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MANUAL

OF

SURVEYING INSTRUCTIONS

FOR THE

SURVEY OF THE PUBLIC LANDS

OF THE

UNITED STATES

AND

PRIVATE LAND CLAIMS.

Prepared in conformity with law under the direction of
THE COMMISSIONER OF THE GENERAL LAND OFFICE.

JUNE 30, 1894.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1894.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, D. C., June 30, 1894.

GENTLEMEN:

The following instructions, including full and minute directions for the execution of surveys in the field, are issued under the authority given me by sections 453, 456, and 2398, United States Revised Statutes, and must be strictly complied with by yourselves, your office assistants, and deputy surveyors.

All directions in conflict with these instructions are hereby abrogated.

In all official communications, this edition will be known and referred to as the Manual of 1894.

Very respectfully,

S. W. LAMOREUX,
Commissioner.

TO SURVEYORS GENERAL OF THE UNITED STATES.

MANUAL OF SURVEYING INSTRUCTIONS.

HISTORY OF LEGISLATION FOR SURVEYS.

The present system of survey of the public lands was inaugurated by a committee appointed by the Continental Congress, consisting of the following delegates:

Hon. THOS. JEFFERSON, *Chairman*	Virginia.
Hon. HUGH WILLIAMSON	North Carolina.
Hon. DAVID HOWELL	Rhode Island.
Hon. ELBRIDGE GERRY	Massachusetts.
Hon. JACOB READ	South Carolina.

On the 7th of May, 1784, this committee reported "An ordinance for ascertaining the mode of locating and disposing of lands in the western territory, and for other purposes therein mentioned." This ordinance required the public lands to be divided into "hundreds" of ten geographical miles square, and those again to be subdivided into lots of one mile square each, to be numbered from 1 to 100, commencing in the *northwestern* corner, and continuing from west to east and from east to west consecutively. This ordinance was considered, debated, and amended, and reported to Congress April 26, 1785, and required the surveyors "to divide the said territory into townships of 7 miles square, by lines running due north and south, and others crossing these at right angles. * * * The plats of the townships, respectively, shall be marked by subdivisions into sections of 1 mile square, or 640 acres, in the same direction as the external lines, and numbered from 1 to 49. * * * And these sections shall be subdivided into lots of 320 acres." This is the first record of the use of the terms "township" and "section."

May 3, 1785, on motion of Hon. William Grayson, of Virginia, seconded by Hon. James Monroe, of Virginia, the section respecting the extent of townships was amended by striking out the words "seven miles square" and substituting the words "six miles square." The records of these early sessions of Congress are not very full or complete; but it does not seem to have occurred to the members until the 6th of May, 1785, that a township six miles square could not contain 49 sections of 1 mile square. At that date a motion to amend was made, which provided, among other changes, that a township should contain 36 sections; and the amendment was *lost*. The ordinance as finally passed, however, on the 20th of May, 1785, provided for townships 6 miles square, containing 36 sections of 1 mile square. The first public surveys were made under this ordinance. The townships, 6 miles square, were laid out in ranges, extending northward from the Ohio River, the townships being numbered from south to north, and the ranges from east to west. The region embraced by the surveys under this law forms a part of the present State of Ohio, and is usually styled "The

Seven Ranges." In these initial surveys only the *exterior lines* of the townships were surveyed, but the plats were marked by subdivisions into sections of 1 mile square, and mile corners were established on the township lines. The sections were numbered from 1 to 36, commencing with No. 1 in the *southeast* corner of the township, and running from *south* to *north* in each tier to No. 36 in the *northwest* corner of the township, as shown in the following diagram:

36	30	24	18	12	6
35	29	23	17	11	5
34	28	22	16	10	4
33	27	21	15	9	3
32	26	20	14	8	2
31	25	19	13	7	1

The surveys were made under the direction of the Geographer of the United States.

The act of Congress approved May 18, 1796, provided for the appointment of a surveyor general, and directed the survey of the lands northwest of the Ohio River, and above the mouth of the Kentucky River, "in which the titles of the Indian tribes have been extinguished." Under this law *one half* of the townships surveyed were subdivided into sections "by running through the same, each way, parallel lines at the end of every two miles, and by making a corner on each of said lines at the end of every mile," and it further provided that "the sections shall be numbered, respectively, beginning with the number one in the northeast section and proceeding west and east alternately, through the township, with progressive numbers till the thirty-sixth be completed." This method of numbering sections, as shown by the following diagram, is still in use:

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

The act of Congress approved May 10, 1800, required the "townships west of the Muskingum, which * * * are directed to be sold in quarter townships, to be subdivided into half sections of three hundred

and twenty acres each, as nearly as may be, by running parallel lines through the same from east to west, and from south to north, at the distance of one mile from each other, and marking corners, at the distance of each half mile, on the lines running from east to west, and at the distance of each mile on those running from south to north. * * * And the interior lines of townships intersected by the Muskingum, and of all the townships lying east of that river, which have not been heretofore actually subdivided into sections, shall also be run and marked. * * * And in all cases where the exterior lines of the townships thus to be subdivided into sections or half sections shall exceed, or shall not extend, six miles, the excess or deficiency shall be specially noted, and added to or deducted from the western and northern ranges of sections or half sections in such townships, according as the error may be in running the lines from east to west or from south to north."

The act of Congress approved February 11, 1805, directs the subdivision of the public lands into quarter sections, and provides that all the corners marked in the public surveys shall be established as the proper corners of sections, or subdivisions of sections, which they were intended to designate, and that corners of half and quarter sections *not marked* shall be placed, as nearly as possible, "equidistant from those two corners which stand on the same line." This act further provides that "The boundary lines actually run and marked * * * shall be established as the proper boundary lines of the sections or subdivisions for which they were intended; and the length of such lines as returned by * * * the surveyors * * * shall be held and considered as the true length thereof, and the boundary lines which shall not have been actually run and marked as aforesaid shall be ascertained by running straight lines from the established corners to the opposite corresponding corners; but in those portions of the fractional townships, where no such opposite or corresponding corners have been or can be fixed, the said boundary line shall be ascertained by running from the established corners due north and south or east and west lines, as the case may be, to the * * * external boundary of such fractional township."

The act of Congress approved April 25, 1812, provided "That there shall be established in the Department of the Treasury an office to be denominated the General Land Office, the chief officer of which shall be called the Commissioner of the General Land Office, whose duty it shall be, under the direction of the head of the Department, to superintend, execute, and perform all such acts and things touching or respecting the public lands of the United States, and other lands patented or granted by the United States, as have heretofore been directed by law to be done or performed in the office of the Secretary of State, of the Secretary and Register of the Treasury, and of the Secretary of War, or which shall hereafter by law be assigned to the said office."

The act of Congress approved April 24, 1820, provides for the sale of public lands in half quarter sections, and requires that "in every case of the division of a quarter section the line for the division thereof shall run north and south * * * and fractional sections, containing 160 acres and upward, shall, in like manner, as nearly as practicable, be subdivided into half quarter sections, under such rules and regulations as may be prescribed by the Secretary of the Treasury; but fractional sections containing less than 160 acres shall not be divided."

