (See map.)

4. THIRD SYSTEM OF SURVEY.

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

14. 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.

15. The township, therefore, measures from north to south, four hundred and eighty-three chains, and from east to west, four hundred and eighty-six chains, subject to the deficiency or surplus from the convergence of meridians.

16. The deficiency or surplus from the convergence or divergence of meridians 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.

17. The surplus or deficiency found on the central meridians when closing on the correction line is divided equally between the quarter-sections adjoining that line.

In cases where the township outlines were first projected, the surplus or deficiency found when closing on the correction line was 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 was carried to the first base line, or forty-ninth parallel of latitude.

18. Since the townships of the third system are, like those of the first and second systems, based on the international boundary and the initial meridians, while their dimensions, on account of the reduction in the number and width of the road allowances, are smaller, there occur fractional townships and ranges of the third system at junctions with the first and second systems.

19. The fractional township of the third system lying between a township of the third system and the township of the first or second system next in number is designated by the larger number followed by the letter A, as for instance:

Township 19A.

for the fractional township of the third system lying between township 18 of the third system and township 19 of the second system, west of the Second meridian

20. Likewise, the fractional range of the third system lying between a range of the third system and the range of the first or second system next in number is designated by the larger number followed by the letter A, as for instance:

Range 24A.

for the fractional range between township 48, range 23 of the third system and townships 47 and 48, range 24 of the first system, west of the Second meridian.

The letter A is omitted, if unnecessary, when it is already appended to the number of the township, as for instance:

Township 47A, Range 24.

for the fractional range between township 47, range 23, of the third system and township 47, range 24, of the first system, west of the Second meridian.

But the letter A is appended to both township and range numbers when another township with the same numbers has the letter A appended to the number of the township, as for instance:

Township 27A, Range 13A.

for the fractional township between township 26, range 12, of the second system and township 27A, range 13, of the third system, west of the Second meridian.

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

21. 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.

22. 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.

23. 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.

24. 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.

25. The correction line is established by projecting the central meridians of the townships 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 correction line is run east and west perpendicularly to the central meridian from the southern base and across three sections on each side of the meridian; on this line are placed the posts marking the township, section, and quarter-section corners for townships on both sides of the correction line.

The rules 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.

26. 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.

27. 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.

6. FIFTH SYSTEM OF SURVEY.

28. Certain townships in the British Columbia 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).

29. 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. (See map.)

7. SETTLEMENTS, GROUP LOTS, TOWNSITES, AND OTHER AUTHORIZED SUBDIVISIONS.

30. Settlements. 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 is adhered to, even when a settlement is laid out in ranges, instead of giving the same number to corresponding lots in the several ranges.

31. 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 improve-

ments 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.

32. The side lines of a settlement lot are parallel lines except at the places, if any, where the course of the base line changes. Unless some reason exists for adopting a different line, it is convenient to make the rear boundary of a settlement lot parallel to the base line.

The side lines of a lot fronting on a river are not extended across the river. They are stopped at the points where they first strike the bank of the river and between those points the bank of the river is the boundary.

33. 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.

34. Group Lots. 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.

35. The limits of groups and their numbers are those of the sectional maps issued or projected by the Surveyor General. Each group comprises eight townships in latitude and fifteen or a smaller number of ranges in longitude.

36. 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.

37. 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.

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

39. 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.

40. *Townsites.* A townsite 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 townsite is commenced.

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

42. As a general rule, streets and avenues are not made less than 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.

43. 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.

44. 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.

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

45. In a townsite 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.

46. 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 be advisable to make the lots narrower than those in the remaining or residential portion.

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.

47. A town block is the land comprised between two adjacent streets and two adjacent avenues.

Blocks are numbered in regular succession, every block having a distinct number or symbol.

The lots in a block are likewise numbered in regular succession.

48. The method of laying out townsites 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.

CHAPTER III.

BOUNDARY MONUMENTS.

1. POSTS, MOUNDS, PITS AND TRENCHES.

49. A boundary monument consists of a standard post planted midway between four pits or in the centre of a circular trench, with or without a mound (Figs. 3 to 12).

In rocky ground requiring the use of the short standard post, the pits are omitted.

50. The standard post, Fig. 1, consists of a piece of one-inch iron pipe 30 inches in length filled with concrete. A malleable iron foot-plate three and one-half inches in diameter, and a bronze cap three inches in diameter, are fastened to the bottom and top, respectively, of the post. It weighs $7\frac{1}{2}$ pounds and is packed in basswood crates of ten posts each, weighing about 85 pounds.

The standard post is used in all ground except where bed-rock or a boulder too large to be moved with the tools of a survey party is encountered above ground or less than twelve inches below the natural surface of the ground.

The post is planted with the top of the bronze cap flush with the surface of the ground. When bed-rock or a boulder too large to be moved with the tools of a survey party prevents sinking the post to the full depth of 30 inches, the foot-plate is placed upon the rock, and earth or stones are accumulated around the post so as to raise the surface of the ground flush with the top of the bronze cap.

51. The short standard post, Fig. 2, is a bronze casting three inches in diameter with a shank $\frac{7}{8}$ -inch in diameter projecting for three inches from its under side, the weight being less than one pound.

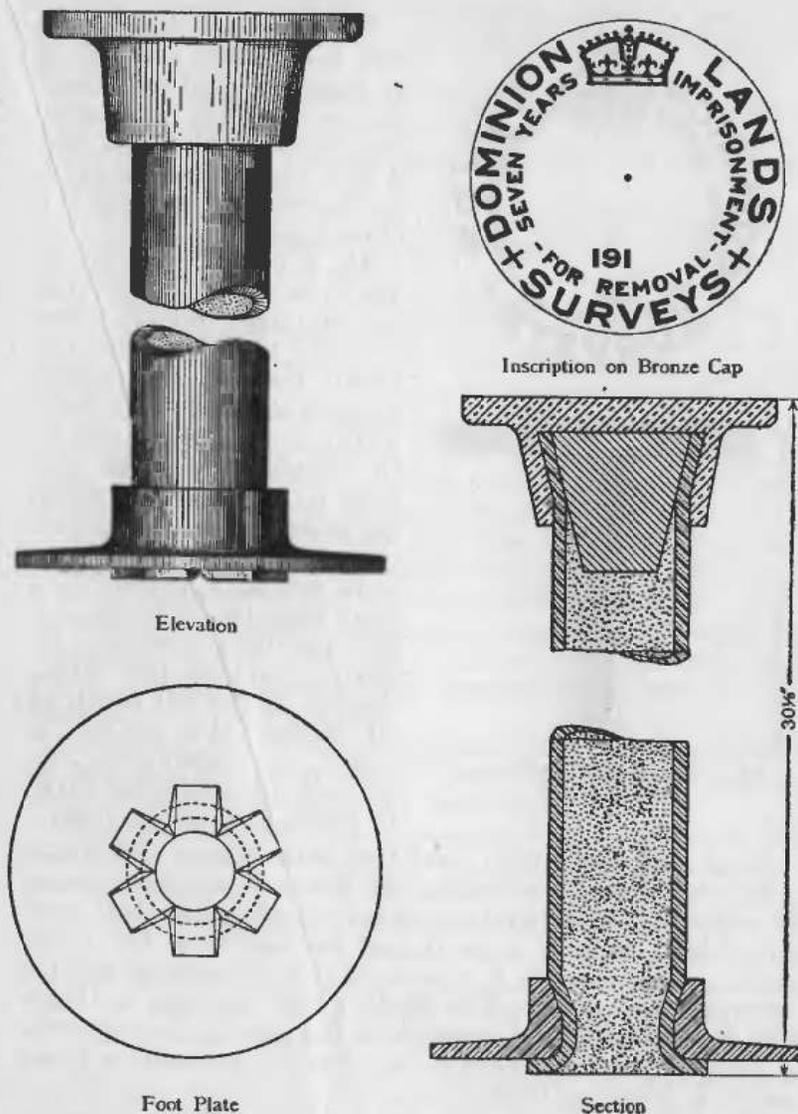


Fig. 1. Standard Post

The short standard post is used whenever bed-rock or a boulder too large to be moved with the tools of a survey party is encountered above ground or less than twelve inches below the natural surface of the ground.

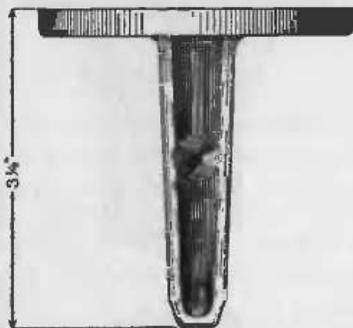


Fig. 2. Short Standard Post for planting in rock

The surface of the rock is laid bare within a radius of at least one yard by removing and widely scattering the covering earth so that it may not be covered again by the action of water or any other agency.

52. A hole 30 inches deep has to be made for receiving the standard post. After inserting the post, with the crown towards the north, the hole is filled with earth which is tamped around it. In tamping the earth care must be taken not to strike the bronze cap. When bed-rock or a boulder too large to be moved is encountered more than twelve inches below the natural surface of the ground thus preventing digging to the full depth of 30 inches, the surface is raised, as previously explained, by gathering earth or stones around the post.

In ground not frozen, and free from stones and roots, a convenient tool for digging the hole is a post-hole auger. In stony or frozen ground, a bar of octagonal drill steel with chisel ends is a good tool for loosening the earth and cutting roots. A spoon shovel is convenient for removing the earth. The kind of tool required is therefore dependent upon the nature of the ground encountered.

Under no circumstance is any force to be used on these posts in planting them.

53. A hole three inches deep and $\frac{7}{8}$ -inch in diameter has to be drilled for receiving the short standard post.

Short sixteen-inch diamond hand drills numbered 1, 2 and 3, have been found convenient for drilling the holes. Number 1 drills are intended for the hardest rocks such as solid quartz, hardest granite, hardest gneiss, etc. Number 2 drills are for medium rocks such as

quartz, granite, gneiss, hornblende, etc. Number 3 drills are for soft rocks such as sandstone, limestone, marble, etc.

A three pound cast-steel sledge-hammer on a ten-inch handle is most convenient for striking. The drill is held in the left hand and the hammer swung with the right hand, the drilling requiring only one man.

A heavier sledge-hammer on a long handle swung by a second man has been found to break the drills when working on very hard rock.

An inexperienced man holding and striking can drill a three-inch-hole in the hardest rock in twenty minutes, and one drill will sink at least two such holes before requiring resharpening.

The drill should be rotated slightly after each blow, and the dust frequently flushed out of the hole by dashing in some water. The use of water is necessary also for preventing overheating of the drill's cutting edge.

When the necessary hole has been drilled, all dirt and foreign matter is carefully removed and the hole filled with a paste made by adding one and one-half ounces of water to two and one-half ounces in volume, not weight, of Portland cement. The post is then inserted with the crown towards the north and pressed down until the cap rests upon the rock surface.

The quantity of cement required is small; it must be of best quality. The supply has to be protected against moisture and is best kept in a water-tight tin.

54. Only a single row of monuments to indicate the corners of 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, for which special instructions are issued, monuments are erected to indicate the corners of legal subdivisions.

55. 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.

An exception is made to this rule in the case of an Indian reserve bounded by the regular road allowance along a township or section line in which case the monuments are placed as directed for other township or section lines.

56. All mounds, pits and trenches are of the same dimensions whether they indicate township, section, quarter-section or other corners.

Whether a mound is or is not built the centre of each of the four pits is seven feet from the post, which is in the centre of the square formed by the pits.

57. A corner mound is five feet square at the base and 30 inches high. Except on correction lines and lines between different systems of survey, the centre of the mound built

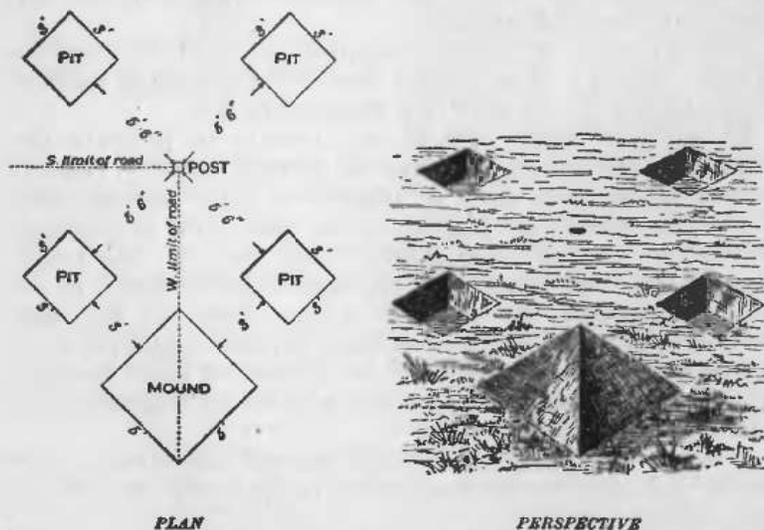


Fig. 3. Monument at township or section corner defining four sections

at a township, section or quarter-section corner is ten feet (nearly) due south from the post as illustrated by Fig. 3 for a township or section corner. A pit is three feet square and eighteen inches deep.

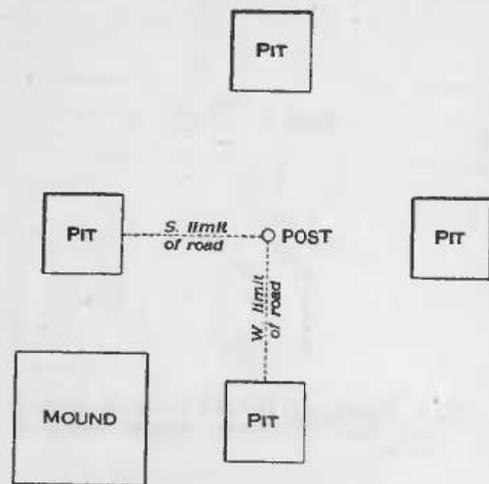


Fig. 4. Monument at township or section corner for south side of correction line

58. At a corner on the south side of a correction line or of an east-and-west line between different systems of survey, or on the west side of a north-and-south line between different systems of survey, the centre of the mound is 10 feet (nearly) south-west from the post (Fig. 4).

At a corner on the north side of a correction line or of an east-and-west line between different systems of survey, the centre of the mound is 10 feet (nearly) north-west from the post (Fig. 5).

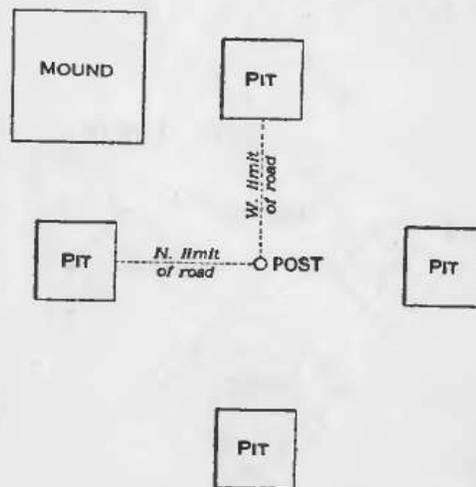


Fig. 5. Monument at township or section corner for north side of correction line

At a corner for the east side of a north-and-south line between different systems of survey, the centre of the mound is 10 feet (nearly) south-east from the post (Fig. 6).

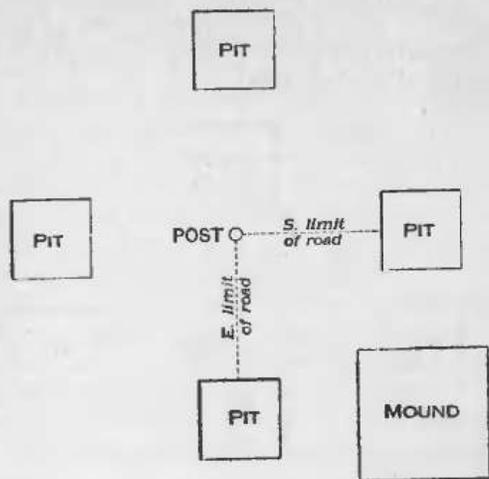


Fig. 6. Monument at township or section corner on east side of line between different systems of survey

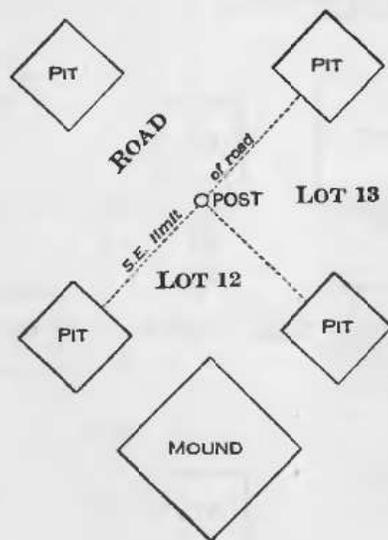


Fig. 7. Monument at corner between lots 12 and 13 of a settlement

59. At other corners, the general principle is to place the mound on the lands which it is intended to mark, and off the road allowances, as illustrated by Fig. 7, but its centre is always placed 10 feet (nearly) from the post and at the regular distance from the pits.

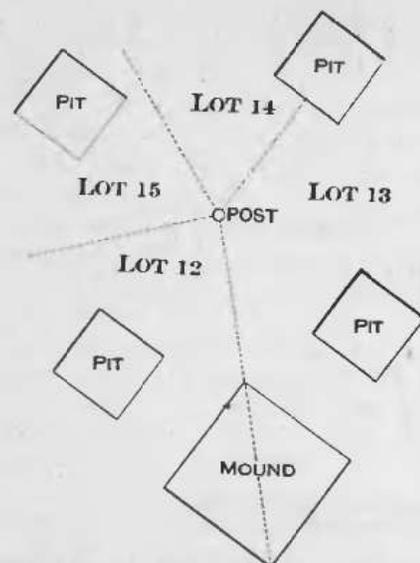


Fig. 8. Monument at corner of four lots

60. At a corner common to four or more lots, the pits are placed diagonally to the line running most nearly towards the north (Fig. 8).

At a corner common to three lots, the pits are placed square to the line opposite the greatest of the three angles formed by the three limits of the lots (Fig. 9).

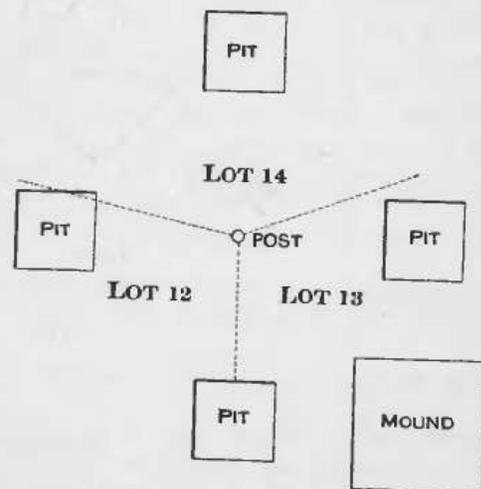


Fig. 9. Monument at corner of three lots

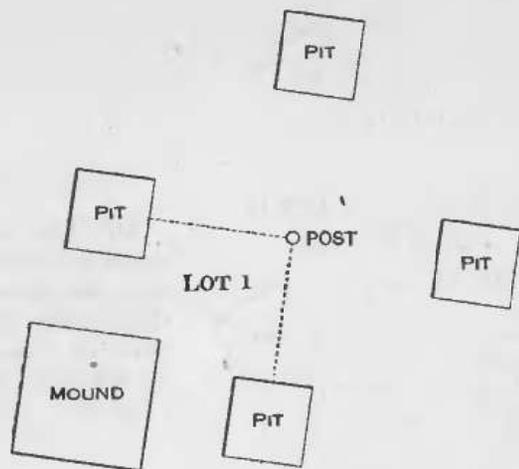


Fig. 10. Monument at northeastern corner of a single lot

61. At the corner of a single lot, the pits are placed square to the western or the eastern boundary of the lot as the case may be (Figs. 10 and 11).

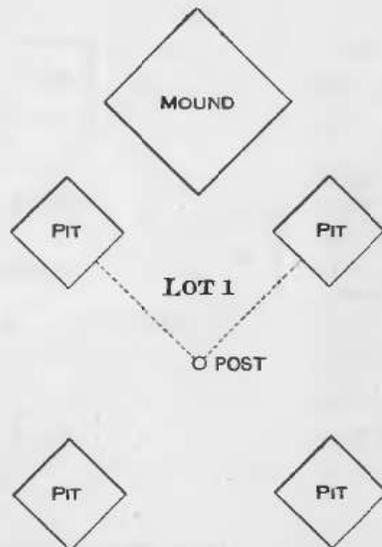


Fig. 11. Monument at south-western corner of a single lot.

The pits on the boundary line between two lots only or at a corner common to two lots only are placed square to the line (Fig. 7).

62. The monuments erected for marking the limits of highways are the same as at corners on correction lines.

63. If a corner fall in water, in the bed of a stream, on an inaccessible mountain or in any other locality unfavourable to the erection of a monument, the surveyor perpetuates such corner by a witness monument on the surveyed line at the nearest suitable point distant a number of full chains from the corner. The distance in chains and the bearing of the site of the true corner from such witness monument are stamped on the post. 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 the 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.

64. The position of a monument may also 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.

65. A witness trench is circular, of six feet inside diameter. The trench proper is twenty-four inches wide and twelve inches deep.

A witness mound is conical, six feet in diameter and thirty inches high.

66. A witness post stands in the centre of the circle formed by the trench. The centre of the mound is on the line surveyed and at a distance of 10 feet from the post in the direction opposite to the corner witnessed. (Fig. 12).

67. Whether at a corner or witness monument, a stone mound is built in preference to an earth mound, when stones are available, but, except with the short standard

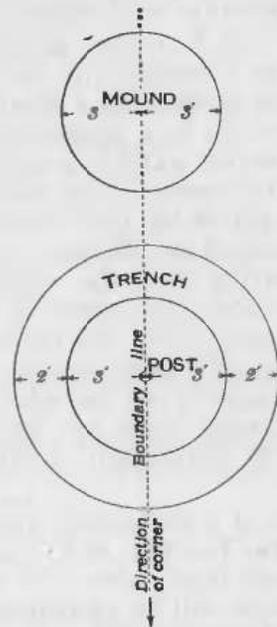


Fig. 12. Witness monument for corner south of monument

post, pits must be dug also, the relative positions of the post, mound and pits being as already described.

When the short standard post is used, the pits are omitted and a stone mound is built at the place which it would occupy if the pits were built.

68. In the formation of mounds, the earth is taken from the pits or trench. They are formed of solid earth, roots and all foreign substances being excluded, and the earth well pressed down with the spade during the process.

69. No mound is built in prairie, the monument consisting of a post and pits or a post and trench only. The earth from the pits or trench is scattered about so that they may not be filled again by cattle pawing the earth into the pits.

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

When large trees or other obstacles interfere, the positions of the pits relative to the directions of the lines may, when necessary, be rotated to suit circumstances, provided the lines joining the centres of opposite pits shall always pass through the post, but one of the pits may be omitted when it is found impracticable to dig the four pits.

Small openings of two chains or less in extent, in continuous bush country, are not classed as prairie, and therefore mounds are built at 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.

71. No mounds or pits are made for perpetuating corners in a townsite. The corners are marked with standard or special posts; the numbers of the lots are stamped on the top plug which is flush with the ground.

72. 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.

73. 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.

74. On all surveys, whether of base lines or township subdivision, monuments are built as the survey progresses and not left to be built at some future time. This rule is to be carried out irrespective of the difficulties which may be met with.

Every boundary monument must, after it has been erected, be inspected by the surveyor or by one of his assistants.

A surveyor must not leave temporary marks on his lines with the expectation that the Department will take the necessary steps to have them replaced by permanent boundary monuments at some future time. If for any reason, the surveyor is unable to erect regular boundary monuments as directed by the Manual, the survey must be discontinued and the facts reported to the head office.

75. The erection of a second boundary monument at a corner where another monument is already in existence is expressly forbidden unless the monument found is destroyed. If the surveyor has no authority to destroy the old monument, he must obtain it before erecting a new monument.

Any surveyor guilty of a contravention of this rule will be liable to dismissal.

2. INSCRIPTIONS ON POSTS.

76. The inscriptions on the posts are made with steel dies.

The set of seventeen dies consists of a $\frac{5}{16}$ -inch straight line die, of the letters N, S, E, W, T, R, of the monogram LS for legal subdivision, and of the figures 0 to 8 inclusive, 9 being made by turning 6 upside down. A string may be inserted through a hole in the shank for tying a strip of red fabric, if deemed necessary for picking up the die readily in case it should drop in the brush or grass. The dies are packed in leather cases with a separate compartment for each.

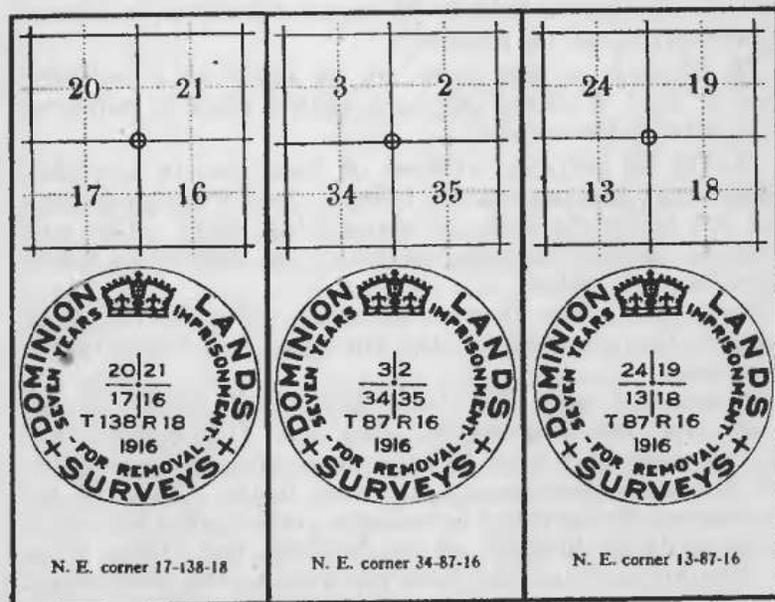


Fig. 13. Section corner in interior of township or on township outline

77. At a township or section corner not on a correction line or an initial meridian or a line between different systems of survey, four $\frac{5}{16}$ -inch cross-lines are stamped with the straight-line die on the bronze cap, to represent the four section lines meeting at that point; the number of the corresponding section is stamped in each of the angles. Below the cross, the number of the township preceded by the letter T and the number of the range preceded by the letter R, are stamped. In ranges east of the Principal meridian, the letter E is stamped after the number of the range. The use of the letter W to denote ranges west of the Principal meridian has been discontinued. The number of the year is to be completed on all posts. (Fig. 13.)

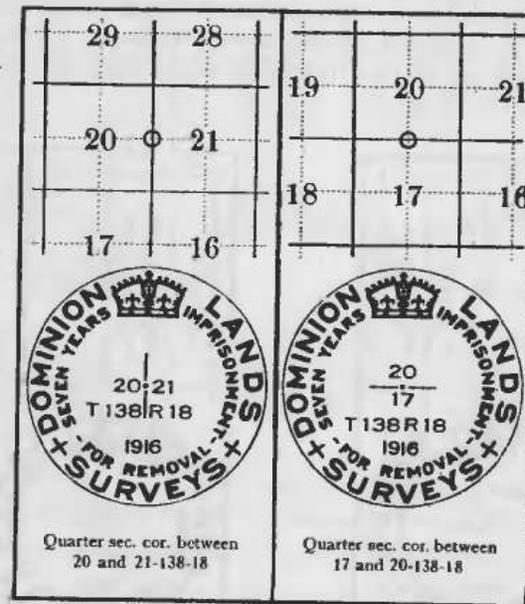


Fig. 14. Quarter-section corner in interior of township

78. The post at a quarter-section corner not on a correction line, an initial meridian or a line between different systems of survey is stamped in the centre with two $\frac{5}{16}$ -inch lines running up and down or right and left, as the case may be, to represent the section line, and the

numbers of the adjoining sections are stamped on the respective sides of this line. Below the centre, the township and range are marked as for a township or section corner. (Fig. 14).

79. The post at a township or section corner on a correction line, or an initial meridian or a line between different systems of survey is stamped with two $\frac{5}{16}$ -inch straight lines in the centre to represent the above line. On the proper side of the stamped line and at right angle thereto a $\frac{5}{16}$ -inch line is stamped to represent the corresponding section line. In the two angles thus formed, the numbers of the corresponding sections are stamped. On a correction line and on a line running east and west between different systems of survey, the numbers of the township and range are stamped above or below the centre of the cap according as the corner belongs to a township situated north or south of the aforesaid line. In all other cases the numbers of the township and range are stamped below the centre (Fig. 15).



Fig. 15. Section corner on north side of correction line



Fig. 16. Section corner on initial meridian

In the case of initial meridians, the only section numbers stamped are those of the sections in range one, those of the sections, in the closing range from the adjoining meridian not being always known at the time of the survey of the meridian (Fig. 16).

80. The post at a quarter-section corner on a correction line or an initial meridian or a line between different systems of survey is marked like the township or section corner post on the said lines except that there are only two $\frac{5}{16}$ -inch stamped lines in the centre to represent the section line, and only one section number (Fig. 17).

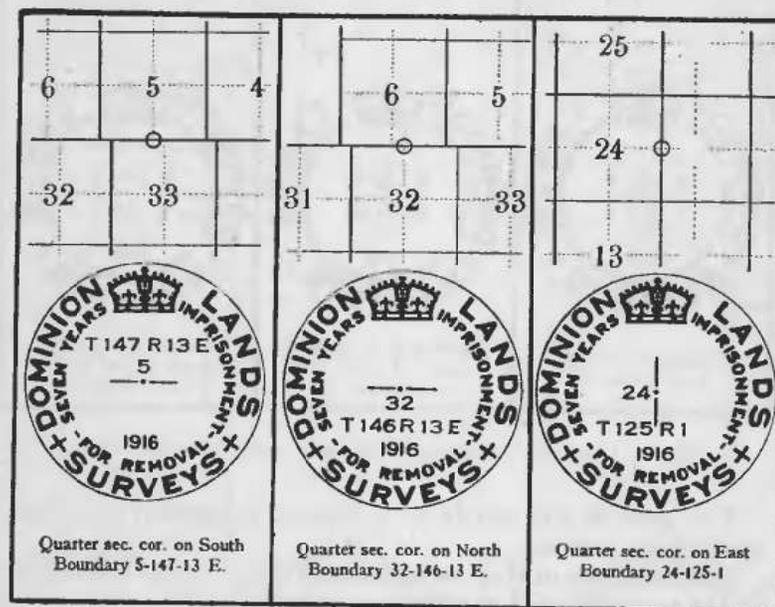


Fig. 17. Quarter-section corner on correction line or initial meridian

81. The post at a legal subdivision corner, not on a correction line or a line between different systems of survey or on an initial meridian, is stamped in the centre with four $\frac{5}{16}$ -inch lines, to represent the legal subdivision lines; the legal subdivision numbers preceded by the monogram LS are stamped in the four angles thus formed.

For a corner in the interior of a section, the number of the section is stamped below the centre of the cap (Fig. 18).

For a corner on a section line, the numbers of the sections are stamped on the respective sides of the centre of the cap (Fig. 18).

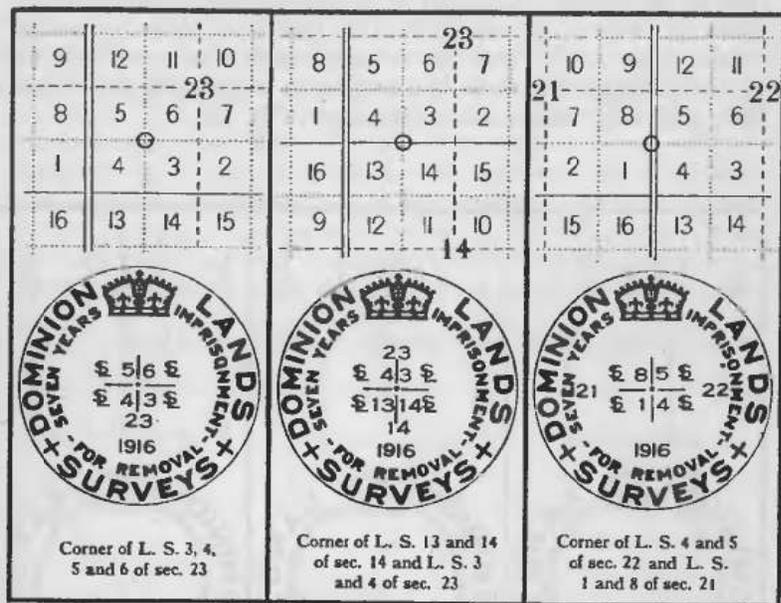


Fig. 18. Legal subdivision corner: in interior of section or on section line

The post at the centre of a section is marked as a legal subdivision corner.

The numbers of the township and range are not inscribed on the posts of legal subdivision corners.

82. The post at a legal subdivision corner on a correction line or on a line between different systems of survey is inscribed for the legal subdivisions which it is intended to mark (Fig. 19).

On an initial meridian the post is marked only for the legal subdivisions in range one.

83. A witness post is marked like the post at the corner it is intended to witness, and there are added the letters WT as an abbreviation of "witness", the distance in chains to



Fig. 19. Legal subdivision corner on correction line



Fig. 20. Witness to section corner in interior of township

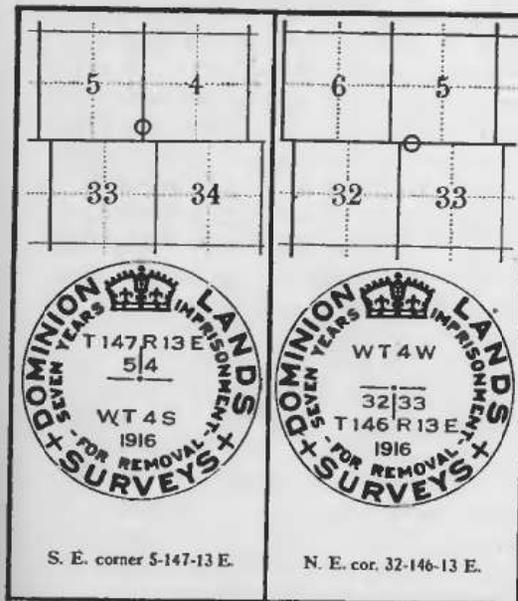


Fig. 21. Witness to section corner on correction line



Fig. 22. Witness to quarter-section corner in interior of township

the section or quarter-section corner, and the letter N, S, E, or W, to indicate the direction to the corner. This additional inscription is placed above the centre of the cap, except when the numbers of the township and range are there, when it is placed below the centre. (Figs. 20, 21 and 22).

There are no witness posts for legal subdivision corners.

84. The general rule for marking a post other than those described above is to stamp in the centre lines representing the boundary lines passing through or ending at the post, and to mark the designations of the adjoining parcels of land in the corresponding angles.

CHAPTER IV.

FIELD-WORK.

1. DIRECTION AND MEASUREMENT OF LINES.

85. The surveys of Dominion lands are astronomical, that is to say, the direction of the lines is referred to the astronomical meridian. The use of the magnetic needle for running such lines, or the limits of townships, sections or lots, or for establishing the boundaries of property of any kind or for ascertaining the courses of traverses in subdivision surveys, is not allowed, but it may be used as a check against errors, for sketching, and for work of a like character.

86. For the purposes of these instructions, the terms "*azimuth*" and "*bearing*" have the following meaning:—

The azimuth of a point *B* from another point *A* is the angle formed by the vertical plane containing *A* and *B* with the plane of the astronomical meridian passing through *A*, such angle being reckoned from north, around through east, south and west, to 360°, east being 90°, south 180°, west 270° and north 360° or 0°. It follows that, except in the case of a meridian or the equator, the azimuth of a straight line changes as the initial point moves along the line and that a direction is not defined by an azimuth unless the initial point is specified or implied.

The bearing of a point *B* from another point *A* is the angle formed by the vertical plane containing *A* and *B* with the plane of a fixed astronomical meridian, which may or may not be the astronomical meridian passing through *A*, such angle being reckoned like the *azimuth* from north around through east, south and west, to 360°. It follows that a straight line has the same bearing at all its points, but except in the case of a meridian or the equator, a direction is not defined by a bearing unless the meridian to which the bearing is referred is specified or implied.

From the above it is seen that the difference between the azimuth and the bearing of a line is that the azimuth is the angle of the line with the meridian of its initial point, while the bearing is the angle of the line with the meridian adopted for reference of all the bearings of the survey.

Let it be assumed, for instance, that in subdividing township 121, an observation for azimuth is made at a point S, Fig. 24, 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.

92. The bearings of each 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.

93. Except in the survey of townships, all lengths or distances are expressed in chains and links. In the survey of a township, 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.

94. Measurements are made with steel tapes, tested frequently during use by comparison with the subsidiary standard of the surveyor. The subsidiary standard is not used on field work, but is carefully preserved for purposes of comparison. Distances are chained along the surface of the ground and reduced to the horizontal by means of the slope which is measured and recorded in the notes.