The act of Congress approved May 24, 1824, provides "That whenever, in the opinion of the President of the United States, a departure

from the ordinary mode of surveying land on any river, lake, bayou, or water course would promote the public interest, he may direct the surveyor general in whose district such land is situated, and where the change is intended to be made, under such rules and regulations as the President may prescribe, to cause the lands thus situated to be surveyed in tracts of two acres in width, fronting on any river, bayou, lake, or water course, and running back the depth of forty acres."

The act of Congress approved May 29, 1830 (secs. 2412, 2413, R. S.), provides for the fine and imprisonment of any person obstructing the survey of the public lands, and for the protection of surveyors, in the discharge of their official duties, by the United States marshal, with sufficient force, whenever necessary.

The act of Congress approved April 5, 1832, directed the subdivision of the public lands into quarter quarters; that in every case of the division of a half quarter section the dividing line should run east and west; and that fractional sections should be subdivided under rules and regulations prescribed by the Secretary of the Treasury. Under the latter provision the Secretary directed that fractional sections containing less than 160 acres, or the residuary portion of a fractional section, after the subdivision into as many quarter quarter sections as it is susceptible of, may be subdivided into lots, each containing the quantity of a quarter quarter section, as nearly as practicable, by so laying down the line of subdivision that they shall be 20 chains wide, which distances are to be marked on the plat of subdivision, as are also the areas of the quarter quarters and residuary fractions.

The last two acts above mentioned provided that the corners and contents of half-quarter and quarter-quarter sections should be ascertained, as nearly as possible, in the manner and on the principles directed and prescribed in the act of Congress approved February 11, 1805.

The act of Congress approved July 4, 1836, provided for the reorganization of the General Land Office, and that the executive duties of said office "shall be subject to the supervision and control of the Commissioner of the General Land Office under the direction of the President of the United States." The repealing clause is, "That such provisions of the act of the twenty-fifth of April, in the year one thousand eight hundred and twelve, entitled 'An act for the establishment of a General Land Office in the Department of the Treasury,' and of all acts amendatory thereof, as are inconsistent with the provisions of this act, be, and the same are hereby, repealed."

From the wording of this act it would appear that the control of the General Land Office was removed from the Treasury Department, and that the Commissioner reported directly to the President; but, as a matter of fact, the Secretary of the Treasury still had supervisory control, for the act of Congress approved March 3, 1849, by which the Department of the Interior was established, provided, "That the Secretary of the Interior shall perform all the duties in relation to the General Land Office, of supervision and appeal, now discharged by the Secretary of the Treasury * * *." By this act the General Land Office was transferred to the Department of the Interior, where it still remains.

In 1855 a manual of instructions to surveyors general was prepared, under the direction of the Commissioner of the General Land Office, by John M. Moore, then principal clerk of surveys, and the act of Congress approved May 30, 1862 (sec. 2399, R. S.), provided "That the printed manual of instructions relating to the public surveys, prepared at the General Land Office, and bearing the date February twenty-second, eighteen hundred and fifty-five, the instructions of the Commissioner

of the General Land Office, and the special instructions of the surveyor general, when not in conflict with said printed manual or the instructions of said Commissioner, shall be taken and deemed to be a part of every contract for surveying the public lands of the United States."

The instructions contained in this volume are issued under the authority given in the clause in said act providing that "The instructions of the Commissioner of the General Land Office * * * shall be taken and deemed to be a part of every contract for surveying the public lands of the United States."

The following comprises so much of the general laws relating to the survey of the public domain as it is deemed necessary to incorporate in this volume, reference being made by chapter and section to the codification of the Public Land Laws, prepared pursuant to acts of Congress approved March 3, 1879 and June 16, 1880, and by section number to the Revised Statutes of the United States.

EXISTING LAND LAWS.—CHAPTER TWO.

THE GENERAL LAND OFFICE.

Duties of Commissioner.

SEC. 32. The Commissioner of the General Land Office shall perform, under the direction of the Secretary of the Interior, all executive duties appertaining to the surveying and sale of the public lands of the United States, or in anywise respecting such public lands; and, also, such as relate to private claims of lands, and the issuing of patents for all grants of land under the authority of the Government. (R. S., 453.)

Returns and accounts relative to lands.

SEC. 35. All returns relative to the public lands shall be made to the Commissioner of the General Land Office; and he shall have power to audit and settle all public accounts relative to the public lands; and upon the settlement of any such accounts he shall certify the balance, and transmit the account with the vouchers and certificate to the First Comptroller of the Treasury for his examination and decision thereon. (R. S., 456.)

Commissioner to perform duties of surveyor-general, etc.

SEC. 38. Upon the discontinuance of any surveying district the authority, powers, and duties in relation to the survey, resurvey, or subdivision of lands therein, and all matters and things connected therewith, as previously exercised by the surveyor-general, shall be vested in and devolved upon the Commissioner of the General Land Office; and deputy surveyors or other agents under his direction shall have free access to any field-notes, maps, records, and other papers turned over to the authorities of any State, pursuant to law, for the purpose of making copies thereof, without charge of any kind. (R. S., 2219, 2220.)

Approval of surveying contracts.

SEC. 45. The Commissioner shall approve all contracts for the survey of the public lands. (R. S., 2398.)

Commissioner's instructions deemed part of contract for surveying.

SEC. 46. The instructions issued by the Commissioner of the General Land Office not in conflict with law shall be deemed part of every contract for surveying the public lands. (R. S., 2399.)

Power of Commissioner to make regulations.

SEC. 61. The Commissioner, under the direction of the Secretary of the Interior, is authorized to enforce and carry into execution every part of the public land laws not otherwise specially provided for. (R. S., 2478.)

CHAPTER THREE.

SURVEYS AND SURVEYORS.

Surveyors-general, how and where appointed.

SEC. 77. There shall be appointed by the President, by and with the advice and consent of the Senate, a surveyor-general for the States and Territories herein named, embracing, respectively, one surveying district, namely: Louisiana, Florida, Minnesota, Kansas, California, Nevada, Oregon, Nebraska and Iowa, Dakota, Colorado, New Mexico, Idaho, Washington, Montana, Utah, Wyoming, Arizona. (R. S., 2207.)

Residence of surveyor-general.

SEC. 83. Every surveyor-general, while in the discharge of the duties of his office, shall reside in the district for which he is appointed. (R. S., 2214.)

Bond of surveyor-general.

SEC. 84. Every surveyor-general shall, before entering on the duties of his office, execute and deliver to the Secretary of the Interior a bond, with good and sufficient security, for the penal sum of thirty thousand dollars, conditioned for the faithful disbursement, according to law, of all public money placed in his hands, and for the faithful performance of the duties of his office; and the President has discretionary authority to require a new bond and additional security, under the direction of the Secretary of the Interior, for the lawful disbursement of public moneys. (R. S., 2215, 2216.)

Duration of office.

SEC. 85. The commission of each surveyor-general shall cease and expire in four years from the date thereof, unless sooner vacated by death, resignation, or removal from office. (R. S., 2217.)