95. Previous to entering on their duties, the chainmen are to be sworn and such oath is filed with the returns of survey.

96. 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.

97. All lines in woods between boundary corners 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 at least four inches in diameter within fifty links from the line.

98. Blazed lines are not intended to mark the boundaries or limits of the parcels of land laid out; they are opened and blazed for the sole purpose of assisting in finding the corner monuments.

2. TOWNSHIP SURVEYS.

99. The first operation in laying out townships in a given portion of country is to establish the meridians and the base lines.

100. The lengths laid out on initial meridians and base lines are measured twice, so that the surveyor may be absolutely certain that no mistake has been made by his chainmen. He uses two tapes: one divided into chains and links, and the other one into feet or some measure other than chains.

101. Every precaution is taken to secure precision in the measurements. Slopes are read with a clinometer and corrections are applied for the inclination of the tape and for its temperature.

102. Azimuth is ascertained and direction given with a six-inch micrometer transit theodolite. The azimuth, which must be correct within a few seconds, is obtained by observation of the Pole Star.

103. When the distance across an obstacle is triangulated it is checked by another operation, entirely independent, either another triangle, an offset, or a micrometer measurement, so as to conform to the principle of double independent chainage.

104. While surveying an initial meridian or a base line, the country is explored for twelve miles on each side of the line.

The main object of the exploration is to ascertain the location and extent of the lands which are adapted for settlement and which should be subdivided. The explorer must endeavour to collect all the information necessary for the purpose.

105. The exploration must also furnish the main topographical features of the country, courses of streams, position and extent of the lakes, hills, etc. Any information as to means of access and routes of travel that may be useful to surveyors coming later is also desirable.

106. The location, kind and extent of the woods are also needed. Particular attention must be paid to merchantable timber, quantities being estimated, if possible.

107. In closing with a base line upon an initial meridian, the last township corner of the base line is connected by a straight line with the township corner on the initial meridian, the deviation never extending beyond the last range or fraction of a range.

108. After the establishment of the base lines, the next operation is the survey of the control meridians and control chords.

109. Except in special cases, the regular procedure is to start a control meridian at the northeast corner of section 33 on the base line and to run it due north or due south to the correction line. The corresponding control meridian

is then surveyed from the next base line to the same correction line. Permanent monuments are erected for all section and quarter-section corners except on the correction line where temporary posts are left. These posts are connected by an instrument line and their positions are so altered as to give an equal depth to the adjoining quarter-sections and to leave a road allowance of correct width, after which permanent monuments are substituted.

110. The east and west section lines across a township are called *chords*. The central chord through the northeast corner of section 16 is the control chord: it is turned from that corner and surveyed easterly and westerly as a perpendicular to the control meridian. The quarter-sections are laid out of theoretic width and permanent monuments are erected for all section and quarter-section corners.

Before commencing the survey of the township the theoretic length of the quarter-section on each chord should be entered by the chief on the form supplied in the chainage book.

111. The subdivision of the township is completed by turning the chords from the section corners on the control meridian and turning the meridional section lines from the section corners on the control chord. The chords are perpendicular to the control meridian but the convergence of meridians, taken from the diagram in the astronomical field tables, is allowed for in turning the meridional section lines from the control chord.

It is not necessary that the whole of the control chord be established before proceeding with the survey of the other subdivision lines: the lines may be taken up in such order as may be convenient.

112. In running chords or meridional section lines, temporary marks are left at theoretic chainage for section and quarter-section corners. The permanent section corner monuments are erected at the intersection of the meridional and chord lines and the quarter-section monuments midway between the section corners, but should a surveyor be certain that the position of a quarter-section corner located by his chainage is not more than a few links out of place, he may dispense with the temporary mark

and erect the permanent monument at once, without waiting for the establishment of the adjoining section corners.

113. Neither chords nor meridional section lines are deflected in the interior of a township, except in the last quarter-section adjoining a township outline previously surveyed. Any deflection or deficiency or surplus is left in this last quarter-section.

114. The central meridian or the central chord may, on account of the nature of the ground or for some other reason, be unsuitable for control. In such a case the surveyor may take for control another meridian or another chord, but unless some reason exists for the change, the central lines are preferable. It must be remembered that if the control meridian is not the central one, the chords are not perpendicular to it.

115. The lengths laid out on the control meridian and control chord are chained twice. Two tapes are used: one divided into chains and links and the other into feet. Where a triangle is resorted to for passing an obstruction, the operation is checked by another triangle in order to conform to the principle of double independent chainage.

116. All section lines are surveyed whether they are along road allowances or not and all section and quarter-section corners on such lines are marked by monuments.

In special cases, for which instructions are issued, quarter-section lines are surveyed and the corners of legal subdivisions on the surveyed lines are marked by monuments.

Section lines are extended across all bodies of water struck by them when it is possible to do so; corners falling on islands are marked by monuments in the regular way.

117. Only one limit of the road allowance along a correction line is surveyed at one time, but connections are made with the monuments on the opposite side of the road and are recorded in the field notes.

118. The opposite limits of the road allowance on a correction line are not parallel; they are perpendicular to the respective control meridians and form an angle equal to the convergence of the said meridians. This angle is calculated from the jog and from the convergence per mile taken from the diagram in the astronomical field tables.

In Fig. 25, which represents a correction line in a range numbering west of an initial meridian, the control meridian

is brought from the south to the point A and the other control meridian from the north to the point B. Instead of making the last quarter-sections at A and B forty

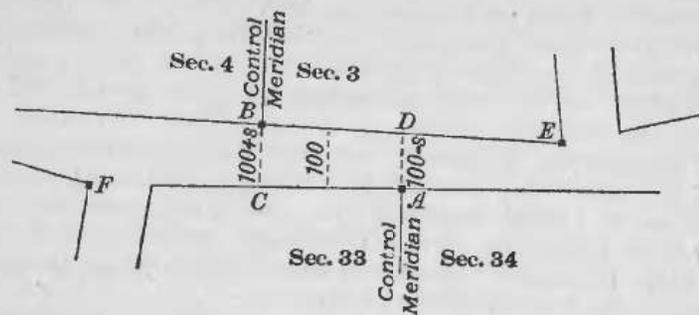


Fig. 25

chains, the surveyor calculates from the data supplied to him, what the depth must be in order to leave one chain for the road allowance and he lays out both quarter-sections of that depth, placing temporary marks at A and B.

The road allowance must be one hundred links wide midway between A and B. Opposite A, it is a little narrower, $(100-s)$ links, while opposite B it is a little wider, $(100+s)$ links. Designating by J the jog in chains and by c the convergence of meridians in minutes per mile,

$$s = 3.7 \times \frac{c}{2} \left\{ \frac{J}{100} \right\}^2 \text{ Links.}$$

The convergence of meridians is taken from the diagram in the astronomical field tables.

At the township corner E, the road is narrower than 100 links, the deficiency d , in links, being:

$$d = s \left\{ \frac{486}{J} - 1 \right\}$$

It is wider than 100 links by the same amount at the township corner F.

119. Starting from the temporary post A at right angles to the control meridian, the line is run westerly as far as C, opposite B and the width CB measured. The deficiency or surplus is divided equally between the last quarter-sections of the control meridians and permanent monuments erected.

Or the start may be made from the temporary post B at right angles to the control meridian and the line run

easterly as far as D opposite A. The width DA is measured and the deficiency or surplus divided equally as before.

120. 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 the irregularity is due to an error in the prior survey, the surveyor may correct it if there is authority in the Dominion Lands Surveys Act for the correction. If the error cannot be corrected he must deflect his own line at some section or quarter-section corner so as to leave a road allowance of normal width.

121. As laid out under the above directions, a correction line is midway between the base lines, and it runs due west (very nearly) as far as the last township corner before striking the next initial meridian. From this corner it is deflected to strike the township corner on the initial meridian: the opposite side of the road in the fractional range is made parallel to this line at a distance of one chain.

122. In the fractional range adjoining an initial meridian, the control and other chords are not surveyed perpendicularly to the control meridian: they are made parallel to the base line. Several cases arise. The figures refer to ranges numbering west of an initial meridian: by reversing them, they apply to ranges numbering east.

123. Fig. 26 illustrates the case where the ranges north and south of the correction line are both more than three sections

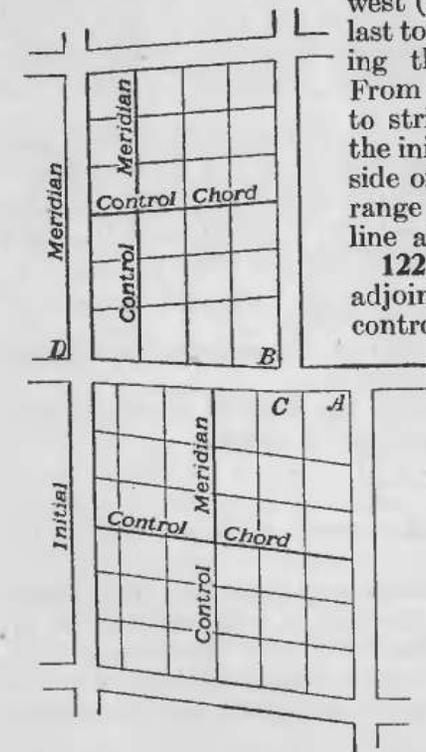


Fig. 26

wide. The control meridians are in their regular places. The north limit of the road on the correction line is,

as far as the township corner B, a perpendicular to the control meridian of the next township to the east. From B, it is a straight line to the township corner D on the initial meridian. The other side of the road starts from the township corner A, established in the survey of the township to the east, runs to a point C one chain south of B, and thence in a straight line to the corner on the meridian.

In the survey of the regular adjoining townships on the east, the last quarter-sections on the meridians at A and B are made equal. This being the case, an inspection of the figure shows that the last quarter-sections of the control meridians of the fractional ranges will seldom be equal: their value must be calculated from the deviations of the base lines.

124. In Fig. 27, the township north of the correction line is less than three sections wide while the township south of it is more than three sections. In the latter, the control meridian is in its regular position: in the township to the north, another meridian is adopted for control. The quarter-sections at the township corners A and B, which are or will be established by the regular mode of survey in the adjoining townships to the east, are equal: hence the last quarter-sections of the control meridians of the fractional range are not equal and their depth must be calculated from the deviations of the base lines.

The limits of the road allowance on the correction line are, as in the preceding case, a straight line between the township corners B and D, and a line deflected at C, one chain south of B, between the township corners A and E.

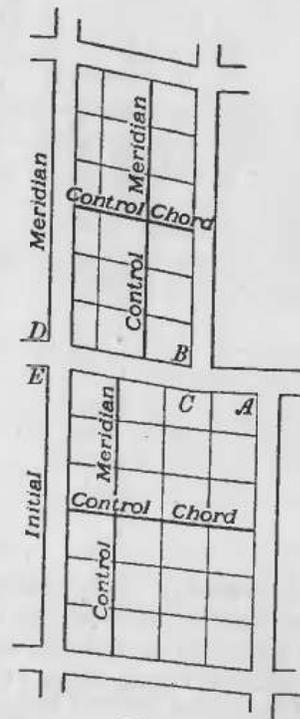


Fig. 27

125. The special case in which there is one range more south of the correction line than to the north of it, is represented by Fig. 28. In this case the south limit of the road is the line AC perpendicular to the control meridian of the next township to the east, thence the line CE from

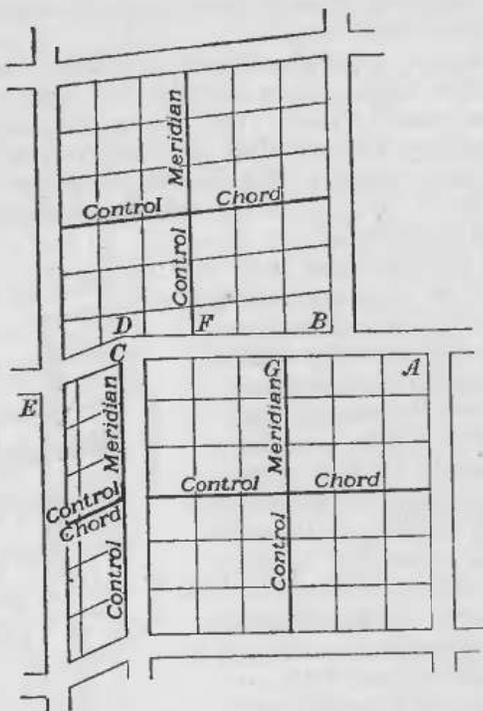


Fig. 28

the township corner of the extra fractional range to the township corner on the initial meridian. The north limit of the road is parallel and one chain distant. The extra fractional range being very narrow, its eastern outline may be taken as control meridian.

The quarter-sections adjoining the correction line at A, B, G and C are equal, but they are different from the quarter-section at F. Their values must be calculated from the deviations of the base lines.

126. A few deflections of a base line across a range exist elsewhere than in the fractional ranges adjoining meridians. In this case, the chords of the four townships, two on each side, established from this portion of the base line, are made

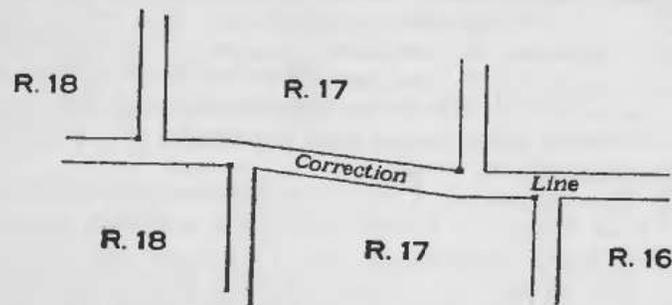


Fig. 29. Abnormal deviation occurring between initial meridians

parallel to it. The limits of the road on the two correction lines are deflected opposite the township corners, as shown in Fig. 29, so as to preserve the full width of one chain.

127. Control meridians between the first and second base line are run from the second base line southerly, and all quarter-sections are made forty chains except the last one adjoining the first base where the deficiency or surplus is left.

128. In subdividing a township of the first system of survey, the control meridian is not run due north and south, but on the bearing of the eastern outline of the township. The control and other chords are not perpendicular to the control meridian: they are run on a bearing of 90° or 270° . All quarter-sections are made forty chains, except those adjoining the outlines of the township.

129. Before starting for his survey, the subdivider is furnished by the head office with diagrams of the measurements on the adjoining surveys. Should the diagrams fail to reach him, he must call attention to the matter and ask for them.

130. 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.

131. 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. A road allowance may also be laid out along a reserve boundary if considered necessary for providing 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.

132. The intersections of the section lines with that side of the road allowance which adjoins the township are indicated by proper monuments, except when a reserve not yet surveyed is formed of a certain number of full sections, in which case the surveyor, in establishing the same, plants the posts as usual in township surveys. Otherwise 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.

133. 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. This applies also to any surveyed settlement that may be within the limits of the lands subdivided.

134. Connection is made with the corner of any group lot, mineral claim, timber berth 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.

135. 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.

136. Owing to the mountainous character of British Columbia, it is impracticable to survey the base, control

and other lines 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.

Section and quarter-section corners have now been established all along the railway and the results of the traverse survey are no longer made use of.

137. The position of the corners established by means of the railway traverse between the Fifth meridian and the Salmon Arm of Shuswap lake has been checked by a triangulation.

138. In mountainous country it is not always possible to follow a regular procedure in subdividing a township, but if at all practicable, each survey line should be part of a closed circuit in order that a check may be had on the accuracy of the survey. If necessary, additional section, quarter-section or legal subdivision lines may be run to complete the circuit, even though the survey of the parcel to be dealt with is complete without them.

A traverse for the purpose of establishing a corner is to be used only as a last resort, and then such traverse should be checked by a second independent traverse.

139. In making subdivision surveys, the lines to be surveyed are the section boundaries. Where this is impossible, on account of the mountainous nature of the country, or where such survey would entail exceptional labour and expense, such quarter-section, or legal subdivision lines must be surveyed as are found most convenient. Where a corner cannot be reached by running along section, quarter-section, or legal subdivision boundaries, it may be established at its correct position by means of a traverse as already mentioned. When it is impossible to reach two corners of a quarter-section, the corner or corners which cannot be reached are indicated by witness monuments so as to comply with the rule, adopted by the Department, that a quarter-section is sufficiently surveyed to be homesteaded, sold or otherwise disposed of when two of its corners are indicated upon the ground. The rule is an arbitrary one but in general is found satisfactory.

140. In subdividing townships it is desirable that astronomical observations be taken in sets of three, and

that as many sets as practicable be taken in each township. A record of these observations and of their calculations shall form a part of the final returns.

3. SETTLEMENTS, GROUP LOTS, AND OTHER SURVEYS.

141. Settlements.—Before proceeding with the survey of a settlement, the surveyor makes a rough compass survey of the road or shore upon which the settlers are located and of their improvements; he also inquires into the claims of each.

Upon the plan of the compass survey, he endeavours 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 should 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 are laid out north and south or east and west. Where this proves 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.

142. 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.

143. 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 must observe at least twice for azimuth during the course of the survey.

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

144. 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.

145. 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.

146. 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.

147. Group Lots.—Before undertaking the survey of a group lot, the surveyor must apply for a lot number.

148. 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.

149. Having fixed upon the initial corner of the lot, the surveyor runs from this corner and marks the boundaries of the lot. Where a part of the boundary is over inaccessible ground, the boundary is run as far as it can be done, and the corner is indicated by a witness monument which is connected to the next boundary by a traverse. Proper monuments are erected at the other corners. Except as stated above, all the boundaries of the lot must be surveyed.

150. 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.

151. 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.

152. Townsites.—A townsite 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.

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

153. 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 townsite is situated.

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

154. *Highways.* 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.

155. The starting and closing points of the highway survey 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 the end of the 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.

156. 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.

157. 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



Fig. 30

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 the two courses. For instance, the bearing of the back course being 70° and of the front course 120° , (Fig. 30)

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. 30), 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 XVII of the Supplement. 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.

158. 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 XVII.

159. 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.

4. RESURVEYS.

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

which have been lost. The expression is also used to include in a general way resurveys, retracements and restorations.

161. 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.

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

163. 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.

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

165. 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 and is not in error.

166. 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.

167. Where a monument is restored or a corner re-established, the new monument is to be erected in accordance with the present regulations for the erection of monuments of original surveys.

In restoring a monument consisting in part of a mound when the post has disappeared, the surveyor has to find out where the post was planted so as to place the new post at the same point. The following information will assist him in coming to a decision.

(a) Prior to the adoption in 1915 of the standard post and new monuments, the mound was in all cases in the centre of the square formed by four pits or in the centre of a circular trench.

(b) Until the adoption of the standard post in 1915, the iron post at a township corner, and since 1890, every other corner post was planted at the northerly corner of the mound, except on correction and similar lines, where it

was planted in the middle of one side of the base of the mound. From 1890 to 1902 a witness iron post was planted at the point of the base of the mound nearest to the corner; from 1903 the post was planted in the trench midway of its width.

(c) In 1913, 1914, 1915, and 1916, placing a post in the centre of a stone mound was authorized when rock prevented driving the post into the ground.

(d) Except as stated above, posts were planted in the centre of the mounds.

168. Whenever a subdivider finds that a corner on the outline of a township is not at 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 as far as the error extends.

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 the disposal of lands will be furnished on application to the Department.

169. 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 re-establishment of lost corners, the defective outline is retraced, or the part where resurvey is objected to may be retraced and the remainder resurveyed.

170. 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 retraced to the quarter-section corner. Lost monuments are re-established 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 re-establishment, 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.

171. 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 in accordance with the instructions given elsewhere for monuments of original surveys; no monument, however is to be restored which is not in the place where it should have been erected in the original survey.

172. Correction surveys are made under the provisions of section 57 of the Dominion Lands Surveys Act. No monument affecting the boundary of patented land can be displaced without the consent in writing of the owner 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 in 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 persons acquiring through the correction any improvements on the lands transferred are required to pay the owner such an amount as may be fixed by the surveyor. In the event of a refusal to pay this amount, the surveyor leaves the error uncorrected and reports 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.

173. In any case where a considerable error is found affecting land which has been patented and the owner does not agree to a correction, the old monument must be left as it is without any restoration and the lines which are incorrect must not be interfered with. There is always some doubt as to whether a monument far out of place is the one erected in the original survey; it is not impossible that it may have been built fraudulently by interested parties or otherwise. Nothing must be done by the surveyor that will give additional standing to such a monument; the parties affected must be left free to appeal to

the courts if they so desire, and the evidence of the original survey must be left undisturbed. The actual bearings and distances are ascertained and the facts of the case reported to the Department.

174. When the effect of the correction of a monument is to add to a man's property, his consent to the correction is not necessary.

175. 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.

176. A resurvey for the purpose of restoring obliterated monuments and re-establishing 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.

177. The names and addresses of those who have offered to give information in this connection are furnished to the surveyor together with forms of notices to such persons. These forms are 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 taken of his offer to furnish information and the resurvey is 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 re-established in its original position, unless it is in error, in which case it is corrected, if possible, under the provisions of section 57 of the Act, or left undisturbed. Persons giving information under the provisions of this section of the Act are not entitled to any remuneration or expense allowances.

178. The petition for a resurvey under section 58 is seldom signed by all the settlers in a township. Those

who do not sign may or may not be in favour of the resurvey. If the surveyor finds that the resurvey is objectionable to the majority of the settlers, it is best to discontinue it and to report the facts to the Department. Where the settlers in one portion of a township object and those in another portion are in favour of the resurvey the latter portion only is to be resurveyed.

179. When making resurveys under section 58, lost corners may be re-established without the consent of the owners of the lands affected.

180. In resurveys under section 58, any material error in the position of a corner must be corrected when the correction affects vacant lands only and does not interfere with road improvements, also when the error is over five chains and the lands affected are vacant and homesteads, or homesteads only. If improvements are affected, their value must be carefully estimated by the surveyor.

181. In the case of homesteads when the error is under five chains, it is generally possible to correct the error if no improvements are involved.

Sometimes roads are improved and fences erected where all the original monuments are lost. If the lines are not too far in error, they must not be disturbed.

182. Under no circumstances must the boundary of patented land be displaced so as to take away part of the land when the owner objects. Sometimes, however, there is reasonable certainty that the owner does not object; such is the case, for instance, for railway land grants when the lands have not yet been sold by the companies.

183. When a monument is re-established or its position moved to correct an error, all lines closing thereon must be retraced to the nearest existing monument in each case. 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 he is at liberty to re-establish 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.

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

185. If, in a township resurveyed under section 58, there are townsite or other subdivision surveys, the plans of which have been registered, the surveyor must consult the records of the Land Titles office in order to obtain information which will enable him to connect his surveys with such subdivision surveys.

186. When the line through a witness monument and the witnessed corner to the adjacent corners on both sides of the witnessed corner is represented on the official plan as a straight line and the line is found not to be straight on the ground, the deflection is to be left at the witness monument, if no monument is erected at the witnessed corner.

187. Whenever it is possible to do so, a monument is to be erected at the witnessed corner and the witness monument is to be destroyed, provided the corner does not fall in a place which is unsuitable for erecting a monument. In such a case, the deflection is to be left at the witnessed corner and not at the witness monument, and the quarter-section lines are to be made straight from corner to corner.

188. Upon resurveys, cases are constantly occurring which cannot be covered by general instructions and complications arise which render it very difficult for the surveyor to decide how to proceed. The best plan then is to report all the facts to the head office, and to send a sketch with accurate bearings and distances.

5. TRAVERSES.

189. A traverse is a connected series of straight lines of which the bearings and lengths have been determined.

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

(a) For establishing a boundary monument or connecting a boundary monument with another one.

(b) For ascertaining the contents of the dry land of a parcel bordering upon a stream or lake, or the area of the portion of a parcel covered with water and thereby rendered useless for farming.

191. In traverses of the first kind, (a), the length of the courses is measured with a steel tape. The stadia is used for traverses of the second kind (b), except in those special cases where it is more convenient and economical to measure lengths with a tape after ice has formed.

192. The lines of the traverse are not boundaries of the parcels bordering on bodies of water. They may serve to indicate whether a certain piece of land, as for instance an island, is or is not included in the parcel of which the contents have been measured by the surveyor, but it does not follow that because the surveyor did not include the island in his survey of the parcel, it will not pass with the grant of the parcel. The boundary of the parcel is determined by the rules of the law and the judicial construction of the terms of the grant, irrespective of the surveyor's intentions.

193. Land abutting on tidal waters is bounded by the line of ordinary high water. In the case of an inland lake or stream, the boundary, if the parcel does not include the bed, is the edge of the bed of the lake or stream which edge is called the *bank*.

194. 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 where it extends into the water or upon the soil itself. 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.

195. 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.

196. 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.

197. 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.

198. Where the land is slowly and imperceptibly added to, either by alluvion or by 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.

199. Riparian owners whose lands border upon unnavigable waters are presumed to be the owners of the bed of such waters in front of their holdings *ad filum aquae*. Their rights in this regard depend to some respect upon the precise terms of the description by which their lands have been conveyed to them and upon statutory enactments. Except as affected by any rights of navigation that may be held by the public and so far at least as the smaller rivers are concerned, riparian rights on inland streams navigable in fact although non-tidal, do not seem to differ much from those on unnavigable streams.

200. A grant of land carries land covered with water lying within the parcel, unless the contrary be made to appear. Islands within the middle thread of non-tidal streams are presumed to pass with the grant of land abutting upon the stream.

201. It is provided by the Irrigation Act, effective since 1898, 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 the Act is supposed to be intended to designate the portion of the bed which becomes uncovered when the water is low. The Act applies to Alberta, Saskatchewan, that portion of Manitoba incorporated within the province in 1912, and the Northwest Territories, with the exception of the provisional districts of McKenzie, Franklin, and Ungava.

202. Grants later than 1898 for lands bordering on lakes or streams in territory subject to the Irrigation Act

do not convey the bed of such lakes or streams, but some of the riparian rights, for instance the right to accretion and the right to islands within the middle thread of the stream, do not seem to be affected by the Act.

203. In patents for Dominion lands issued by the Department of the Interior, the area which the parcel granted is stated to contain is the area of the dry land only, and does not include the area of the land covered with water, if any, conveyed by the grant of the parcel.

204. From the foregoing it follows that along tidal waters, the line to be traversed is the high-water mark at ordinary tides, which line is the actual boundary of the land.

205. On non-tidal waters, the object of the traverse being to measure the contents of the land not covered by water, and not to locate boundaries, the line to be traversed in all cases is the bank, even though the parcels may include part or the whole of the bed.

206. Every river averaging one chain or more in width is traversed. When over two chains in average width, both banks are traversed. When under two chains, a single traverse is sufficient, the area of the bed being calculated with enough precision by means of the average width.

207. All islands and all bodies of water which do not dry up, are traversed when they exceed five acres in extent. Bodies of water, which are known to dry up, are not traversed. In case of doubt as to whether the extent is over five acres or whether a body of water dries up, the traverse is made.

208. An island smaller than five acres is located by the traverse and its dimensions ascertained approximately.

209. In following the bank, islands separated from the mainland by shallow and narrow channels are, in traversing, considered as belonging to the mainland and included in the adjoining parcels, but when the channel is deep, or is wide, or carries a large amount of water, the island is dealt with as a separate parcel so that it may be excluded by the terms of the patent when it is intended that it shall not pass with the grant of the land abutting on the body of water.

210. Alkaline mud flats which do not bear the weight of a man walking, are treated as lakes.

211. Water areas less than five acres in area, which are investigated but not traversed, are reported on in the field notes.

212. All water areas affecting the lands surveyed must be dealt with. A surveyor working in a township completes the survey of a body of water extending into the next township if the additional shore line to be traversed is not more than a mile or two.

213. Many of the small bodies of water found in the western provinces and commonly called lakes or ponds are not permanent, but shallow depressions filled with surface water, the depth and extent of which vary greatly at different seasons of the year. When the country is opened up and drained, they dry up and disappear more or less completely. The edge of such bodies of water, or of a marsh, or any other natural feature which is not susceptible of a precise definition and delimitation, is inadmissible as a boundary. When a parcel of land borders upon such a feature, as in a settlement or group lot, the boundary of the lot is defined by one or several straight lines, the corners being indicated by witness monuments if their positions are unsuitable for the erection of monuments. In townships, the land is dealt with by selecting the legal subdivisions and quarters of legal subdivisions (10 acres) which are not rendered worthless by water.

214. A marsh producing hay is not traversed and no deduction is made for it from the area.

215. 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.

216. 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.

217. A traverse is commenced at one of the traverse hubs planted by the surveyor while running the section

or lot lines, or at some boundary monument. It is closed upon the next traverse hub or upon another boundary monument.

218. The traverse of a water area or island lying entirely within a section or lot must be properly connected with the rest of the survey.

219. 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.

220. 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.

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

222. In the revision of water areas the survey is commenced at a section or quarter-section corner. If the next corner can be found the instrument is set up to read the bearing shown for the section line on the township plan. If the next corner cannot be found, the instrument is oriented by means of the magnetic needle, to read the azimuth of magnetic north deduced from previous readings on section lines, or from previous astronomical observations, or taken from the magnetic map and corrected for the instrumental index and the convergence. The index correction, which is furnished by the Head Office, is subtracted from the map azimuth taking its algebraic sign into account; the convergence is added or subtracted according as the place is west or east of the centre of the range. An astronomical observation for azimuth must be taken when the weather is favourable.

223. When no observation is taken and the instrument is oriented by means of the compass, the traverse must be continued until it closes upon another section or quarter-section corner. As many ties as possible should be made to adjacent monuments. In prairie country all traverses should be tied in at both ends; where another monument cannot, after search, be found, the final station may be tied back to the starting point. In the case of a large lake or river a tie must be made to a monument at least every three miles.

224. The stadia traverse of a water area is made from one or more instrumental stations at or near the shore, the rodmen following the bank and giving side shots at suitable distances apart. For small water areas it may be possible to make the traverse from a single station, the rodmen following the shore in opposite directions till they meet at the far side. For rivers and narrow bodies of water there may be some advantage in keeping one rodman on each side and surveying both sides at the same time.

225. Under normal conditions the survey is made on one side only, the front rodman travelling away from the surveyor, while the rear rodman travels towards the surveyor. The rear rodman having reached the surveyor, and the front rodman the next instrumental station, the surveyor moves his instrument to the next station while the rodmen are waiting in their places. Upon the arrival of the surveyor, the front rodman shows him the point of the new station, and the instrument is set up. The rear rodman places his rod upon the last station for orienting the transit, and the survey proceeds as before. The number of side shots depends upon the irregularity of the shore line, but the points determined must never be more than five chains apart.

226. The rodmen must be taught how to hold the rod vertically, how to ascertain that it is not hidden, and how to select a new instrumental station. They must also be instructed to turn the face of the rod slightly towards the sun when by so doing the sun can be made to shine upon the graduations. A system of signals must be arranged with the rodmen for directing them to stop or start again, or to indicate when the rod is hidden.

227. Before the front rodman leaves the instrument, he should be shown where the next instrumental station is to be.

228. The courses must, as far as practicable, be limited to lengths which can be read on the rod with the whole interval of the threads. They should very seldom exceed 30 chains, as stadia measurements beyond that distance lack precision.

229. When the sun is shining and the distance is great the rod cannot be read unless the sun is shining upon its face, and so only one of the rods can be used for measuring side shots according to the direction of the sun. The rodman who is not giving side shots along the shore takes charge of the boat and gets a few soundings. He also gives side shots or stations on islands.

230. For reading distances, the upper or lower thread is set on an even chain division of the rod. The number of chains and tens of links to the lower or upper thread is then counted, and the fraction of ten links estimated. Distances read by means of the whole interval are twice as accurate as those read with the half intervals. The length of courses between stations must always be measured with the whole interval, when the distance is less than twenty chains; the readings of the half intervals are, in such instances, to be used only as a check. The sum of the readings with the half intervals must equal the reading with the whole interval. For greater precision, and as a precaution against errors, the three threads should always be read, more especially for instrumental stations. Short courses should be avoided.

231. When the instrumental station is only a few feet above the water it is not necessary to record vertical angles along the shore. When, however, the inclination exceeds $1^{\circ} 30'$ for courses and 3° for side shots, the vertical angle must be recorded, and the proper correction applied to the distance read.

232. The rod is graduated to tenths of a link. The greatest care must be taken to keep it in good order, and the graduations clean. Figures must not be placed upon the rod; they are unnecessary and confuse the graduation.

233. Soundings are taken at each instrumental station, where practicable. When the water is shallow and the bed is uniform fewer soundings are necessary. For sounding, quarter-inch hemp rope is procured, and a two or three-pound lead weight is attached at the end. Every foot of the rope is marked with a small piece of string. Every ten feet is marked with a piece of red bunting, or other woollen material and every five feet with a piece of blue bunting. Before leaving the shore the end of the

rope is tied to the boat, and the rod is folded and placed in secure position. Soundings must not be taken with the rod.

234. Certain instrumental corrections have to be applied to the distances read on the rod. These corrections are determined and tabulated for each instrument at the Surveys Laboratory; they are printed on cards for use in the field.

235. If the nature and conditions of the shore are such that the traverse cannot be made with stadia in summer without opening lines in woods, the traverse is postponed and made on ice after it has formed. It may also be more convenient and economical to make a chained traverse on ice of certain rivers than to make the survey with stadia in summer. With these two exceptions, all traverses which are not intended to establish boundary monuments are made with the stadia.

236. In making a chained traverse of a river on ice, one line only is run and right angle offsets are measured to both sides. On other water areas the line is run near the shore. There must be enough offsets to determine all the irregularities of the bank; they must never be more than five chains apart and the offsets must not be more than four chains in length.

6. LIMITS OF ERROR.

237. With the astronomical field tables, the azimuth of the pole star may, with moderate care, be ascertained within a minute. With the addition of the errors resulting from the production of the lines, the bearings returned in the field notes for the section lines of a subdivision should therefore generally be correct within three minutes, if determined by the pole star. Sun azimuths are not quite so accurate; another minute may be added to the limit.

238. In running around a section, the accumulation of angular errors should seldom exceed three minutes. The limit may be exceeded when the transit for running the lines has to be set up on boggy or insecure ground, or when the nature of the ground is such as to require very short courses.

239. In flat or gently rolling country, it is found that when all the measurements around a section are made by one set of trained chainmen, and the lines are run with a moderate amount of care, the closing error is usually well within five links. Over marshy ground or muskegs, the closing error reaches 10 or 15 links. In the mountains of

British Columbia, the closing error is generally within ten links; it may reach fifteen links under unfavourable conditions.

240. The closing error in running around a section is readily ascertained by means of Table XIV of the Supplement giving the deflection of a trial line for deviations from 1 to 149 links at the end of 81 chains. The deviation is 2.36 links per minute, approximately 0.6 links per quarter minute; this coefficient, 0.6, may be used instead of the table so long as the deviation is not very large. If the four sides of a section were at right angles, the opposite sides would be equal in length; the effect of the convergence or divergence of these sides, as indicated by their bearings, is calculated with the coefficient 0.6 or taken at sight from the table. The difference between the calculated and the measured values is the closing error, north and south or east and west as the case may be. From these two errors, the total closing error is deduced.

241. The same agreement cannot be expected when the measurements are made by different sets of chainmen, even though the length of their chains may be identical. There is a personal error which may amount to as much as two links per mile.

242. Under the most unfavourable circumstances, the greatest error in a stadia traverse should not exceed one chain in one hundred chains.

243. Surveyors must check their measurements and closing errors as the work proceeds. Closing errors frequently in excess of the above limits indicate carelessness or defective practice in some part of the work; in such a case the surveyor has to decide whether the faults are of sufficient importance to require retracing the boundaries. A closing error exceeding the limit by a considerable amount, indicates a mistake in some part of the work and in such a case sufficient retracement must be made to locate the mistake.

244. All closing errors are checked on receipt of the progress sketches and the surveyor's attention is called to those which are excessive.

7. MAGNETIC OBSERVATIONS.

245. A surveyor who, in the course of his work, has occasion to observe for azimuth in a township, should make at least one determination of the magnetic declination in the township. Several are preferable, if they can be made without interfering with the survey.

CHAPTER V.

THE FIELD-BOOK.

1. ORIGINAL FIELD-NOTES OF LINES.

246. 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, etc., and in addition must present, as far as possible, a full and complete topographical description of the country surveyed. (See specimens, pages 108 to 113).

247. 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 do not 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.

248. For resurveys, retracements, etc., the bearing of the instrument line is entered at the top of the page; the offsets from the instrument line to the monuments are shown, and the bearings of the true line are entered along the line joining the monuments. (See specimen, pages 114 and 115).

249. The chainage field-book provides two pages for each section side; the left page is for a complete and accurate record of the actual chaining operations along the line; the right page is for the complete regular field-notes, all chain measurements shown thereon being deduced from the records on the left page. The book also contains additional pages for the check chainage of the control meridian and chord, the chainage of triangle bases and the solution of triangles, in case this work is entrusted to the chainmen.