Continuance of duties and bond after expiration of commission.

SEC. 86. Every surveyor-general, except where the President sees cause otherwise to determine, is authorized to continue in the uninterrupted discharge of his regular official duties after the day of expiration of his commission and until a new commission is issued to him for the same office, or until the day when a successor enters upon the duties of such office; and the existing official bond of any officer so acting shall be deemed good and sufficient and in force until the date of the approval of the new bond to be given by him, if recommissioned, or otherwise, for the additional time he may so continue officially to act, pursuant to the authority of this section. (R. S., 2222.)

Transfer of papers and discontinuance of office in case of completed surveys.

SEC. 87. Whenever the surveys and records of any surveying district are completed the surveyor-general thereof shall be required to deliver over to the secretary of state of the respective States, including such surveys, or to such other officer as may be authorized to receive them, all the field-notes, maps, records, and other papers appertaining to land titles within the same; and the office of surveyor-general in every such district shall thereafter cease and be discontinued. (R. S., 2218.)

Devolution of powers upon Commissioner in case of discontinuance.

SEC. 88. In all cases of discontinuance, as provided in the preceding section, the authority, powers, and duties of the surveyor-general in relation to the survey, resurvey, or subdivision of the lands therein, and all matters and things connected therewith, shall be vested in and devolved upon the Commissioner of the General Land Office. (R. S., 2219.)

Free access to public records delivered to States, and condition of such delivery.

SEC. 89. Under the authority and direction of the Commissioner of the General Land Office any deputy surveyor or other agent of the United States shall have free access to any such field-notes, maps, records, and other papers for the purpose of taking extracts therefrom or making copies thereof without charge of any kind; but no transfer of such public records shall be made to the authorities of any State until such State has provided by law for the reception and safe-keeping of such public records, and for the allowance of free access thereto by the authorities of the United States. (R. S., 2220, 2221.)

General duties of surveyors-general.

SEC. 90. Every surveyor-general shall engage a sufficient number of skillful surveyors as his deputies, to whom he is authorized to administer the necessary oaths upon their appointments. He shall have authority to frame regulations for their direction, not inconsistent with law or the instructions of the General Land Office, and to remove them for negligence or misconduct in office.

Second. He shall cause to be surveyed, measured, and marked, without delay, all base and meridian lines through such points and perpetuated by such monuments, and such other correction parallels and meridians as may be prescribed by law or by instructions from the General Land Office in respect to the public lands within his surveying district, to which the Indian title has been or may be hereafter extinguished.

Third. He shall cause to be surveyed all private land claims within his district, after they have been confirmed by authority of Congress, so far as may be necessary to complete the survey of the public lands.

Fourth. He shall transmit to the register of the respective land offices within his district general and particular plats of all lands surveyed by him for each land district; and he shall forward copies of such plats to the Commissioner of the General Land Office.

Fifth. He shall, so far as is compatible with the desk duties of his office, occasionally inspect the surveying operations while in progress in the field, sufficiently to satisfy himself of the fidelity of the execution of the work according to contract, and the actual and necessary expenses incurred by him while so engaged shall be allowed; and where it is incompatible with his other duties for a surveyor-general to devote the time necessary to make a personal inspection of the work in progress, then he is authorized to depute a confidential agent to make such examination, and the actual and necessary expenses of such person shall be allowed and paid for that service,

and five dollars a day during the examination in the field; but such examination shall not be protracted beyond thirty days, and in no case longer than is actually necessary; and when a surveyor-general, or any person employed in his office at a regular salary, is engaged in such special service, he shall receive only his necessary expenses in addition to his regular salary. (R. S., 2223.)

Bond of deputy surveyor.

SEC. 91. Every deputy surveyor shall enter into bond, with sufficient security, for the faithful performance of all surveying contracts confided to him; and the penalty of the bond in each case shall be double the estimated amount of money accruing under such contract, at the rate per mile stipulated to be paid therein. The sufficiency of the sureties to all such bonds shall be approved and certified by the proper surveyor-general. (R. S., 2230.)

Oath of deputy surveyor.

SEC. 92. The surveyors-general, in addition to the oath now authorized by law to be administered to deputies on their appointment to office, shall require each of their deputies, on the return of his surveys, to take and subscribe an oath that those surveys have been faithfully and correctly executed according to law and the instructions of the surveyor-general. (R. S., 2231.)

Suit on bond of deputy surveyor; lien of.

SEC. 93. The district attorney of the United States, in whose district any false, erroneous, or fraudulent surveys have been executed, shall, upon the application of the proper surveyor-general, immediately institute suit upon the bond of such deputy, and the institution of such suit shall act as a lien upon any property owned or held by such deputy or his sureties at the time such suit was instituted. (R. S., 2232.)

Duties of register and receiver performed by surveyor-general.

SEC. 98. The President is authorized in any case where he thinks the public interest may require it, to transfer the duties of register and receiver in any district to the surveyor-general of the surveying district in which such land district is located. (R. S., 2228.)

Rules of survey.

SEC. 99. The public lands shall be divided by north and south lines run according to the true meridian, and by others crossing them at right angles, so as to form townships of six miles square, unless where the line of an Indian reservation, or of tracts of land heretofore surveyed or patented, or the course of navigable rivers, may render this impracticable; and in that case this rule must be departed from no further than such particular circumstances require.

Second. The corners of the townships must be marked with progressive numbers from the beginning; each distance of a mile between such corners must be also distinctly marked with marks different from those of the corners.

Third. The township shall be subdivided into sections, containing, as nearly as may be, six hundred and forty acres each, by running through the same, each way, parallel lines at the end of every two miles; and by making a corner on each of such lines at the end of every mile. The sections shall be numbered, respectively, beginning with the number one in the northeast section, and proceeding west and east alternately through the township with progressive numbers till the thirty-six be completed.

Fourth. The deputy surveyors, respectively, shall cause to be marked on a tree near each corner established in the manner described, and within the section, the number of such section, and over it the number of the township within which such section may be; and the deputy surveyors shall carefully note, in their respective field-books, the names of the corner trees marked and the numbers so made.

Fifth. Where the exterior lines of the townships which may be subdivided into sections or half sections exceed, or do not extend six miles, the excess or deficiency shall be specially noted, and added to or deducted from the western and northern ranges of sections or half sections in such townships, according as the error may be in running the lines from east to west, or from north to south; the sections and half sections bounded on the northern and western lines of such townships shall be sold as containing only the quantity expressed in the returns and plats, respectively, and all others as containing the complete legal quantity.

Sixth. All lines shall be plainly marked upon trees, and measured with chains, containing two perches of sixteen and one-half feet each, subdivided into twenty-five equal links; and the chain shall be adjusted to a standard to be kept for that purpose.

Seventh. Every surveyor shall note in his field-book the true situations of all mines, salt licks, salt springs, and mill-seats which come to his knowledge; all watercourses over which the line he runs may pass; and also the quality of the lands.

Eighth. These field books shall be returned to the surveyor-general, who shall cause therefrom a description of the whole lands surveyed to be made out and transmitted to the officers who may superintend the sales. He shall also cause a fair plat to be made of the townships and fractional parts of townships contained in the lands, describing the subdivisions thereof, and the marks of the corners. This plat shall be recorded in books to be kept for that purpose; and a copy thereof shall be kept open at the surveyor-general's office for public information, and other copies shall be sent to the places of the sale and to the General Land Office. (R. S., 2395.)

SEC. 100. The boundaries and contents of the several sections, half sections, and quarter sections of the public lands shall be ascertained in conformity with the following principles:

Boundaries and contents of public lands, how ascertained.

First. All the corners marked in the surveys returned by the surveyor-general shall be established as the proper corners of sections, or subdivisions of sections, which they were intended to designate, and the corners of half and quarter sections, not marked on the surveys, shall be placed as nearly as possible equidistant from two corners which stand on the same line.

Second. The boundary lines, actually run and marked in the surveys returned by the surveyor-general, shall be established as the proper boundary lines of the sections or subdivisions for which they were intended, and the length of such lines as returned shall be held and considered as the true length thereof. And the boundary lines which have not been actually run and marked shall be ascertained by running straight lines from the established corners to the opposite corresponding corners; but in those portions of the fractional townships, where no such opposite corresponding corners have been or can be fixed, the boundary lines shall be ascertained by running from the established corners due north and south or east and west lines, as the case may be, to the water-course, Indian boundary line, or other external boundary of such fractional township.

Third. Each section or subdivision of section, the contents whereof have been returned, by the surveyor-general, shall be held and considered as containing the exact quantity expressed in such return; and the half-sections and quarter-sections, the contents whereof shall not have been thus returned, shall be held and considered as containing the one-half or the one-fourth part, respectively, of the returned contents of the section of which they may make part. (R. S., 2396.)

SEC. 101. In every case of the division of a quarter section the line for the division thereof shall run north and south, and the corners and contents of half-quarter sections which may thereafter be sold shall be ascertained in the manner and on the principles directed and prescribed by the section preceding, and fractional sections containing one hundred and sixty acres or upwards shall in like manner, as nearly as practicable, be subdivided into half quarter-sections, under such rules and regulations as may be prescribed by the Secretary of the Interior, and in every case of a division of a half-quarter section, the line for the division thereof shall run east and west, and the corners and contents of quarter-quarter sections, which may thereafter be sold, shall be ascertained, as nearly as may be, in the manner and on the principles directed and prescribed by the section preceding; and fractional sections containing fewer or more than one hundred and sixty acres shall in like manner, as nearly as may be practicable, be subdivided into quarter-quarter sections, under such rules and regulations as may be prescribed by the Secretary of the Interior. (R. S., 2397.)

Lines of division of half-quarter sections, how run.

SEC. 102. Whenever, in the opinion of the President, a departure from the ordinary method of surveying land on any river, lake, bayou, or water-course would promote the public interest, he may direct the surveyor-general, in whose district such land is situated, and where the change is intended to be made, to cause the lands thus situated to be surveyed in tracts of two acres in width, fronting on any river, bayou, lake, or water-course, and running back the depth of forty acres; which tracts of land so surveyed shall be offered for sale entire, instead of in half quarter sections, and in the usual manner, and on the same terms in all respects as the other public lands of the United States. (R. S., 2407.)

Variance in shape of surveys on rivers, etc.

SEC. 106. The public surveys shall extend over all mineral lands, and all subdividing of surveyed lands into lots less than one hundred and sixty acres may be done by county and local surveyors at the expense of claimants; but nothing in this section contained shall require the survey of waste or useless lands. (R. S., 2406.)

Extension of public surveys over mineral lands.

SEC. 107. The printed manual of surveying instructions for the survey of the public lands of the United States, and private land claims, prepared at the General Land Office, and bearing date June thirtieth, eighteen hundred and ninety-four, the instructions of the Commissioner of the General Land Office, and the special instructions of the surveyor general, when not in conflict with such printed manual, or the instructions of said Commissioner, shall be taken and deemed to be part of every contract for surveying the public lands of the United States and private land claims. (R. S., 2399, as amended by act approved August 15, 1894.)

What instructions to be deemed part of contract.

SEC. 111. Contracts for the survey of the public lands shall not become binding upon the United States until approved by the Commissioner of the General Land Office, except in such cases as the Commissioner may otherwise specially order. (R. S., 2398.)

Contracts for surveys of public lands, when binding.

SEC. 112. The Commissioner of the General Land Office has power, and it shall be his duty, to fix the prices per mile for public surveys, which shall in no case exceed the maximum established by law; and, under instructions to be prepared by the Commissioner, an accurate account shall be kept by each surveyor-general of the cost of sur-

Prices of surveys, how established; cost of surveying private claims and railroad grants to be refunded.

veying and platting private land claims, to be reported to the General Land Office, with the map of such claim; and patents shall not issue for any such private claim, nor shall any copy of such survey be furnished, until the cost of survey and platting has been paid into the Treasury by the claimant or other party; and before any land granted to any railroad company by the United States shall be conveyed to such company or any persons entitled thereto, under any of the acts incorporating or relating to said company, unless such company is exempted by law from the payment of such cost, there shall first be paid into the Treasury of the United States the cost of surveying, selecting, and conveying the same by the said company or persons in interest. (R. S., 2400; 19 Stats., 121.)

When survey may be had by settlers in township.

SEC. 115. When the settlers in any township, not mineral or reserved by Government, desire a survey made of the same, under the authority of the surveyor-general, and file an application therefor in writing, and deposit in a proper United States depository, to the credit of the United States, a sum sufficient to pay for such survey, together with all expenses incident thereto, without cost or claim for indemnity on the United States, it may be lawful for the surveyor-general, under such instructions as may be given him by the Commissioner of the General Land Office, and in accordance with law, to survey such township and make return thereof to the general and proper local land office, provided the township so proposed to be surveyed is within the range of the regular progress of the public surveys embraced by existing standard lines or bases for the township and subdivisional surveys. (R. S., 2401.)

Deposit for expenses of surveys deemed an appropriation, etc.

SEC. 116. The deposit of money in a proper United States depository, under the provisions of the preceding section, shall be deemed an appropriation of the sums so deposited for the objects contemplated by that section, and the Secretary of the Treasury is authorized to cause the sums so deposited to be placed to the credit of the proper appropriations for the surveying service; but any excesses in such sums over and above the actual cost of the surveys, comprising all expenses incident thereto, for which they were severally deposited, shall be repaid to the depositors respectively. (R. S., 2402.)

Settlers' deposits for surveys to go in part payment of lands, and are assignable.

SEC. 117. Where settlers make deposits in accordance with the provisions of section one hundred and fifteen, the amount so deposited shall go in part payment for their lands situated in the townships, the surveying of which is paid for out of such deposits; or the certificates issued for such deposits may be assigned by indorsement and be received in payment for any public lands of the United States entered by settlers under the pre-emption and homestead laws of the United States, and not otherwise. (R. S., 2403.)*

Surveyors-general to survey private land claims when confirmed, etc.