No erasures or obliterated marks are to be made. Erroneous entries may be cancelled with a pencil stroke but must not be erased or rendered illegible.

Base line across river lots

Tp. 90 R. 9 W. - Mer. By of Sec.

Temp. 40° Date, 17th October Chainer, J.C.S.

| North $\frac{1}{2}$ | | | | Going South | | | | South $\frac{1}{2}$ | | | | Going South | | | |
|---------------------|-------------------------|--------|--------|-------------------------------------|-------------------------|-------|-------|---------------------|---------|-------|-------|-------------|---------|-------|-------|
| Distance | Remarks | Slope | Corr. | Distance | Remarks | Slope | Corr. | Distance | Remarks | Slope | Corr. | Distance | Remarks | Slope | Corr. |
| - | Road | | | | From Permanent Mark | | | | | | | | | | |
| 4.10 | From Per. Mark | -0.10 | | 5.00 | From Permanent Mark | -0.10 | | | | | | | | | |
| | +0.00 to edge of Valley | | | 5.00 | | +0.20 | 01 | | | | | | | | |
| 5.00 | | -5.00 | 1.90 | 5.00 | | +0.10 | | | | | | | | | |
| 5.00 | | -6.00 | 2.74 | 5.00 | | +0.20 | 01 | | | | | | | | |
| 5.00 | | -4.10 | 1.32 | 20.00 | | | | | | | | | | | |
| 95 | | -4.00 | 0.23 | 00 | Correction Temp | - | 02 | | | | | | | | |
| 20.050 | | | -6.19 | 20.00 | Planted Temp. Chain | + | 3 | | | | | | | | |
| - 61 | Correction Temp. | - | 25 | f. 012 | Moved ahead | + | 01 | | | | | | | | |
| 19.989 | Chain | + 3 | | 20.012 | Planted P. | | | | | | | | | | |
| + 11 | Moved ahead | | -6.14 | 5.00 | From Temp. Hub | | | | | | | | | | |
| 20.000 | Planted P. | | | | +0.90 to edge of Slough | | | | | | | | | | |
| 3.00 | | -5.10 | 1.22 | 5.00 | | 0.00 | | | | | | | | | |
| | +0.11 to N. edge Creek | | | | +3.70 to edge of Slough | | | | | | | | | | |
| | +2.91 to S. edge Creek | | | 5.00 | | +0.10 | | | | | | | | | |
| 5.00 | | +5.00 | 1.90 | 5.00 | | +0.30 | 002 | | | | | | | | |
| 5.00 | | +9.30 | 6.85 | 1.025 | | 0.20 | | | | | | | | | |
| 2.10 | | +9.30 | 2.88 | | | | | | | | | | | | |
| | +0.03 to edge Valley | | | | | | | | | | | | | | |
| 5.00 | | | | 21.025 | | | | | | | | | | | |
| 40.100 | | Slopes | -12.85 | 1 st Course = 20.000chs | Slopes | -0.02 | | | | | | | | | |
| - 128 | | Temp. | - 25 | 2 nd " = 20.025 " | Temp. | - 25 | | | | | | | | | |
| 39.972 | | Chain | + 3 | Correct length each course = 20.012 | Chain | + 3 | | | | | | | | | |
| + 2.8 | Moved ahead | | | | | | | | | | | | | | |
| | to Permanent Mark | | -12.80 | 1.00 Road | | | | | | | | | | | |
| - | Adjustment | | | - | Adjustment | | + 03 | | | | | | | | |
| 40.000 | Length of Quarter | | | 40.025 | Length of Quarter | | | | | | | | | | |

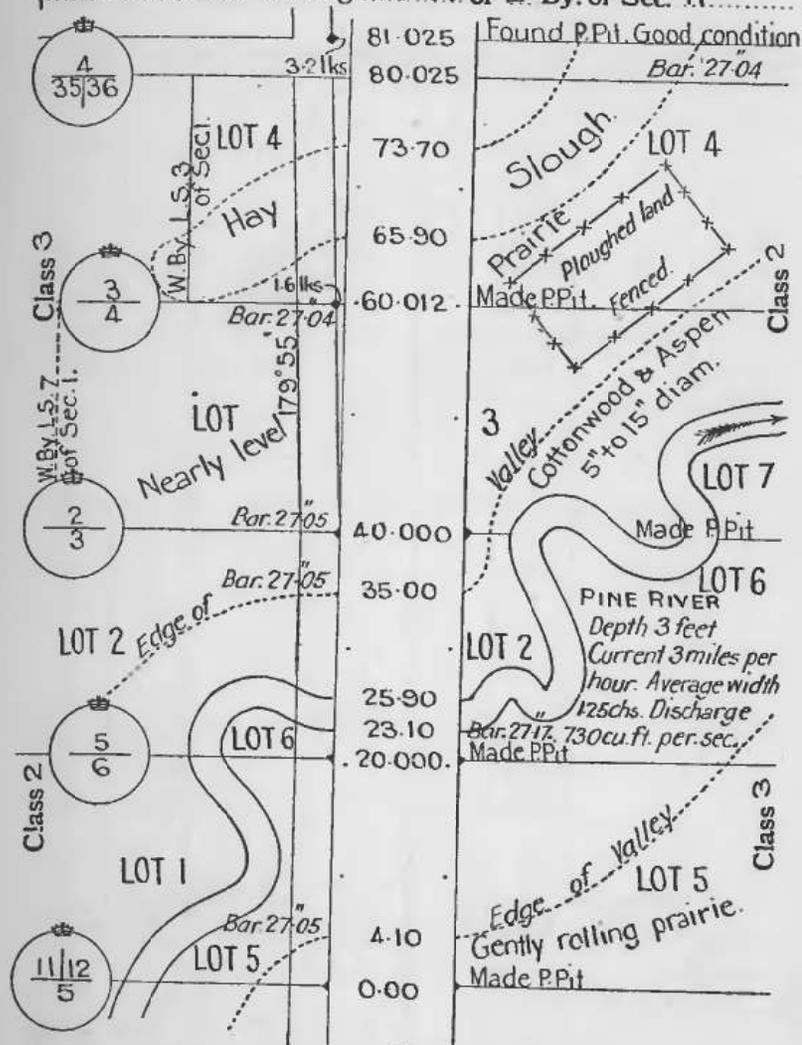
1st Half. 40.000
Temp. 39° 2nd Half. 40.025
Total. 80.025

SPECIMEN OF FIELD NOTES

Base line across river lots

Tp. 90 R. 9 W. - Mer. By of Sec. Course 179° 58'

produced from bearing 179° 58' of E. By of Sec. 11



The above line was run on 17th day of October, 1917.

OF SUBDIVISION SURVEY

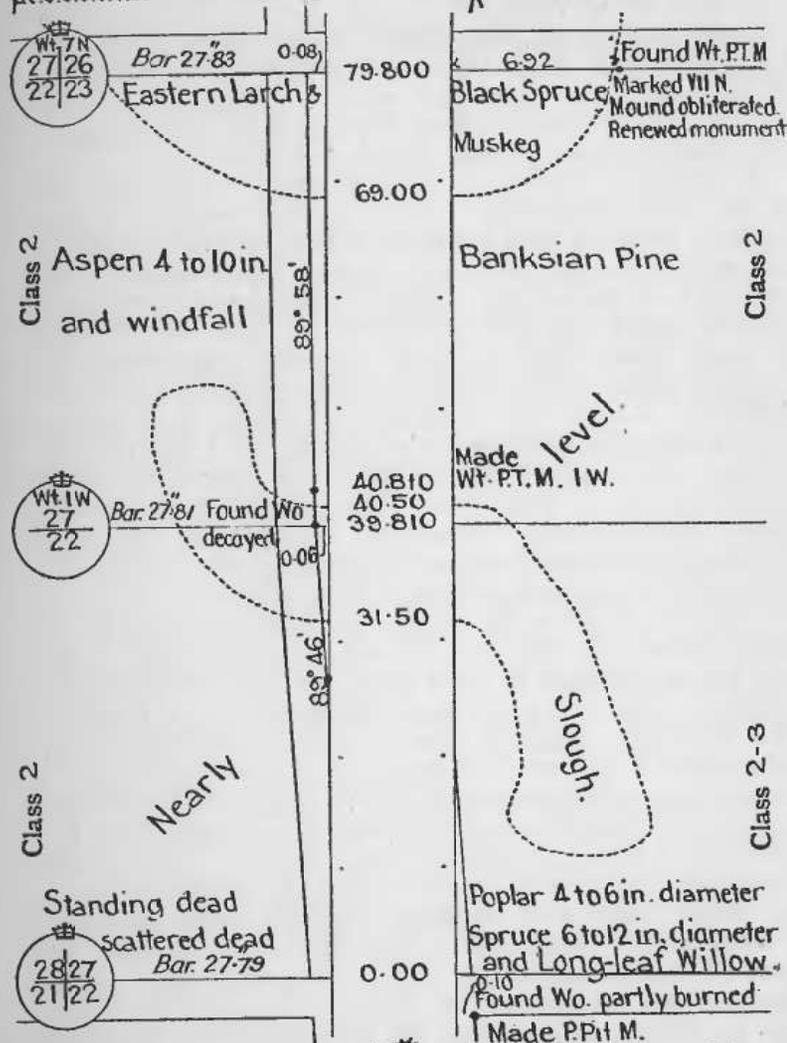
Tp. 35 R. 14 W. - Mer. N. By. of Sec. 22

Temp. 50° Date, 13th October Chainer, A. J. F.

| West ½ | | | | East ½ | | | |
|----------|--------------------------|---------------|--------|-----------|--------------------------|---------------|--------|
| Distance | Remarks | Slope | Corr. | Distance | Remarks | Slope | Corr. |
| 1 00 | Road | 0 00 | | | From Wo. | | |
| 5 00 | | + 3 00 | 68 | | + 0 69 to edge of Slough | | |
| 5 00 | | - 2 00 | 30 | 5 00 | | + 1 00 | 0 07 |
| 5 00 | | - 1 00 | 07 | 5 00 | | + 0 00 | - |
| 5 00 | | - 1 00 | 07 | 5 00 | | - 1 00 | 0 07 |
| 5 00 | | - 1 00 | 07 | 5 00 | | - 2 00 | 0 30 |
| 5 00 | | + 0 40 | 03 | 5 00 | | - 3 00 | 0 68 |
| | + 1 50 to edge of Slough | | | 5 00 | | - 2 00 | 0 30 |
| 5 00 | | 0 00 | - | | - 0 81 to edge of Muskeg | | |
| 4 822 | to Wo. | 0 00 | - | 5 00 | | 0 00 | |
| | | | | 5 00 | | 0 00 | |
| | | | | | 0 04 to E. by Sec. 22 | | |
| 39 822 | | | | 40 004 | | | |
| - 12 | | Slopes - 1 22 | - 14 | | | Slopes - 1 42 | |
| | | Temp. - 25 | | | | Temp. - 25 | |
| | | Chain + 30 | | | | Chain + 30 | |
| | | | - 1 17 | | | | - 1 37 |
| - - | Adjustment | | | - - | Adjustment | | |
| 39 810 | Length of Quarter | | | 39 990 | Length of Quarter | | |
| 1 000 | | 0 10 | - - | | | | |
| 40 810 | Made Wt. P.T.M. | | | | | | |
| | | | | 1st Half | 39 810 | | |
| | | | | Temp. 48° | 2nd Half | 39 990 | |
| | | | | Total | 79 800 | | |

SPECIMEN OF FIELD NOTES OF

Inst. line
 Tp. 35 R. 14 W. Mer. N. By. of Sec. 22 Course 90° 00'
 produced from bearing 90° 00' of Inst. line
 N. By. of Sec. 21

The above line was run on 13th day of October..... 1917...

RETRACEMENT AND RESTORATION SURVEY

250. The transit book is for the use of the instrument man in which to make his original notes of all his instrument work including observations and measurement of angles. The entries are not to be copied or deduced from any previous record.

Field pages have been placed in this book so that the transitman may enter topography notes, such as streams, rivers, lakes, etc., markings on posts which are checked by him, and the course of all lines he runs, or he may use these pages in any further way he sees fit.

A deflection table has been placed on the last page of the book for use in turning section angles. For its use it is assumed that the angle is first turned and a picket set, and then that the angle between the picket thus set and the back-picket is accurately determined by repetition in both direct and reverse positions. The forward picket is then offset the amount necessary to obtain the required angle. The amount to offset is derived from this deflection table. The quadrant in which the angle is turned should be indicated by an arrow on the diagram.

Pages for recording the reading of the angles of triangles are furnished in this book. The angles to be entered under the heading, "Observed Angles" are found by dividing the reiterate angles by the number of reiterations. These angles are then adjusted to total 180.

A sketch must be drawn on the form supplied in this book, showing clearly the method of running the "jog" and the adjustment of the closings on the correction line.

251. A separate page must be used for every section line surveyed, except in cases where the information to be entered is of such an extent that a separate page is required for each half-section. Each page must be complete in itself. 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.

252. 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, etc. 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.

253. The following abbreviations may be used in the notes:—

| | |
|--------------|---|
| A. | for acre |
| A.M. | " forenoon |
| Az. | " azimuth |
| Bar. | " barometer |
| Bea. | " bearing |
| B.T. | " bearing tree |
| By. | " boundary |
| Chs. | " chains |
| Cor. | " corner |
| Corr. | " correction |
| Diam. | " diameter |
| Dist. | " distance |
| D.L.S. | " Dominion Land Surveyor |
| E. | " East |
| Fd. | " found |
| Ft. | " feet |
| Frac. | " fractional |
| H.C.R. | " horizontal circle reading |
| I. | " old pattern iron post |
| Ins. | " inches |
| Inst. | " instrument |
| Lat. | " latitude |
| Lks. | " links |
| Long. | " longitude |
| L.S. | " legal subdivision |
| M. | " mound |
| Mag. | " magnetic |
| Mer. | " meridian |
| Mkd. | " marked |
| N. | " North |
| Obsn. | " observation |
| P. | " standard post |
| P. Rock | " short standard post cemented in rock |
| P. Pit. | " standard post and four pits |
| P. Pit. M. | " standard post, mound, and four pits |
| P. Pit. S.M. | " standard post, four pits, and stone mound |

| | |
|--------------|--|
| P.S.M. | for standard post and stone mound |
| Pit. | " 4 pits |
| P.M. | " afternoon |
| Pol. | " Polaris |
| Pr. | " principal |
| R. | " range |
| Ry. | " railway |
| R.O. | " reference object |
| S. | " South |
| Sec. | " section |
| Sta. | " station |
| S.M. | " stone mound |
| T. | " trench |
| Temp. | " temperature |
| T.H. | " traverse hub |
| Tp. | " township |
| Var. | " variation |
| W. | " West |
| Wo. | " wooden post |
| Wt. | " witness |
| Wt. P.S.M. | " witness standard post and stone mound |
| Wt. P.T. | " witness standard post and trench |
| Wt. P.T.M. | " witness standard post, trench, and mound |
| Wt. P.T.S.M. | " witness standard post, trench, and stone mound |

254. 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:—

(1) ON THE LEFT PAGE.

(a) The temperature at the start and finish of chaining.

On the control lines a correction is applied for temperature. For this purpose 62° Fahr. is considered standard and the thermometer is read only to the nearest ten degrees. For every ten degrees more or less than standard a correction is applied of half a link per mile. Above standard the chain is too long and below standard too short.

For lines other than control lines the approximate temperature of the chain may be estimated from experience.

(b) The width of road crossed, if any.

(c) The uncorrected distance measured at each stretch of the chain.

(d) The positive or negative slope angle of each measurement. Angles of elevation and depression are positive and negative respectively. The slope angle should be read at the same time by both the front and rear chainmen.

(e) The plus or minus measurements to all topographical features, etc.

(f) The chain correction for personal error of chainmen. This correction differs for each set of chainmen and may be determined within reasonable limits, by measuring a half mile, which has been previously chained by them, on hubs, using the subsidiary standard tape. The chainmen should go over this course more than once as a check. This correction should be determined several times during the season.

(g) The calculation of the position of the quarter-section post and of the length of each quarter-section.

Opposite the word "adjustment" is to be entered the distance between the temporary picket and the intersection point at section corners.

On the control lines the posts are planted at the mean of the two chainages, and the distance the post is moved after the first chainage is entered at the foot of the page, but the distance to be recorded in the field-notes is that of the original chainage, unless found considerably in error. In such a case the measurements must be repeated until reasonable agreement between two results is obtained.

(2) ON THE RIGHT PAGE.

(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. 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 all surveys the field-notes must show the inscriptions on all posts found or placed by the chainers in the field. The inscriptions are to be entered exactly as they are on the post, that is, in the correct relative position to the crown and not relative to the direction in which the line is being run. This information must be entered on the ground and is not to be filled in at any other time.

(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, water areas, rivers, bottom lands, swamps, marshes, brush and 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 or other water area is crossed, the data used for ascertaining the distance across it.

(g) The approximate course, direction, average width, depth, rate of current, and discharge of all streams, and whether the water is fresh or alkaline in the bodies of water 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.

(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, etc., etc.

(n) The aneroid barometer reading in inches at the top or bottom of all prominent elevations or depressions on lines not levelled, or when none such exists at section and quarter-section corners.

(o) The date of the survey.

255. When a large valley is crossed by the line not levelled aneroid readings are 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.

256. The index error of the aneroid should be determined whenever convenient by comparison at a Meteorological station or at the Surveys Laboratory 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.

257. The discharge of streams crossed by a line, which is to be noted in the field-notes, is intended only to give a general idea of the volume of water carried by the stream and does not require an accurate measurement.

For obtaining it, a portion of the stream where the cross-section is fairly uniform is selected in the vicinity of the line and the depth is measured at a few points for plotting a rough cross-section. The velocity of the current is ascertained by laying out a small base along the stream and observing the number of seconds a float takes to pass opposite the ends of the base. For ordinary streams, it is sufficient to assume that the mean velocity is from 70 to 90 per cent, of the surface velocity.

258. When possible, the difference between the actual and normal levels of the water is recorded. If the water is lower than normal, the latter can be determined from the condition of the banks. When high flood marks are visible, their height is also recorded.

259. For very small streams carrying only a few cubic feet per second, it is sufficient to estimate the volume, but it must be given in all cases.

Rivers that are gauged by the Irrigation or Water Power services are excepted from the above instructions.

When the discharge of a stream has been observed on one line, it is not necessary to observe it again on another line, unless there has been a considerable change in the condition of the stream.