SEC. 118. Each surveyor-general, when thereunto duly authorized by law, shall cause all confirmed private land claims within his district to be accurately surveyed, and shall transmit plats and field-notes thereof to the Commissioner of the General Land Office for his approval. When publication of such surveys is authorized by law, the proof thereof, together with any objections properly filed, and all evidence submitted either in support of or in opposition to the approval of any such survey, shall also be transmitted to said Commissioner. (R. S., 2447.)

Penalty for interrupting surveys.

SEC. 120. Every person who in any manner, by threat or force, interrupts, hinders, or prevents the surveying of the public lands, or of any private land claim which has been or may be confirmed by the United States, by the persons authorized to survey the same, in conformity with the instructions of the Commissioner of the General Land Office, shall be fined not less than fifty dollars, nor more than three thousand dollars, and be imprisoned not less than one nor more than three years. (R. S., 2412.)

Protection of surveyor by marshal of district.

SEC. 121. Whenever the President is satisfied that forcible opposition has been offered, or is likely to be offered, to any surveyor or deputy surveyor in the discharge of his duties in surveying the public lands, it may be lawful for the President to order the marshal of the State or district, by himself or deputy, to attend such surveyor or deputy surveyor with sufficient force to protect such officer in the execution of his duty, and to remove force should any be offered. (R. S., 2413.)

Surveyors to explore and select timber lands to reserve for use of the Navy.

SEC. 122. The President is authorized to appoint surveyors of public lands, who shall explore such vacant and unappropriated lands of the United States as produce the live-oak and red-cedar timbers, and shall select such tracts or portions thereof, where the principal growth is of either of such timbers, as in the judgment of the Secretary of the Navy may be necessary to furnish for the Navy a sufficient supply of the

*See amending acts, 20 Stat., 352, and 22 Stat., 327, and General Land Office Circular of June 24, 1885.

same. Such surveyors shall report to the President the tracts by them selected, with the boundaries ascertained and accurately designated by actual survey or water-courses. (R. S., 2459.)

APPOINTMENT OF DEPUTY SURVEYORS.

1. Sec. 2223, U. S. Revised Statutes, provides that "Every surveyor general shall engage a sufficient number of skillful surveyors as his deputies, to whom he is authorized to administer the necessary oaths upon their appointments. He shall have authority to frame regulations for their direction, not inconsistent with law or the instructions of the General Land Office, and to remove them for negligence or misconduct in office."

Each surveyor general should exercise great care in the appointment of deputy surveyors, and should thoroughly satisfy himself, before making such appointments, that the applicants possess the *proper theoretical and practical qualifications*, as well as *moral standing and fitness* for the important trusts to be confided to them.

To enable the deputy surveyor to fully understand and appreciate the responsibility under which he is acting, his attention is invited to the provisions of the second section of the act of Congress approved August 8, 1846, entitled "An act to equalize the compensation of the surveyors-general of the public lands of the United States, and for other purposes," which is as follows:

"SEC. 2. That the surveyors-general of the public lands of the United States, in addition to the oath now authorized by law to be administered to deputies on their appointment to office, shall require each of their deputies, on the return of his surveys, to take and subscribe an oath or affirmation that those surveys have been faithfully and correctly executed according to law and the instructions of the surveyor-general; and on satisfactory evidence being presented to any court of competent jurisdiction that such surveys, or any part thereof, had not been thus executed, the deputy making such false oath or affirmation shall be deemed guilty of perjury, and shall suffer all the pains and penalties attached to that offense; and the district attorney of the United States for the time being, in whose district any such false, erroneous, or fraudulent surveys shall have been executed, shall, upon the application of the proper surveyor-general, immediately institute suit upon the bond of such deputy; and the institution of such suit shall act as a lien upon any property owned or held by such deputy, or his sureties, at the time such suit was instituted."

2. All persons appointed deputy surveyors will deliver to the surveyor general their official oaths, duly subscribed and sworn to, as follows:

Oath prescribed by act of Congress approved May 13, 1884, to be taken by any person elected or appointed to any office of honor or profit either in the civil, military, or naval service of the United States (except the President of the United States):

I, ——— ———, do solemnly ——— that I will support and defend the Constitution of the United States against all enemies, foreign and domestic; that I will bear true faith and allegiance to the same; that I take this obligation freely, without any mental reservation or purpose of evasion; and that I will well and faithfully discharge the duties of the office on which I am about to enter. So help me God.

——— ———.

Sworn to and subscribed before me this —— day of ———, A. D., 189—.

——— ———,

——— ———.

A full record of all appointments of deputy surveyors, together with their official oaths, will be carefully preserved in the office of the surveyor general.

3. The deputy surveyor having been duly appointed, and his oath of allegiance filed in the surveyor general's office, contracts for surveys may then be entered into between the surveyor general and such deputy surveyor, and all surveying contracts and bonds will be made out in the following form:

FORM OF CONTRACT.

This agreement, made this —— day of ———, 189—, between the surveyor general of the United States for ———, acting for and in behalf of the United States, of the one part, and ——— ———, deputy surveyor, of the other part —

Witnesseth, That the said ——— ———, for and in consideration of the conditions, terms, provisions, and covenants hereinafter expressed, and according to the true intent and meaning thereof, doth hereby covenant and agree with the said surveyor general, in his capacity aforesaid, that —— the said ——— ———, in —— own proper person, with the assistance of such chainmen, axmen, flag-bearers, and mound-men as may be necessary, in strict conformity with the laws of the United States, the printed manual of surveying instructions, as revised and approved in 1894, and other surveying instructions issued by the Commissioner of the General Land Office, and with such special instructions as — may receive from the said surveyor general in conformity therewith (all of said instructions to be taken and deemed a part of this contract), will well, truly, and faithfully survey, mark, and establish ——— ——— and that —— will complete these surveys in the manner aforesaid, and return the true and original field-notes thereof to the office of the said surveyor general on or before the —— day of ——— next ensuing the date hereof, on penalty of forfeiture, and paying to the United States the sum mentioned in the annexed bond, if default be made in any of the foregoing conditions. And it is further expressly stipulated and made a condition of this contract that the surveys herein described shall not be commenced before the said ——— ——— shall have been officially notified by the said surveyor general of the approval of this contract by the Commissioner of the General Land Office.

And the said surveyor general, in his official capacity aforesaid, covenants and agrees with the said ——— ——— that on the completion of the surveys above named, in the manner aforesaid, there shall be paid to the said ——— ———, by the Treasury Department of the United States, as a full compensation for all work performed under this agreement, at the rate of ——— dollars for base, standard, meridian, and meander lines, ——— dollars for township lines, and ——— dollars for section and connecting lines, except where the lines of survey pass over mountainous lands, or lands heavily timbered, or covered with dense undergrowth, and in such case at the rate of ——— dollars for base, standard, meridian, and meander lines, ——— dollars for township lines, and ——— dollars for section and connecting lines per mile, for every mile and part of mile actually run and marked in the field, *random lines and offsets not included.*

Provided, however, That no payment shall be made until the plats and field notes of the survey executed under this contract shall have been accepted by the Commissioner of the General Land Office.