260. The topography of the interior of the sections must be sketched on the township forms supplied for the purpose. This information is to be collected by the surveyor from his own observation and from that of the various members of his party during their survey operations and in going to and coming from their work, and is to be entered on the form each day. The information should comprise the approximate location of valley banks, water areas, streams and trails, the extent of swamps, muskegs, marsh or hay lands, and wooded country, the position of hills and ridges and any other topographical data of importance. This information must also be sketched in the field-book. It is not sufficient to show the crossings on the line; sketching as shown in the specimen field-notes is required.

261. 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.

262. *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.

263. *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.

264. *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.

265. *Sandy* soils contain 80 per cent or more of sand principally finely comminuted quartz, with not infre-

quently 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.

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

267. *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.

268. *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).

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

270. *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.

271. *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.

272. *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.

273. *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.

274. *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.

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

276. 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.

277. In describing trees, the correct names are to be employed.

278. The kinds of trees most frequently met with in Manitoba, Saskatchewan, Alberta and the Northwest Territories are the following:—

Conifers—

Lodgepole pine—(*Pinus murrayana*)

Jack pine—Banksian, Gray or Northern Scrub pine (*Pinus banksiana*)

Tamarack—Eastern larch (*Larix laricina*)
 Black spruce—Swamp spruce (*Picea mariana*)
 White spruce—(*Picea canadensis*)
 Engelman spruce—(*Picea engelmanni*)
 Douglas fir—(*Pseudotsuga mucronata*)
 Balsam fir—(*Abies balsamea*)
 Cedar—Arbor vitae (*Thuja occidentalis*)

Poplar—

Aspen—Trembling or White poplar (*Populus tremuloides*)

Balsam poplar—Black poplar, Balm of Gilead (*Populus balsamifera*)

Cottonwood—(*Populus deltoides*)

Narrow-leaf cottonwood (*Populus angustifolia*)

Birch—

Canoe birch—Paper or White birch (*Betula alba*, var. *papyrifera*)

Alder—

Speckled alder—(*alnus incana*)

Mountain alder—(*alnus tenuifolia*)

Oak—

Burr oak—Scrub oak (*Quercus macrocarpa*)

Elm—

White elm—American elm (*Ulmus americana*)

Ash—

Mountain ash—(*Pyrus americana*)

Green ash—(*Fraxinus pennsylvanica*, var. *lanceolata*)

Maple—

Manitoba maple—Box elder (*Acer negundo*)

Mountain maple—(*Acer spicatum*)

Willow—

Almond-leaf willow, Peach-leaf willow—(*Salix amygdaloides*)

Glossy-leaf willow—(*Salix lucida*)

Long-leaf willow, Sand-bar willow—(*Salix longifolia*)

Cherry Trees—

Bird cherry—Pigeon, Pin or Wild red cherry (*Prunus pennsylvanica*)

Choke cherry—(*Prunus virginiana*).

279. The general instructions have to be departed from for surveys in the mountains of the railway belt in British Columbia. The field-book, for which special instructions are issued, is somewhat more elaborate than for other parts of Dominion lands.

2. FIELD-NOTES OF TRAVERSES.

280. The left page of the field-book is for the notes; the right page for a sketch of the survey. The stations are designated by numbers, the side shots by letters. In the first column of the left page is entered the letter of the side shot or number of station sighted on. The second column is for the distance read or estimated, the third column for the bearing, the fourth column for the vertical angle, the fifth column for the corrected distance, and the remainder of the page for remarks. The remarks column is filled in wherever necessary for a ready interpretation of the notes.

281. At each instrumental station the following entries are to be made in the notes or on the sketch:—

(a) The estimated width of shore or horizontal distance between high and low-water marks.

(b) The nature of the shore, whether sandy, gravelly rocky, alkaline, marshy, or covered with reeds, etc.

(c) The nature of the bank whether well defined or indefinite.

(d) The nature of the surrounding land, whether low, marshy, swampy, high, steep, rocky, dry, timbered, etc.

(e) The nature and extent of the slopes from the surrounding land towards the water.

(f) The surface of the water, whether open or containing reeds or other water vegetation.

(g) The depth of the water.

282. For convenience in preparing the official plans from the notes of surveys for the revision of water areas, the following classification has been adopted:—

Class 1.—Water areas that have entirely dried up.

Class 2.—Water areas likely to dry up.

Class 3.—Water areas which do not dry up, but which have shore lines subject to large variations (say 10 to 20 chains).

Class 4.—Water areas which do not dry up, but which have shore lines subject to moderate variations (say 5 to 15 chains).

Class 5.—Lakes whose shore lines do not change.

This classification is to be used in so far as it will apply in connection with subdivision surveys.

283. After completing the survey of a water area, entry is made in the notes regarding the nature of the water, whether clear or turbid, fresh or alkaline, etc., the sources of supply, the outlet, and such other data as may be of interest. When the nature of the bank

of a water area varies, the place where it changes should be stated with reference to the quarter-section boundary. It is of the greatest importance that the report on a body of water should be complete. Every detail that can possibly be of use in determining the character of the water area must be reported.

This report is also used as a basis for the classification of the body of water under one of the above heads.

284. The classification is made at the time of the survey. When a water area is classified as class 3, sufficient soundings must be taken to show approximately the limits of the part permanently covered by water. Different parts of the shore line of a water area may be classified differently if necessary.

285. The field-books are numbered consecutively, and each book fully indexed. At the top of the index page are entered the instrument and diaphragm used. In the first column is entered separately each traverse, investigation or report contained in the book. The entry for a water area is the name or number, if any, shown on the plan sent to the surveyor. If no name or number is shown on the plan, the local name, if any, is given. The traverse of an island is indexed separately from that of a lake in which it is situated. In the columns headed "Sections" and "T.R.M." every section and township, into which the body of water extends, is entered. The page number to be given is that on which the notes of each water area begin. Under "Plot numbers" is entered every plot on which that part of the water area appears.

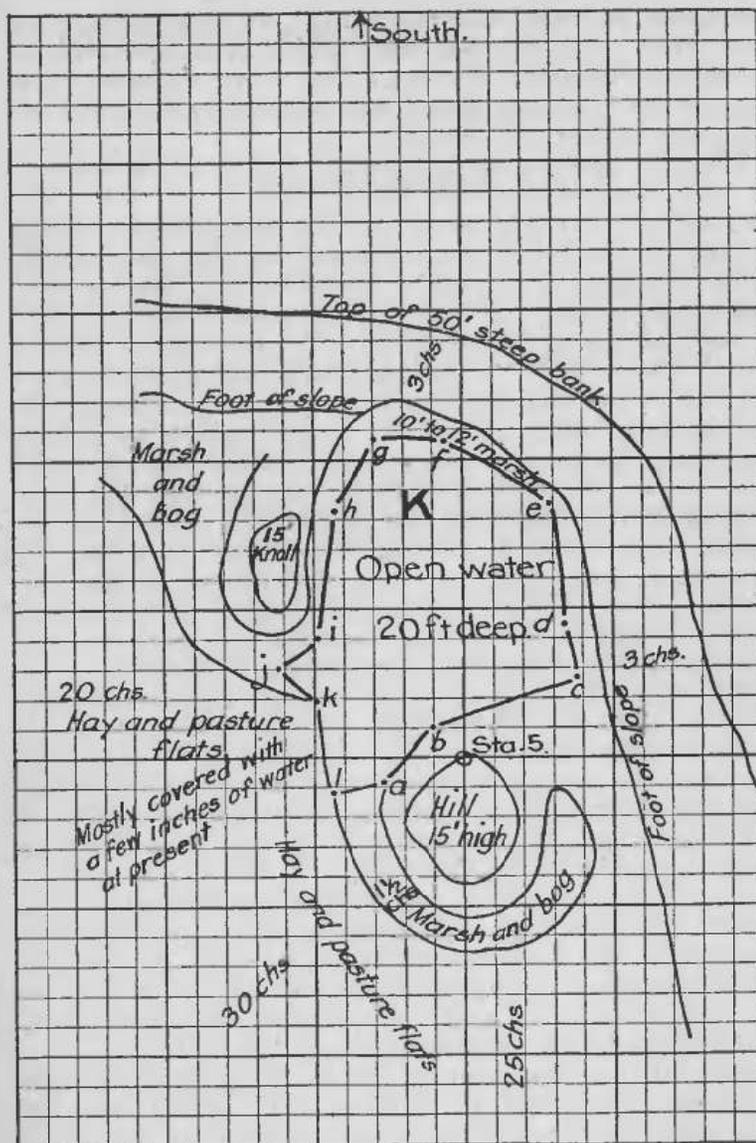
286. Particular attention must be paid to keeping the notes neatly. Care must be taken in writing the entries and drawing the topography so that the notes shall present a neat appearance.

287. The original field-books, and the plans must be mailed to the head office as soon as they are plotted. (See specimen field-notes, pages 128 and 129)

288. The survey of the courses is checked by plotting. The survey must always be plotted before leaving the locality, so that any error may be corrected before proceeding farther. If necessary two field-books may be used concurrently, one being left in camp for plotting while the other is in use on the survey. When the distance between starting and closing corners differs more than three per cent from the distance in the original survey, the section lines must be retraced with the stadia in order to locate the error. The surveyor's own work must close within one per cent.

| WATER AREA K. in Sec. 14 T. 46, R. 15 3 rd . MER. | | | | | |
|--|-------------------|---------|----------------|--------------------|--|
| DATE June 8 th 1916. | | | | | |
| POINT | UNCORR'D DISTANCE | BEARING | VERTICAL ANGLE | CORRECTED DISTANCE | REMARKS |
| | | | | | Sta. 1 at Pit M at N.E. cor. Sec. 15. |
| | | | | | Inst. set to read 179°59' sighting to |
| | | | | | 1/4 Sec. corner E. by Sec. 15. |
| 5 | 17.33 | 95-11 | -2°16' | 17.39 | |
| | | | | | Sta. 5. Sta. on top of hill 15' high. |
| | | | | | Vegetation to water's edge. Reeds 2 ch. then |
| | | | | | open water. 20 ft to foot of bank rising 15 ft |
| | | | | | in 1 ch. Water 20 ft. deep in centre. |
| a | 2.87 | 81-20 | -3°12' | 2.88 | |
| b | 1.45 | 136-30 | -6°20' | 1.46 | |
| c | 4.60 | 231-47 | | 4.64 | |
| d | 6.00 | 219-40 | | 6.04 | |
| e | 9.00 | 200-41 | | 9.05 | |
| f | 10.75 | 177-10 | | 10.81 | |
| g | 11.00 | 160-00 | | 11.06 | |
| h | 9.63 | 142-00 | | 9.69 | |
| i | 6.65 | 131-48 | | 6.70 | |
| j | 7.00 | 116-30 | | 7.05 | |
| k | 5.28 | 106-48 | | 5.32 | |
| l | 4.55 | 80-00 | | 4.59 | |
| 6 | 24.60 24.50 | 97-15 | | 24.67 | |
| Report: Clear freshwater 20 ft deep. | | | | | |
| Surface is open with a narrow fringe of reeds. | | | | | |
| Shores are marshy. A shallow marsh extends | | | | | |
| easterly and northerly from 20 to 30 chs. | | | | | |
| No springs, no outlet. | | | | | |

SPECIMEN OF FIELD NOTES



OF STADIA TRAVERSE SURVEY

289. Ruled paper, together with a drawing board, protractor, boxwood scale, tacks, etc., are supplied from the head office. For plotting, the paper is pinned securely to the board with small drawing tacks. Care must be taken that the board and supply of ruled paper are preserved from dampness as much as possible.

290. The plot is made in pencil on a scale of ten chains to an inch, the section lines being ruled in red ink. The stations are first plotted by placing the diameter of the protractor parallel or perpendicular to the lines of the paper, according as the paper is used with lines running north and south, or east and west. The course is marked first in one position of the protractor, and again after turning the protractor 180°. A straight line is then drawn between the two points and the length of the course plotted with the boxwood scale. If all the measurements have been accurately made, the plot of the courses should easily close within the prescribed limit without resorting to a computation by latitudes and departures. Providing the closing error found in plotting the courses is within the prescribed limit, such error is distributed among the courses affected before plotting side shots. The positions of the stations in the trial plot are marked upon the plan for convenience in checking the accuracy of the plot.

291. After the courses have been corrected, the side shots are plotted. Where there are only two or three side shots from one station they may be plotted in the usual way, but when the number of side shots is greater, a fine needle may be put through the centre of the protractor exactly on the station and the shots plotted by means of the scale on the diameter of the protractor. A fine needle must be used, so that the hole may not be worn and enlarged.

292. The soundings taken must be plotted on the plan. As a general rule it will be sufficient to estimate the distance to the sounding; the approximate bearing can be read on the instrument. All other information that may have been collected must also be entered on the plan.

293. All the plots sent in are to be numbered consecutively. Each sheet of traverse plots should bear the designation of the water areas, the numbers of township, range, and meridian, the surveyor's name, the date and the number of the field-book in which the full notes of the traverse are to be found. Care should be taken to make the returns distinct and legible.

CHAPTER VI.

RETURNS OF SURVEY.

1. PROGRESS REPORTS.

294. A surveyor must report at least once a month the progress of his work, and forward the report at the first available opportunity. He must not put off the preparation of such reports, until an opportunity occurs for sending them; he should prepare them regularly and forward them at the first opportunity. The first monthly report is to cover the period commencing on the date the surveyor leaves home for the field.

295. The monthly reports must specify the progress of the survey and the surveyor's personal movements, and indicate as far as possible the arrangements for continuing the work.

296. 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".

297. The sketches must also show the main topographical features, that is to say, the rivers, water areas, 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 is unnecessary to indicate every little swamp, pond or rise that may be found.

298. 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.

299. If the surveyor has reason to believe that he will be unable to complete all the surveys for which he has instructions he must notify the Department, stating the order in which he proposes to do the work and what surveys he will be compelled to leave. This

should be done as early in the season as possible in order that other arrangements may be made for the completion of the work if considered necessary.

300. In the revision of water areas, a report is required on the sketch forms supplied for each township in which work is done. The report must give the following information:—

(a) A statement that all bodies of water in the township have been investigated.

(b) Where bodies of water have dried up, a statement of what section lines require to be surveyed. This is done by indicating with a coloured pencil on the diagram. Where the line has been run, the monument erected must be given, together with chainage and bearings, and the witness monument destroyed, if any.

(c) A statement of the condition in which the monuments in the township were found. Sufficient information on this point may be obtained during the progress of the survey, or in travelling through the township. It is not intended that much time shall be spent to obtain a comprehensive report on the monuments alone. The report must also state whether the settlers are in favour of a resurvey and if roads have been graded and fences built.

(d) Any topographical information that will facilitate the compiling of correct township plans. The old editions of township plans frequently show features, such as trails, creeks, etc., which have considerably changed or have ceased to exist. If any inaccuracies in such features or in the descriptive notes respecting timber, etc., are noticed on the plans furnished to the surveyor, they should be reported. It is not intended that a special survey should be made for this purpose, but any information that is found in the ordinary course of the work should be supplied.

301. The report for a township is not to be sent in until all the work in the township has been completed, but must be sent as soon as possible thereafter.

302. 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.

303. 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. Instructions, sketches, and other information sent to the surveyor in connection with uncompleted surveys are to be returned to the Department at once upon closing operations.

2. DECLARATIONS OF OCCUPATION.

304. 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.

Declarations from all 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.

305. The surveyor must make a careful note of all Indians, whether they are treaty or non-treaty Indians, found in occupation of lands at the time of subdivision. Their names and the quarter-sections they occupy, are to be reported in transmitting the progress sketches of the subdivision so that their holdings may be protected pending the final disposition of their cases. No statutory declaration is to be taken from Indians but a special report on each case, with a sketch showing improvements, is to be furnished with the final returns of the survey. The report must state whether the man is a treaty or non-treaty Indian.

3. TIMBER REPORT.

306. 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, he states whether, in his judgment, from the knowledge gained on the ground, it is desirable to reserve the timber for the needs of settlers or whether it is advisable to set apart the same as a timber berth or as a timber reserve.

307. Before deciding whether land is or is not to be open for entry, the timber has to be taken into consideration. The decision depending upon the information contained in the timber report, this information must be full, definite, and reliable.

308. A statement is required of the quantity of timber over ten inches in diameter suitable for lumber, the percentage of the species, the average diameter for the different species and as nearly as possible, the location of the timber by sections or quarter-sections. The methods of timber estimating are described in technical books published for the use of lumbermen.

309. Even when reporting that the timber has no commercial value, the quantity, sizes, and percentage

of species must be stated by the surveyor, the information being required for deciding what is to be done with the township. The timber may acquire commercial value after a few years growth or when markets are developed in the neighbourhood, or the forest cover may be such as to indicate poor soil, more valuable if kept in timber although the timber itself is of little or no commercial value.

310. The facilities afforded by streams for floating out the timber must also be described.

When there is no timber, the fact must be stated.

311. A separate timber report is required for each township and must accompany the progress sketch when the subdivision is completed.

4. PLANS.

312. Plans of townships are made at the head office 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.

313. 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.

314. 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 permanent bodies of water, or streams which have been traversed, or by parcels of land previously laid out. Areas of patented lands are omitted.

315. For a quarter quarter-section divided into two or more parts by a traversed water area or stream, the separate area of each part is given.

316. 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.

Townsites, not less than one inch to 250 feet.

Highways, not less than one inch to ten chains.

317. 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 line by broken lines.

318. 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.

319. 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.

320. 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.

321. The plan of a townsite 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 dis-

ting 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. It must also conform with the provincial regulations.

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

323. 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.

324. 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.

325. 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 vermilion.
- (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 (or in feet).
- (e) Monuments found on the ground are indicated by square black marks.
- (f) Standard posts planted are indicated by square blue marks.

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

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

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

329. 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.

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

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

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

333. 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.

334. 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 differences 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.

335. 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.

336. 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 water areas, 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.

337. 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.

5. FIELD-NOTES.

338. The field-notes sent in to be placed on record in the Department are to be a fair and exact copy of the original notes (not including the chainage notes) taken in the field, after applying to each bearing the corrections deduced from the astronomical observations and the offsets, if any, from the instrument line to the monument on which it may close; 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.

339. 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.

A separate index is to be made for each township. This index may be made by drawing a diagram of the townships on a suitable scale on the blank page at the front of the book. Single lines may be used to indicate road allowances, heavier lines being used for township boundaries. If preferred blank forms for index similar to the index on the second page of the field-book will be supplied on request. These forms may be attached to the field-book.

340. 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.

341. Reductions of the traverse plots are prepared at the head office and attached to the field-notes.

342. 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.

343. 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.

344. 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.

345. 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.

346. 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.

6. DIARY.

347. The official diary is to be forwarded to the head office immediately after the close of field operations. On the blank page at the front are to be entered the names and duties of the persons employed on the survey.

The daily record of the party's operations should show as far as possible, not only the general work of the party but also the particular work performed by the chief and each assistant.

7. REPORTS.

348. 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.

349. 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.

350. 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.

351. 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.

352. From the data collected by the explorer, the surveyor compiles a sketch map, on the forms supplied, 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. It is intended merely for office use, and provided the information is plain and unmistakable, fine draughtsmanship is not required.

353. 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.

354. A general report is also required from all other surveyors, 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.

This report should be prepared immediately after the close of operations in the field and as soon as completed should be forwarded to the head office.

A surveyor who has been engaged upon surveys in an unsettled district should furnish a report giving information as to the best route and the best mode of travel to reach the district most conveniently and economically.

The report should contain as well an account of the survey operations, a description of the main features of the district, such as the lakes, rivers, mountains, etc., a statement of the probable resources and the industries most likely to succeed and a description of the general quality of the land. Minor details and particulars as to local districts or townships may be left for the descriptions of each township to be furnished separately.

A surveyor working in wet, swampy districts is requested to record any facts which come under his observation touching the general question of drainage or reclamation of the swampy areas and shall incorporate such observations in his general report.

8. FINAL RETURNS.

355. The final returns of survey are as follows:

For a survey of governing lines:

- (a) Field-notes.
- (b) Level notes.
- (c) Azimuth observations.
- (d) Magnetic observations.
- (e) Sketch map.
- (f) General report.
- (g) Oaths of chainmen.
- (h) Accounts in duplicate on the forms supplied.
- (i) Diary.

For the subdivision of townships:

- (a) Field-notes.
- (b) Level notes.
- (c) Magnetic observations.
- (d) General report.

- (e) Oaths of chainmen.
- (f) Accounts in duplicate on the forms supplied.
- (g) Diary.
 - For other surveys.
- (a) Field-notes.
- (b) Level notes.
- (c) Magnetic observations.
- (d) General report.
- (e) Plans.
- (f) Oaths of chainmen.
- (g) Accounts in duplicate on the forms supplied.
- (h) Diary.

356. The original field-books of the chainers and transitmen together with the topographical sketch of the township are to be submitted along with the final returns.

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

9. INSPECTION AND EXAMINATION OF SURVEYS.

358. 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.

359. Should the field inspection disclose work below the standard required by the instructions, the surveyor will be notified.

360. 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.

361. 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.

The original field-books of the chainers and transitmen will be returned to the surveyor along with any memoranda upon examination that may require to be answered.

CHAPTER VII.

LEVELS.

1. GENERAL.

362. Levels are divided into the following general classes, the order stated being that of the accuracy required:—

- (a) Precise levels, almost invariably run along a railway track.
- (b) Levels along travelled routes.
- (c) Levels taken along meridians and base lines during their survey.
- (d) Levels taken during subdivision of townships.

Differences of elevation are also recorded by means of vertical angle readings during the survey of section lines in the railway belt in British Columbia.

363. Special instructions are issued for precise levelling and for levels along travelled routes, and also for recording elevations in the railway belt. The general instructions given herein refer to levels taken during the survey of meridians and base lines, and during the subdivision of townships.

364. The general arrangement whereby all elevations may be ultimately referred to mean sea-level is to extend lines of precise levels through the country as facilities become available. The datum carried by them from the sea is transferred to the base lines intersected, and distributed from the latter over local districts during the subdivision of townships. Since, however, base lines are surveyed in advance of settlement, and routes suitable for precise levels are, therefore, not available for some time after these surveys are made, it occurs that a precise elevation is seldom directly available as a reference during the survey of base lines.

It may also occasionally occur that a base line datum is not available during the subdivision of townships, owing to the fact that the base line in the locality was surveyed before levels along such lines were inaugurated.

It is to be noted, however, that uncertainty regarding the datum used in no way lessens the necessity of levels being run with the general accuracy of their class. Errors in datum can be readily corrected at a future time without again going over the lines while errors in a line itself inevitably lead to future confusion.

365. In the following instructions clauses 366 to 389 are applicable to meridian and base line levels and also to subdivision levels. Clauses 390 to 398 are applicable to the former only, and clauses 399 to 420 to the latter only.

2. LEVELS TAKEN ALONG MERIDIANS AND BASE LINES AND DURING SUBDIVISION OF TOWNSHIPS.

366. The elevations to be recorded are the surface of the ground at all section, quarter-section, and witness posts, and at a point about midway between posts, the surface of water in all lakes, ponds and streams crossed by the lines, and of water in large swamps, noting that it is swamp water. The elevation of water in a swamp may vary considerably over an apparently level surface. It is desirable that the intermediate points taken between posts be at twenty and sixty chains, unless there is some marked local reason for the contrary. The elevations of the transit stations should also be noted. The above are sufficient to define the general surface, except in unusual cases.

367. The elevation of the ground is to be recorded at the intersection of all travelled roads, and important pack trails. If a railway survey line is crossed, connection is to be made to any railway bench-mark which can be found, and in addition the surface of the ground should be recorded at the nearest railway chainage stakes, noting any marks on the stake.

368. The specimen page is to be strictly followed in keeping the notes. The entry of the chainage (where

LEVELS

Along *E.* By. of Sec. *23, 65, 4* Going *N.*Date *March 31st* 1917. *J. S.* Leveller

| CHAINAGE | Back Sight | Height of Instrument | Intern. Sight | Fore Sight | Elevation (A) |
|---------------------|----------------|----------------------|---------------|--------------|----------------|
| <i>Sec. 23</i> | | | | | |
| <i>B.M. 86</i> | <i>10.73</i> | <i>526.41</i> | | | <i>1662.13</i> |
| | <i>9.04</i> | <i>531.28</i> | | <i>4.17</i> | <i>1668.69</i> |
| <i>20.00</i> | | | <i>3.5</i> | | <i>1674.2</i> |
| <i>23.84</i> | | | <i>9.3</i> | | <i>1668.4</i> |
| | <i>2.79</i> | <i>526.42</i> | | <i>7.65</i> | <i>1670.08</i> |
| <i>31.53</i> | | | <i>2.1</i> | | <i>1670.7</i> |
| | <i>8.95</i> | <i>531.94</i> | | <i>3.43</i> | <i>1669.44</i> |
| <i>40.00</i> | | | <i>6.0</i> | | <i>1672.4</i> |
| | <i>4.93</i> | <i>530.75</i> | | <i>6.12</i> | <i>1672.27</i> |
| | <i>3.47</i> | <i>532.66</i> | | <i>1.56</i> | <i>1675.64</i> |
| <i>60.00</i> | | | <i>4.4</i> | | <i>1674.7</i> |
| | <i>6.00</i> | <i>537.87</i> | | <i>0.79</i> | <i>1678.32</i> |
| <i>80.00</i> | | | <i>6.4</i> | | <i>1677.9</i> |
| <i>Sec. 26</i> | | | | | |
| <i>B.M. 87.3.00</i> | | | | <i>2.15</i> | <i>1682.17</i> |
| | <i>+ 45.91</i> | | <i>-</i> | <i>25.87</i> | |
| | <i>- 25.87</i> | | | | |
| | <i>+ 20.04</i> | | | | |

SPECIMEN OF

| Elevation (B) | REMARKS |
|---------------|--|
| <i>515.68</i> | <i>6" nail in 8" spruce. 2.15^{chs} N. 7 lks W. of P. $\frac{23}{14} \frac{24}{13}$</i> |
| <i>522.24</i> | |
| <i>527.8</i> | <i>Ground</i> |
| <i>522.0</i> | <i>Water, in Crowfoot creek, 4 ft. w, 1 ft. d. flowing N.W.</i> |
| <i>523.63</i> | |
| <i>524.3</i> | <i>Transit Sta. No 15</i> |
| <i>522.99</i> | |
| <i>526.0</i> | <i>Ground $\frac{1}{4}$ P Middle sec. 22</i> |
| <i>525.82</i> | |
| <i>529.19</i> | |
| <i>528.3</i> | <i>Ground</i> |
| <i>531.87</i> | |
| <i>531.5</i> | <i>Swamp water</i> |
| <i>535.72</i> | <i>Top of Wt. P. $\frac{45}{26} \frac{25}{23} \frac{24}{24}$</i> |
| | <i>515.68</i> |
| | <i>+ 20.04</i> |
| | <i>535.72</i> |

LEVEL NOTES

taken) of any point, the F.S. read on that point, the elevation it gives rise to, the B.S. on the same point, and H. I. it gives rise to and any topographical notes referring to the point on the right hand page, should all be entered on the same line. In the case of the first line on each page no F.S. is entered, and on the last line no B.S. is entered. The last elevation is repeated at top of next page, so that the F.S. and B.S. taken on this point occupy two lines; but under no circumstances should a B.S. and F.S. taken on different points occupy the same line.

369. Readings on turning points are to be read to the hundredth of a foot, those on the ground to a tenth of a foot. The length of sight is not to exceed 450 feet unless the circumstances are very exceptional.

370. Descriptions of topographical features should be entered so that the level books are complete in themselves and that reference to the field-books is not necessary. The chainage should be obtained from the field-notes of the chainmen, and be entered either at the time of levelling or subsequently. In the case of streams the approximate width, depth, and current, and the direction are to be noted. The width is not always correctly given by the chainage of the two sides. Where the line crosses a lake the chainage of both shores should be stated, and where the crossing is complicated, an approximate sketch should be entered in the book, particular attention being paid to the location of section lines.

371. The surveyor should use his discretion as to whether it is advisable to have the leveller reduce the elevations of all or any of the intermediate sights. If the leveller is pressed for time, these reductions can be made after the books have been sent in. The elevations of all turning points and bench-marks are, however, to be reduced in the field, except in the case of check lines.

372. As the levels follow a straight line across country, making it frequently impossible, on account of hills, to individually equalize back-sights and fore-sights, attention should be paid to approximate adjustment of these lengths, so that their separate sums will not vary to a dangerous degree. Such adjustment should be, as far as possible, carried out for each individual division.

373. Permanent bench-marks are to be established at suitable places. In subdivision one bench-mark should be established on every section line, and so placed that the interval to the next one does not exceed one mile. On meridians and base lines they should average about three bench-marks in every two miles. Bench-marks may consist of the top of a corner or witness post, when it is the new pattern, and the ground is firm and dry, or of a mark "T" cut on solid rock or on a massive boulder, or a six-inch spike in a tree. A section post may be used as a B.M. only when it occurs as a survey monument. Such posts must not be planted simply for use as a B.M. When the B.M. is on a tree a small blaze should be made above the nail and the letters "B.M." and the number, in Arabic figures, should be cut on the blazed part. The tree should not be mutilated. The nail is to be driven horizontally into the tree immediately below the blaze and left projecting about one inch. Stumps or hubs must not be used for permanent bench-marks.

374. A bench-mark may be placed at any point along a line, but should not be placed on a road allowance. When near a corner, its position should be recorded with reference to the post, taking no separate account of the presence or absence of a road allowance, and the post should be recorded according to its marking, thus:—

Nail in 10" spruce, 1.12 chs. W; 15 lks. S. of P. $\frac{5}{4}$
32|33

When far from a corner it is best to record it with reference to the general chainage. When a B.M. is near a witness post, its position should be referred to the witness post. Offsets from the centre of the line to the B.M. should be measured, not estimated.

375. Bench-marks are to be numbered as specified in clauses 397 and 404. Every B.M. is to have a number assigned to it in the notes, unless it has been numbered in a previous survey in which case no new number is to be assigned to it. When the B.M. is on a tree the number should be cut on the tree, but no number need be cut on rock or on a boulder, and no marking of any kind, referring to the levels, is to be placed on a survey post when such is used as a B.M. A number having been once assigned to a B.M., the same number is always to be used when subsequent reference is made to the B.M.

376. Such lines are to be checked along meridians and base lines, and during the subdivision of townships as are indicated in the clauses referring especially to these two classes of levels.

377. When the main and check lines are run by the same leveller, one line must be completed over a division before the other is commenced. A division means a part of the line not less than half a mile in length (unless some natural feature necessitates a break at a shorter distance) and must be always terminated at each end by a permanent or temporary bench mark, the latter being of the nature defined in clause 403.

378. Whenever a closing clearly indicates a large accidental error such as reading the feet wrongly or an inversion of the B.S. and F.S., it should not be considered that the error occurred in some particular place in one of the lines, with the result that the other is retained, but a third line should be run with sufficient accuracy to get rid of the uncertainty.

379. The last foresight at the end of a forward line must not be used as the first backsight of the check line. The instrument is to be set up in an entirely new position before the check line is commenced, so that these two rod readings shall differ by at least a foot.

380. The main and check lines should be run with equal care in regard to difference of terminal elevations, so that the mean determination may be used after the books have been sent in, if such is considered advisable, but the surveyor is to carry the elevation forward according to the main line only.

381. The name of the leveller and rodman should be stated on the title page. The leveller should initial every page. These initials signify that he certifies that the rod readings and other entries on the page are the original and true record. No subsequent erasure should be made. Any entry, replacing the original, should be accompanied by an explanatory note.

382. The original level books actually used on the line are to be sent in as returns. If it is advisable to make a copy of any page or book, owing to want of clearness or to mistakes occurring, the copy is to be so marked and the original is to be sent in along with the copy, noting that a copy has been made. "Copy" means any page which is not the page on which the original record was made when the rod was read.

383. The attention of surveyors is particularly called to the certificate which is entered at the end of each level book. Neglect to mark a page as a copy when it is not the original record inevitably leads to facts appearing on examination which, while they would be readily explained if the page had been marked as a copy, cannot but throw doubt on the field-work when the page is returned as an original.

384. The notes of each day's work should be critically examined by the leveller in order to make sure that nothing has been omitted which will make them full and clear. Special attention should be paid to seeing whether all information regarding chainage has been noted, and that the number of the section is entered in the extreme left hand column.

385. The surveyor should frequently examine the level notes. If continued neglect of certain instructions is shown in the notes, it can only be interpreted as evidence that the surveyor did not properly supervise the work during the season.

386. Surveyors must impress on their levellers that absolute honesty in their work is essential. In the examination of their work, evidence of honesty combined with ordinary care will be ranked as of more importance, and entitled to greater merit, than any apparent high degree of accuracy.

3. ADJUSTMENT OF INSTRUMENT.

387. A good dumpy level should remain in adjustment throughout a season, yet its adjustment should be watched and a test made about once a week during the regular course of the levelling and recorded in the field-book. The following method is recommended and it is desired that it be used to insure uniformity in the records. Having taken the reading of the back-sight, let the rodman hold the rod an inch or half an inch from the eye end of the telescope on a peg, X. Look through the object end of the telescope and by means of a pencil set on the rod at the centre of the field of view read the height of the instrument. Call this reading *a*. Read the fore-sight, which for this purpose should be about 300 feet distant, and call this reading *b*. Then set the instrument up at the fore-sight so that when levelled up, the eye end may be as before, about an inch or half an inch

from the rod and read the height of the instrument which call a' . Then take a reading of the rod again held on X and call it b' . The distance d in feet may be read from the stadia points of the rod at either set up.

We have then for the deviation of the line of sight in the distance d .

$$D = \frac{(a + a') - (b + b')}{2}$$

and for any other distance, such as d' the error would be $D \frac{d'}{d}$. When the quantity D is positive the line of sight dips below the horizontal.

The above does not take into account the correction for curvature which, strictly speaking should be applied to the two longer sights. This correction is, however, very small and may be neglected. It affects the result by less than half a hundredth of a foot when the distance used is 300 feet.

388. No adjustment is advisable unless the quantity D is over 0.02 foot for a distance of 300 feet, reliance being placed on equalization of the sum of the back-sight and fore-sight distances, rather than on constant interference with the adjustment. It is noted that no adjustment, no matter how accurately done, can compare with this equalization, and without equalization an error in adjustment too small to be detected, may cause large errors in a short distance.

389. In order to adjust:—To get the correct rod reading for the true horizontal line of sight, the quantity D should be applied to the last rod reading b' according to sign, without moving the instrument from its last place, the rod is again held on the peg X, and the line of sight of the telescope is raised or lowered by means of the micrometer screw under the eye end until the middle wire intersects the correct rod reading. The level vial is then adjusted by its capstan screws so that the bubble stands exactly in the centre. The whole operation should then be repeated as a check.

4. MERIDIAN AND BASE LINE LEVELS.

390. All lines are to be checked by running a second independent line, using different turning points for the two lines. The check line should be run in the opposite direction to the first, unless some strong reason prevents. The

check levels should be entered on the page following the corresponding main line when such is practicable.

391. Whenever the difference between the main and check levellings in a division exceeds 0.10 foot $\sqrt{\text{distance}}$ in miles, the whole division must be re-levelled until two levellings agree within this limit. The limit amounts to 0.07 ft. in a division half a mile long, and 0.12 ft. for a mile and a half.

392. The partial discrepancy of a line of levels is the difference between the main levelling and the check levelling between two successive bench-marks. This discrepancy is considered positive when the check levels would make the forward bench-mark higher than the main line makes it. The forward B.M. is that one which is in advance of the other in the direction of the main course of the work.

The discrepancy is computed as follows, it being noted that in levelling all back-sights are considered as being positive and all fore-sights as being negative:—

(a) Set down the difference between the sum of the back-sights and the sum of the fore-sights on the main line. This is the main measure.

(b) Set down the difference between the sum of the back-sights and the sum of the fore-sights on the check line. This is the check measure.

The closing error is the difference between the two measures. When the check line is run in the opposite direction to the main line (as it should be) the sign of the closing error is always the same as the sign of the smaller of the two measures. When the duplicate lines are run in the same direction, the sign is the same as that of the duplicate measures when the main is the smaller, and opposite when the main is the greater.

In the rare case of two B.M.'s being at almost the same elevation, it may happen that the main line shows the forward B.M. to be a little higher, and the check line shows it to be a little lower, than the rear B.M., or *vice versa*. In such case the discrepancy is the sum of the two measures, and the sign is always opposite to that of the main line, independently of whether the check levels were run in the same or opposite direction.

393. The main and check measures of each division, and the partial discrepancy, with its proper sign, are to be entered on the check page, on the lines reserved for this purpose.

394. A record of the rise or fall between the ends of successive divisions, and of the discrepancies found when checking each division, is to be entered from day to day in the pages reserved for this purpose at the end of each book. Such of the continued sums of each of these entries as will act as a check on the whole should be noted in order to avoid carrying forward clerical errors. The accumulated discrepancy from the beginning of the line is to be carried forward from each book to the next one.