It is further agreed by and between the parties to this agreement that no accounts shall be paid unless properly certified by the surveyor general (or his successor in office) that the surveys are in accordance with the instructions herein referred to and the provisions of this agreement, and until approved plats and certified transcripts of field notes of the surveys for which the accounts are rendered are filed in the General Land Office.

And it is further understood and agreed by and between the parties to this agreement that the said surveys will not be approved by the said surveyor general (or by his successor in office) unless they shall be found to be in exact accordance with the instructions hereinbefore specified: *Provided also,* That no member of [or delegate to] Congress or subcontractor shall be admitted to any share or part of this contract, or to any benefit to arise thereupon, and that no payment shall be made for any surveys not executed by the said deputy surveyor ——— ——— in — own proper person.

In testimony whereof the parties to these articles of agreement have hereunto set their hands and seals the day and year first above written.

Signed, sealed, and acknowledged before us:

Witnesses to surveyor general's signature.

——— ———

Residence: ———

——— ———

Residence: ———

——— ———, [SEAL.]

United States Surveyor General for ———.

Witnesses to deputy surveyor's signature.

——— ———

Residence: ———

——— ———

Residence: ———

——— ———, [SEAL.]

United States Deputy Surveyor.

FORM OF BOND.

Know all men by these presents, that we, ——— ——— of ———, as principal, and ——— ——— of ———, ——— ——— of ———, ——— ——— of ———, and ——— ——— of ———, as sureties, are held and firmly bound unto the United States of America in the sum of ——— dollars, lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, our heirs, executors, and administrators, and each and every one of us and them, jointly and severally, firmly by these presents.

Signed with our hands and sealed with our seals this —— day of ——— 189—.

The condition of the above obligation is such, that if the above-bounden ——— ———, deputy surveyor, shall well, truly, and faithfully, according to the laws of the United States, the printed manual of surveying instructions and other surveying instructions issued, or which may hereafter be issued, by the Commissioner of the General Land Office, and to such special instructions as — may receive from the surveyor general in conformity therewith, make and execute the surveys which are required of ——— to be made by the foregoing contract, and return the true field notes of the said surveys to the surveyor general in the manner and within the period named in the said contract, then this obligation to be void; otherwise, it shall remain in full force and virtue.

Signed, sealed, and acknowledged before us:

——— ——— [L. S.]*

Residence: ——— ——— ——— [L. S.]

——— ——— ——— [L. S.]

Residence: ——— ——— ——— [L. S.]

——— ——— [L. S.]

Affidavits of sureties.

——— OF ———,

County of ———, *ss:*

I, ——— ———, one of the sureties on the official bond of ——— ——— as ———, do depose and say that I am worth, in unincumbered property, not exempt from execution under the laws of the ——— of ———, ——— dollars and upward, after payment of my just debts and liabilities, as follows:

Real estate, valued at $———, and consisting of † ———.

Personal estate, valued at $———, and consisting of ‡ ———.

Signature: ——— ———.

(Post-office address:) ——— ———.

Sworn to and subscribed before me this —— day of ———, 189—.

[SEAL.] ——— ———,

——— ———.

---

* Attach an adhesive seal after each signature and covering L. S.

† Here state whether city property, improved or unimproved, or improved farms, or unimproved lands, and where situated.

‡ Here describe the nature of the property, whether bonds, stocks, merchandise, etc.

——— OF ———,

County of———, *ss:*

I, ——— ———, one of the sureties on the official bond of ——— ——— as ———, do depose and say that I am worth, in unincumbered property, not exempt from execution under the laws of the ——— of ———, ——— dollars and upward after payment of my just debts and liabilities, as follows:

Real estate, valued at $———, and consisting of * ———.

Personal estate, valued at $———, and consisting of †———.

Signature: ——— ———,

(Post-office address:) ——— ———.

Sworn to and subscribed before me this —— day of ———, 189—.

[SEAL.] ——— ———,

——— ———.

——— OF ———,

County of ———, *ss:*

I, ——— ———, do hereby certify that ——— ———, who administered the above oath, was, at the time of doing so, a ——— in and for said ———, duly qualified to act as such, and that I believe his signature as above written is genuine.

In testimony whereof, I have hereunto set my hand and affixed the seal of ——— this —— day of ———, one thousand eight hundred and——.

——— ———,

——— ———.

Certificate.

I, ——— ———, hereby certify that in my opinion the sureties to the above bond are sufficient, and I hereby approve the same.

——— ———,

United States Surveyor General for ———.

1. The names of the U. S. surveyor general, deputy surveyor, sureties, and witnesses must be written in full, and the residence of witnesses written after their signatures.

2. A full description of the surveys embraced in the contract must be written in the blank space left for that purpose.

3. The date when the surveys can be commenced shall not be earlier than the commencement of the fiscal year for which the appropriation is made, except in cases where the appropriation is made immediately available.

4. The rates named in any contract must not exceed those fixed by law.

5. The signatures of the surveyor general and of the deputy surveyor must each be witnessed by two persons.

6. All erasures, mutilations, and interlineations must be avoided.

7. The bond must be dated the day it is signed by all the parties thereto, and its execution must be subsequent to the execution of the contract.

8. The names of all the parties executing the bond, and of the witnesses thereto, must be written in full.

9. The affidavits of sureties must be made before some officer (preferably an officer of the United States) duly authorized to administer oaths and having a seal.

10. The sufficiency of sureties must be certified to by the surveyor general.

11. The amount of the bond must be *at least* double the estimated amount that will be due to the deputy surveyor upon the completion of the contract made under the same.

12. The *duplicate* and *triplicate* contracts and bonds will be forwarded to the General Land Office, and when approved the Commissioner will forward the *triplicate* to the First Comptroller of the Treasury.

SYSTEM OF RECTANGULAR SURVEYING.

[See Plates I, III, and IV.]

1. Existing law requires that in general the public lands of the United States "shall be divided by north and south lines run according to the true meridian, and by others crossing them at right angles so as to form townships six miles square," and that the corners of the townships thus surveyed "must be marked with progressive numbers from the beginning."

* Here state whether city property, improved or unimproved, or improved farms, or unimproved lands, and where situated.

† Here describe the nature of the property, whether bonds, stocks, merchandise, etc.

Also, that the townships shall be subdivided into thirty-six sections, each of which shall contain six hundred and forty acres, as nearly as may be, by a system of two sets of parallel lines, one governed by true meridians and the other by parallels of latitude, the latter intersecting the former at right angles, at intervals of a mile.

2. In the execution of the public surveys under existing law, it is apparent that the requirements that the lines of survey shall conform to true meridians, and that the townships shall be 6 miles square, taken together, involve a mathematical impossibility due to the convergency of the meridians.

Therefore, to conform the meridional township lines to the true meridians produces townships of a trapezoidal form which do not contain the precise area of 23,040 acres required by law, and which discrepancy increases with the increase in the convergency of the meridians, as the surveys attain the higher latitudes.

In view of these facts, and under the provisions of section 2 of the act of May 18, 1796, that sections of a mile square shall contain 640 acres, *as nearly as may be*, and also under those of section 3 of the act of May 10, 1800, that "in all cases where the exterior lines of the townships, thus to be subdivided into sections and half sections, shall exceed, or shall not extend 6 miles, the excess or deficiency shall be specially noted, and added to or deducted from the western or northern ranges of sections or half sections in such township, according as the error may be in running lines from east to west, or from south to north; the sections and half sections bounded on the northern and western lines of such townships shall be sold as containing only the quantity expressed in the returns and plats, respectively, and all others as containing the complete legal quantity," the public lands of the United States shall be surveyed under the methods of the system of rectangular surveying, which harmonizes the incompatibilities of the requirements of law and practice, as follows:

First. The establishment of a principal meridian conforming to the true meridian, and, at right angles to it, a base line conforming to a parallel of latitude.

Second. The establishment of standard parallels conforming to parallels of latitude, initiated from the principal meridian at intervals of 24 miles and extended east and west of the same.

Third. The establishment of guide meridians conforming to true meridians, initiated upon the base line and successive standard parallels at intervals of 24 miles, resulting in tracts of land 24 miles square, *as nearly as may be*, which shall be subsequently divided into tracts of land 6 miles square by two sets of lines, one conforming to true meridians, crossed by others conforming to parallels of latitude at intervals of 6 miles, containing 23,040 acres, *as nearly as may be*, and designated *townships.*

Such townships shall be subdivided into thirty-six tracts, called sections, each of which shall contain 640 acres, as nearly as may be, by two sets of parallel lines, one set *parallel to a true meridian* and the other *conforming to parallels of latitude*, mutually intersecting at intervals of 1 mile and at right angles, *as nearly as may be.*

Any series of contiguous townships situated north and south of each other constitutes a *range*, while such a series situated in an east and west direction constitutes a *tier.*

The accompanying diagram (Plate III), and the specimen field notes (page 142), pertaining to the same, will serve to illustrate the method of running lines to form tracts of land 24 miles square, as well as the

method of running out the exterior lines of townships, and the order and mode of subdividing townships will be found illustrated in the accompanying specimen field notes (page 172), conforming with the township plat (Plate IV). The method here presented is designed to insure as full a compliance with all the requirements, meaning, and intent of the surveying laws as practicable.

The section lines are surveyed from *south* to north* and from *east* to west, in order to throw the excess or deficiency in measurement on the north and west sides of the township, as required by law. In case where a township has been partially surveyed, and it is necessary to complete the survey of the same, or where the character of the land is such that only the north or west portions of the township can be surveyed, this rule can not be strictly adhered to, but, in such cases, it will be departed from only so far as is absolutely necessary. It will also be necessary to depart from this rule where surveys close upon State or Territorial boundaries, or upon surveys extending from different meridians.

3. The tiers of townships will be numbered, to the north or south, commencing with No. 1, at the base line; and the ranges of the townships, to the east or west, beginning with No. 1, at the principal meridian of the system.

4. The thirty-six sections into which a township is subdivided are numbered, commencing with number *one* at the *northeast* angle of the township, and proceeding west to number six, and thence proceeding east to number twelve, and so on, alternately, to number thirty-six in the southeast angle. In all cases of surveys of fractional townships, the sections will bear the same numbers they would have if the township was full.

5. Standard parallels shall be established at intervals of every 24 miles, north and south of the base line, and guide meridians at intervals of every 24 miles, east and west of the principal meridian; thus confining the errors resulting from convergence of meridians and inaccuracies in measurement within comparatively small areas.

INSTRUMENTS.

6. The surveys of the public lands of the United States, embracing the establishment of base lines, principal meridians, standard parallels, meander lines, and the subdivisions of townships, will be made with instruments provided with the accessories necessary to determine a direction with reference to the true meridian, independently of the magnetic needle.

Burt's improved solar compass, or a transit of approved construction, with or without solar attachment, will be used in *all* cases. When a transit *without* solar attachment is employed, *Polaris observations* and the *retracements* necessary to execute the work in accordance with existing law and the requirements of these instructions will be insisted upon.

7. Deputies using instruments with solar apparatus will be required to make observations on the star Polaris at the beginning of every survey, and, *whenever necessary, to test the accuracy of the solar apparatus.*

The observations required to test the adjustments of the solar apparatus will be made at the corner where the survey begins, or at the

*See "Method of Subdividing," p. 53.

camp of the deputy surveyor nearest said corner; and in all cases the deputy will fully state in the field notes the exact location of the observing station.

Deputy surveyors will examine the adjustments of their instruments, and *take the latitude* daily*, weather permitting, while running *all lines of the public surveys.* They will make complete records in their field notes, under proper dates, of the making of all observations in compliance with these instructions, showing the character and condition of the instrument in use, and the precision attained in the survey, by comparing the direction of the line run with the meridian determined by observation.

On every survey executed with solar instruments, the deputy will, *at least once on each working day*, record in his field notes the proper reading of the latitude arc; the declination of the sun, corrected for refraction, set off on the declination arc; and note the correct *local mean time* of his observation, which, for the record, will be taken *at least two hours from apparent noon.*

8. The construction and adjustments of all surveying instruments used in surveying the public lands of the United States will be tested at least once a year, and oftener, if necessary, on the true meridian, established under the direction of the surveyor general of the district; and if found defective, the instruments shall undergo such repairs or modifications as may be found necessary to secure the closest possible approximation to accuracy and uniformity in all field work controlled by such instruments.

A record will be made of such examinations, showing the number and character of the instrument, name of the maker, the quantity of instrumental error discovered by comparison, in either solar or magnetic apparatus, or both, and means taken to correct the same. The surveyor general will allow no surveys to be made until the instruments to be used therefor have been approved by him.

9. The township and subdivision lines will usually be measured by a two-pole chain of 33 feet in length,† consisting of 50 links, each link being seven and ninety-two hundredths inches long. On uniform and level ground, however, the four-pole chain may be used. The measurements will, however, always be expressed in terms of the four-pole chain of 100 links. The deputy surveyor shall provide himself with a measure of the standard chain kept at the office of the surveyor general, to be used by him as a field standard. The chain in use will be compared and adjusted with this field standard each working day, and such field standard will be returned to the surveyor general's office for examination when the work is completed.

Deputy surveyors will use eleven tally pins made of steel, not exceeding 14 inches in length, weighty enough toward the point to make them drop perpendicularly, and having a ring at the top, in which will be fixed a piece of red cloth, or something else of conspicuous color, to make them readily seen when stuck in the ground.

PROCESS OF CHAINING.

In measuring lines with a two-pole chain, *five* chains are called a "*tally;*" and in measuring lines with a four-pole chain, *ten* chains are called a "*tally,*" because at that distance the last of the ten

* The adjustments should be *verified daily* when the instrument is in use.