395. Separate books must be used for lines entirely separate, such as different base lines.

396. Particular attention should be given to permanence in the bench-marks. If an exceptionally favourable object, such as solid rock or a massive boulder, is encountered, it should always be utilized, even though some little distance off the line, or near an inferior B.M. already established.

397. Bench-marks are to be numbered consecutively, the number increasing in the direction of the survey. The same number must not occur twice in the same base line between two initial meridians. A memorandum showing what numbers may be used is supplied to the surveyor with his instructions.

398. The great length which must be levelled along a meridian or base line without any external check, and the widespread effect of error on future levelling, should be constantly kept in mind. The only way to keep error under control is by running two entirely independent lines in all cases. If they do not agree, an additional line should always be levelled instead of trying to locate the error by study of the notes. Confusion in the identity of a mark at the end of a division, when the next division is being commenced, is a dangerous source of error which is not exposed by check levels.

5. SUBDIVISION OF TOWNSHIPS.

399. Levels are to be run along the control meridian and control chord. In addition they are to be run along the section lines which are distant an even number of

miles from the control meridian and control chord. It is also desirable when none of the outer circuits are closed by levels already run in adjoining townships in previous seasons, or to be run by the surveyor, that one or two or such outer circuits may be closed by levels along parts of the outlines. If the control meridians or control chords of two adjoining townships should be situated an uneven number of miles apart, so that a residue, three miles wide, will occur, one only of the two intervening lines need be levelled. If exceptionally unfavourable conditions for levelling occur on any of the lines specified, such other section lines should be levelled as will result in closed circuits not exceeding eight miles in length. It is, however, expected that the control meridian and control chord will always be levelled. Levels carried across lakes exceeding half a mile along the line need not be considered in summing the length of a circuit. It is not intended that levels should be run along any section line which is not being surveyed.

400. The section lines may be levelled in any order or direction, the levels being commenced anew, if necessary, at any corner. When they are commenced at a corner not previously connected to any levels a permanent or temporary bench-mark is first to be established. An assumed elevation is to be assigned to this, and the same datum is to be carried through to the next corner to which levels have been previously carried. The assumed elevations need not be all reduced in the field to a common datum, but the rise or fall between the ends of each mile must be determined as this is needed to find the closing error of each circuit. Assumed elevations are to be entered in the column (on the right hand page) to the right of the elevation column, leaving the latter to be filled in subsequently when the assumed datum is reduced to any common datum, not necessarily sea-level if this is not known to the surveyor.

401. It is not intended to make profiles of the lines but to ascertain elevations at known points so that they may be recorded on a plan while, at the same time, an accurate basis of elevations is carried forward. It is particularly desired that the levels run along the control meridians and connecting lines be sufficiently accurate to act as a check in connecting the levels run along base lines. A small difference in the care used will change a condition

of good agreement over a township to one where every different line converging on a corner will give a most troublesome difference of elevation.

402. Where a trial line is first run, the levels may be run over either the trial or the final line, but in the former event the difference of elevation of the section corners on the two lines should be found subsequently by a hand level, and entered in the level book opposite to the elevation previously recorded.

403. When no permanent bench-mark is established close to a section corner a temporary bench-mark must always be placed. It may be any definite mark which can be readily identified and is sufficiently stable to last until the survey is completed and inspected. It is to consist of an actual mark, such as a nail. A stump or other feature, unmarked, and defined only by a description, is not to be used. The top of a corner post is not suitable for a temporary bench-mark, unless the post be the new pattern of pipe filled with concrete.

404. Permanent bench-marks are to be numbered consecutively in the order of time at which they are established, without regard to their location, the numbers used increasing throughout the whole season. Numbers already used along any outline of a township, or part of a base line, are not to be used in any part of a township which has the outline or base line as a boundary. There is no objection to missing certain numbers. The main requirements are that a plan of a township (which it is to be noted, includes boundaries of other townships) shall not have numbers duplicated, and that the same number shall not occur throughout the books of a surveyor's season as being applied to different B.M.'s. A memorandum showing what numbers may be used is supplied in the case of an ordinary subdivision survey. When the survey is of a miscellaneous character, the numbers used should as far as possible, conform to the two requirements specified above.

405. The words "First record" must be entered in the notes the first time a reading is taken on a new B.M.

406. Different section lines should not be entered on the same page excepting the extreme end of another section. A new page should be commenced for each section line. Levels run in different townships should not be entered in the same book. If there is a probability that any day's work will include levels in different townships the necessary

books should be carried from camp. Subsequent copying of lines into different books is an unsatisfactory substitute for original entry in the proper book. None of the four outlines of a township are, however, considered to be in a different township, but care should be taken to distinguish similar outlines from one another in the notes. If a small part only of a township is being surveyed in a season, the levels of two townships in the same locality may be entered in one book, provided all the levels taken in the two townships can be included in the book.

407. The index to pages in the front of the level book should be made complete.

408. The levels along control meridians and control chords are to be checked in the manner provided in clauses 390 to 394 for meridians and base lines. In addition to such check levels a connection is to be checked from each control meridian to the next, so that such connection shall average not more than eight miles, and not less than four miles, in distance from the nearest control chord or base line. It is preferable that such checked connection should be along lines in a continuous east and west direction, without any intermediate jog to the north or south.

409. In arranging lines to be checked, preference should always be given to such lines as will form in conjunction with the levels along control meridians or chords a connected and checked system extending through the whole subdivision. Care should always be taken to check the short connection along the correction line between the ends of lines which have been checked on opposite sides.

410. Surveyors are expected to carry out such levels in the outlying parts of their subdivision as will form a fair proportion of all the levels which ultimately should be run in the whole district.

411. Lines, other than control meridians and chords and their connections, should be checked whenever time permits. Such check levels, which are additional to those already specified, should, as far as practicable, be extended over an entire division. Stopping work on the main line to check isolated portions is likely to cause confusion.

412. A check with the transit is advisable across a rough valley by means of reading vertical angles from both sides. For this purpose the chainage, the height above the ground

of the transit axis, and of the point sighted on should be noted at both stations.

413. When a subdivision covers only part of a township, the remainder of which will, in the ordinary course of events, be subdivided at a future time, only such lines need be levelled in the part as would have been levelled if the whole township were being subdivided. If, however, the subdivision ends at an Indian or other reserve, such lines, (either along retraced boundaries of the reserve or along other lines being surveyed) should be levelled as will close any large circuits, but no such lines should be levelled merely to close a circuit including an area of less than three square miles.

414. The closing error of each circuit is to be entered on a diagram which is to be forwarded with the surveyor's progress sketches during the season. The closing error is found as follows:—Consider the circuit as formed in the clockwise direction regardless of the direction in which each side has been levelled. Enter along each side the difference of the elevations of the bench-marks at its extremities, prefixing the plus sign when it is a rise, going in the clockwise direction and the minus sign when it is a fall. Add up all the plus quantities and then all the minus quantities. The difference of these sums, preceded by the sign of the greater (arithmetically), is the closing error of the particular circuit, and is to be entered on the diagram in the centre of the circuit.

415. No exact limit is specified within which a circuit must close but if the error exceeds one foot, as much of the circuit as time allows should be re-run.

416. When the closing errors of adjoining circuits are large and have different signs, the presumption is that a large part of the errors of both circuits is in the side or sides common to the two circuits. When the signs are the same, it indicates that some accumulating error in one direction is occurring over the township.

417. A fair indication of the general accuracy of the whole is furnished by summing the closing errors algebraically over all the work. In ordinary country this sum should not exceed two feet for an area equal to a whole township.

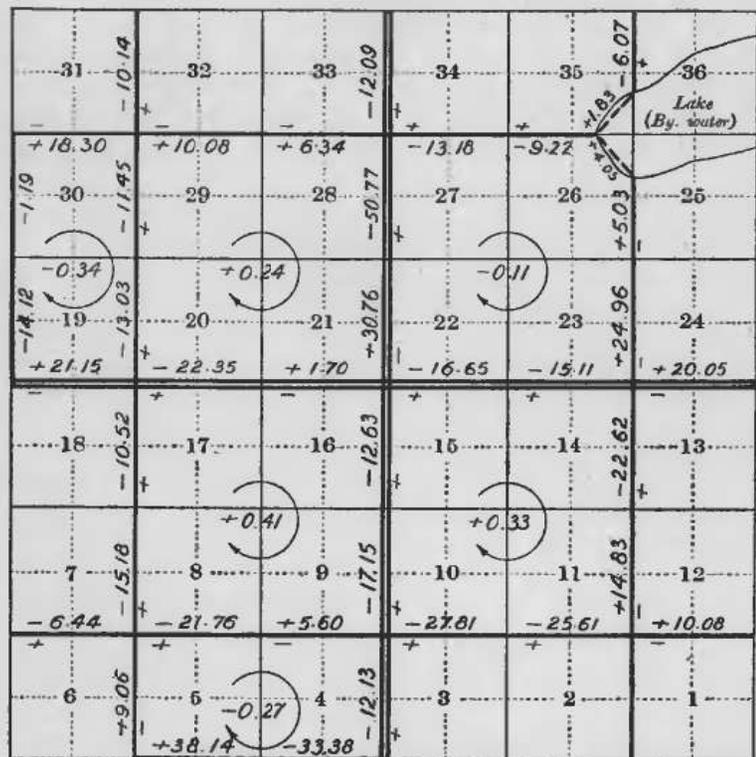
418. In very rough country cases may occur where definite rules cannot be followed. The regularity of the levels along alternate sections should, however, be preserved

SPECIMEN OF DIAGRAM OF CLOSING ERRORS

Township 100 Range 15 West of — Meridian
 Levels by J. A. Brown D.L.S.
 up to the 25 August 1916

NOTE: Lines which have been levelled are shown in heavy black.
 Double lines indicate check levels.

W. S. Smith Leveller



Sum of positive closings..... 0.98
 Sum of negative closings..... 0.72
 Net total..... +0.26

Certified correct,

J. A. Brown Dominion Land Surveyor.

(In the diagrams actually made by surveyors the heavy black lines of the specimen are replaced by red lines)

as far as is possible without causing delay to the general progress of the survey. It is generally preferable, in very rough country, to level once around a closed circuit, rather than to check a smaller mileage of unclosed lines. Local spur lines, not forming parts of closed circuits should be run if otherwise large areas would have no levels run through them.

419. It is always an advantage to ascertain the elevations of lakes and other prominent features, not on the lines, even in an approximate manner.

420. In the general arrangement of the survey, the effect on the level work on any particular order of running the lines should be kept in mind. The levels should be commenced at the same time as the survey and be kept up with the general progress throughout the season.

CHAPTER VIII.

REGULATIONS.

1. EMPLOYMENT OF SURVEYORS, ARTICLED PUPILS, AND LEVELLERS.

421. The salary of a surveyor in charge of a party commences on the day he leaves home for the field, and is paid for every day, including Sundays, he is engaged upon matters connected with the survey, until his work is complete. Time spent upon private affairs or work not connected with the survey is deducted in calculating the surveyor's salary. Neither the Surveyor General, the Deputy Minister, nor the Minister has authority to pay the surveyor while not employed on the survey.

422. To be eligible for employment in charge of a party or as first assistant, a surveyor must own, in addition to the standard measure required by section 35 of the Dominion Lands Survey Act, a transit theodolite with a telescope of not less than one and one-half inches aperture, a sidereal watch, a stadia rod, a clinometer, and two steel band chains, one of them being one or more full chains in length and graduated in links, the other one or more hundred feet in length and graduated in feet. A spare transit theodolite is recommended.

In addition to the above a surveyor in charge of governing surveys must have a six-inch transit.

All the instruments enumerated above must be of approved pattern and in good order.

423. 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.

424. The salary of a Dominion Land Surveyor not in charge of a party, an articled pupil or a qualified leveller commences on the day he leaves home to report to the chief of the party and ceases when he reaches home after being discharged.

425. 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.

2. ALLOWANCES.

426. 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.

427. 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.

A stub attached to the requisition is also sent the surveyor. This stub is to be filled in at the same time as the requisition and is to be retained by the surveyor to be forwarded with his accounts at the close of the season. All unused requisitions must be returned to the head office at the close of the season.

428. 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), boxes used for shipping instruments, also all material and charges for repairing transport.

429. 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 sixty-five cents a day for himself and every member of his party while in the field.

430. 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.

431. Camp equipage is 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.

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

433. Medicines and medical expenses, otherwise than provided in cases of accidents, are not allowed.

434. The board and camp equipage allowance for a surveyor not in charge, for an articled pupil, and for a qualified leveller, are twenty-five cents and ten cents a day, respectively.

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

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

437. 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. Surveyors are warned not to expect compensation for losses sustained through accident or otherwise. In order to protect themselves they should be prepared to adopt the remedy provided in this clause.

3. ENGAGEMENT OF THE MEMBERS OF A SURVEY PARTY.

438. The members of the party other than surveyors, articled pupils, and levellers are engaged at the place where the party is organized. At the end of the survey they are brought back to the same place and are discharged. Their wages are paid from the day of their engagement to the day of their discharge.

439. The wages of each individual may be arranged in such manner as the surveyor considers advisable. If the work is at no great distance from settlements, he must so regulate the wages and the terms of the agreement signed by the men as to be tolerably certain that they will not leave him.

440. An agreement in duplicate setting forth fully and clearly the terms of his engagement, must be executed by every member of the party. The chief must take care to explain these terms carefully and see they are perfectly understood before the agreement is signed.

441. The agreement must state the rate per day for salaries and wages. As the pay-list has to be prepared to show the rate per day for wages, the members of the party should be engaged at a certain rate per day rather than per month.

442. The form can be amended to suit requirements of the surveyor. He must not make the engagement up to a certain date or such longer period as shall prove sufficient for the completion of the said surveys; this proviso would render the agreement void.

443. A definite period beyond which the service will not run in any event, must be stated. This should be sufficiently long to amply cover the length of season the surveyor considers will be necessary, but in addition to stating this limiting period he must add, "or such shorter period as shall prove sufficient for the completion of the said surveys." If a definite limiting period is not stated the agreement is void, and if the subsequent proviso is not added the surveyor might be liable for wages until the end of the period stated, independently of whether his surveys are ended or not.

444. A list of applications for positions on survey parties is published each spring and furnished to all surveyors in charge of parties, in order that they may, if they wish, communicate with the applicants direct.

445. The employment of persons under twenty years of age upon parties organized for the survey of Dominion lands is forbidden by Order in Council. Women are not allowed on survey parties.

4. TRAVEL TO AND FROM SURVEY.

446. Dominion land surveyors, articled pupils, and levellers are allowed railway fares and travel expenses from home to the place where the party is organized and to return home, provided they stay with the party until the end of the survey. The chief of the party is forbidden to allow railway fares or travel expenses or salary while travelling, under any circumstances whatever, to any member of the party who leaves before the close of the operations and the discharge of the party, even if he leaves with the permission of the chief. This must be explained by the chief to every surveyor, articled pupil or leveller when engaging him.

447. Transportation for the whole party is provided by the chief from the time and place where the party is organized until the discharge of the party. At the close of field operations, when the party is discharged at a point other than the place of organization, the party or any member thereof is allowed transportation back to the place where they were engaged. When a member of the party does not wish to return, he is not entitled to the cash value of the railway fare. The Department will reimburse the chief of the party only for actual expenses; when possible, transportation requisitions should be used.

448. If a ticket agent refuses to honour a requisition issued by the head office, the surveyor must report at once stating the facts.

5. SURVEY POSTS.

449. Posts are stored at Winnipeg, Edmonton, Peace River, and a few other places.

450. Store-keepers are instructed not to deliver posts without an order from the Surveyor General. A surveyor requiring posts must apply to the head office for an order. If the short survey post is required, it must be mentioned in the application, otherwise the standard survey post

will be supplied. The order for the posts is mailed to the store-keeper direct and a duplicate to the surveyor who must send the shipping directions to the store-keeper.

451. Unless in exceptional circumstances, shipping directions are not transmitted by the head office to the store-keeper, 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 store-keeper.

452. In cases of emergency, an order may be telegraphed by the head office to the store-keeper, but it is preferable that the request for the posts and the order should go by mail.

453. The store-keeper ships posts in such quantities and to such places as the surveyor directs, so long as the total number of posts covered by the order is not exceeded, but he is not allowed to break crates without a special order from the head office.

454. In preparing a surveyor's instructions, an estimate is made of the number of posts required and an order for same given to the store-keeper. A duplicate of the order is transmitted with the instructions. If more posts are wanted than are covered by the order, the surveyor is expected to apply in time to the head office for the additional number wanted.

455. Posts not used are charged to the surveyor at one dollar each if not returned to stores.

456. At the close of the field operations, a statement must be furnished on the form supplied showing the number of posts received and used during the season and the disposal of unused posts.

457. Tools for digging or drilling post holes, such as post-hole augers, crow-bars 4½, 5 and 5½ ft. long, rock-drills, and sledge-hammers, also two-pound tins of Portland cement, are kept in stock and supplied to surveyors upon request.

When conditions are favourable, surveyors may have the rock-drills resharpened in the field. Otherwise, application should be made for whatever drills may be deemed necessary for planting the short posts during a season's work, the dulled drills being returned for resharpening.

6. BLANK FORMS.

458. Lists of blank forms are furnished by the head office. A surveyor requiring forms must make a requisition

for the same by filling upon the printed list the number of each required.

7. DISPOSAL OF OUTFIT.

459. 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. The agreement for wintering horses should contain a list of the horses to be wintered together with a description of each animal.

(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 or discarded.

8. ACCOUNTS.

460. 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.

461. 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.

462. 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. Surveyors are requested, however, to ask credits by telegraph in cases of emergency only, explaining the nature of the emergency in each case.

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.
Bank d'Hochelega,
Canadian Bank of Commerce,
Dominion Bank,
Imperial Bank of Canada,
La Banque Nationale.
La Banque Provinciale du Canada,
Merchants Bank of Canada,
Molsons Bank,
Northern Crown Bank,
Royal Bank of Canada,
Standard Bank of Canada,
Union Bank of Canada,

463. 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.

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.

464. 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.

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

466. Vouchers for payments to merchants or to a railway or express company, must be made out on the printed form of the merchant or company, otherwise such vouchers will not be allowed.

467. Included in vouchers of merchants there have been items, such as "Freight paid railways." Surveyors filing such vouchers should obtain from the merchant the freight bills, otherwise such items cannot be allowed.

468. Upon all vouchers payment must be certified by written signature. Vouchers certified by stamp are not acceptable. The locality where payment is made must be shown in all cases.

469. Vouchers should be numbered in consecutive order, in the lower right hand corner.

470. Vouchers for all payments and all accounts excepting for personal service while employed at office work preparing final returns should be forwarded as soon as possible after the close of operations in the field.

471. 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 circumstance 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.

472. 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.