† See R. S. 2395, sec. 99, par. 6 (page 11).

tally pins with which the forward chainman sets out will have been stuck. He then cries "tally," which cry is repeated by the other chainman, and each registers the distance by slipping a thimble, button, or ring of leather, or something of the kind, on a belt worn for that purpose, or by some other convenient method. The hind chainman then comes up, and having counted in the presence of his fellow the tally pins which he has taken up, so that both may be assured that none of the pins have been lost, he then takes the forward end of the chain, and proceeds to set the pins. Thus the chainmen alternately change places, each setting the pins that he has taken up, so that one is forward in all the odd, and the other in all the even tallies. Such procedure, it is believed, tends to insure accuracy in measurement, facilitates the recollection of the distances to objects on the line, and renders a mistally almost impossible.

LEVELING THE CHAIN AND PLUMBING THE PINS.

1. The length of every surveyed line will be ascertained by precise horizontal measurement, as nearly approximating to an air line as is possible in practice on the earth's surface. This all-important object can only be attained by a rigid adherence to the three following observances:

First. Ever keeping the chain drawn to its utmost degree of tension on even ground.

Second. On uneven ground, keeping the chain not only stretched as aforesaid, but *leveled.* And when ascending and descending steep ground, hills or mountains, the chain will have to be *shortened* to one-half or one-fourth its length (and sometimes more), in order accurately to obtain the true horizontal measure.

Third. The careful plumbing of the tally pins, so as to attain precisely *the spot* where they should be stuck. The more uneven the surface, the greater the caution needed to set the pins.

MARKING LINES.

1. All lines on which are to be established the legal corner boundaries will be marked after this method, viz: Those trees which may be intersected by the line will have two chops or notches cut on the sides facing the line, without any other marks whatever. These are called "*sight trees*" or "*line trees.*" A sufficient number of other trees standing within 50 links of the line, on either side of it, will be *blazed* on two sides diagonally or quartering toward the line, in order to render the line conspicuous, and readily to be traced, the blazes to be opposite each other, coinciding in direction with the line where the trees stand very near it, and to approach nearer each other toward the line, the farther the line passes from the blazed trees. Due care will ever be taken to have the lines so well marked as to be readily followed, and to cut the blazes deep enough to leave recognizable scars as long as the trees stand.

Where trees 2 inches or more in diameter are found, the required blazes will not be omitted.

Bushes on or near the line should be bent at right angles therewith, and receive a blow of the ax at about the usual height of blazes from the ground sufficient to leave them in a bent position, but not to prevent their growth.

2. On trial or random lines, the trees will not be blazed, unless occasionally, from indispensable necessity, and then it will be done so guardedly as to prevent the possibility of confounding the marks of the trial line with the *true*. But bushes and limbs of trees may be lopped, and *stakes set* on the trial or random line, at every ten chains, to enable the surveyor on his return to follow and correct the trial line and establish therefrom the *true line*. To prevent confusion, the temporary stakes set on the trial or random line will be *pulled up* when the surveyor returns to establish the true line.

INSUPERABLE OBJECTS ON LINE—WITNESS POINTS.

1. Under circumstances where the survey of a township or section line is obstructed by an impassable obstacle, such as a pond, swamp, or marsh (not meanderable), the line will be prolonged across such obstruction by making the necessary right-angle offsets (Plate IV, sec. 22); or, if such proceeding is impracticable, a traverse line will be run, or some proper trigonometical operation will be employed to locate the line on the opposite side of the obstruction; and in case the line, either *meridional* or *latitudinal*, thus regained, is recovered beyond the intervening obstacle, said line will be surveyed back to the margin of the obstruction and *all the particulars, in relation to the field operations, will be fully stated in the field notes.*

2. As a guide in alinement and measurement, at each point where the line intersects the margin of an obstacle, a *witness point** will be established, *except* when such point is *less than 20 chains* distant from the true point for a legal corner which falls in the obstruction, in which case a *witness corner*† will be established at the intersection. (See Plate IV, section 22.)

3. In a case where all the points of intersection with the obstacle to measurement fall *more than 20 chains* from the proper place for a legal corner in the obstruction, and a witness corner can be placed on the offset line *within 20 chains* of the inaccessible corner point, such "witness corner" will be established. (See Plate IV, south boundary of section 16.)

ESTABLISHING CORNERS.

1. To procure the faithful execution of this part of a surveyor's duty, is a matter of the utmost importance. After true coursing and most exact measurements, the establishment of corners is the consummation of the field work. Therefore, if the corners be not perpetuated in a permanent and workmanlike manner, the *principal object* of surveying operations will not have been attained.

2. The points at which corners will be established are fully stated in the several articles: "Base Lines," "Principal Meridians," "Standard Parallels," etc., following the title "Initial Points," page 50.

3. The best marking tools adapted to the purpose will be provided for marking *neatly*, *distinctly*, and *durably*, all the letters and figures required to be made at corners, *arabic* figures being used exclusively; and the deputy will always have at hand the necessary implements for keeping his marking irons in perfect order.

DESCRIPTIONS OF CORNERS.

1. The form and language used in the following articles, in describing, for each one of the thirteen classes of corners, eight specific construc-

* See "Witness Points," page 48. † See "Witness Corners," page 47.

tions and markings, with the stated modifications in certain cases, will be carefully followed by deputy surveyors in their *field notes;* and their *field work* will strictly comply with the requirements of the descriptions.

2. When pits and mounds of earth are made accessories to corners, the pits will always have a *rectangular* plan; while the mounds will have a *conical* form, with *circular* base; and in all cases both pits and mounds will have dimensions *at least* as great as those specified in the descriptions. Deputy surveyors will strictly adhere to these provisions, and no departure from the stated requirements will be permitted, either in *instructions* or *practice in the field.* (See Plates V and VI).

3. Referring to the numbered paragraphs, the corners described in "3" will be preferred to those described in either "1" or "2", when corners are established in loose, sandy soil, and good bearing trees are available; under similar conditions, the corners described in "5" and "8" will be preferred to those described in "4" and "7", respectively.

4. The selection of the particular construction to be adopted in any case will be left, as a matter of course, to the judgment and discretion of the deputy, who will assign the greatest weight to the *durability* of the corner materials and *permanency* of the finished corners.

5. The following abbreviations and contractions will be used in the descriptions of corners, viz:

A. M. C.	for auxiliary meander corner.	N.	for north.
bdy.	for boundary.	¼ sec. cor.	for quarter section corner.
bdrs.	for boundaries.	R.	for range.
bet.	for between.	Rs.	for ranges.
C. C.	for closing corner.	sec., secs.	for section, sections.
cor., cors.	for corner, corners.	S. M. C.	for special meander corner.
dist.	for distance.	S. C.	for standard corner.
E.	for east.	sq.	for square.
ft.	for foot or feet.	S.	for south.
fracl.	for fractional.	T. or Tp.	for township.
ins.	for inches.	Ts. or Tps.	for townships.
diam.	for diameter.	W.	for west.
lks.	for links.	W. C.	for witness corner.
M. C.	for meander corner.	W. P.	for witness point.

For "18 inches long, 7 inches wide, 6 inches thick," in describing a corner stone, write "18×7×6 ins.," being particular to always preserve the same order of length, width, and thickness (or depth), and use a similar form when describing *pits.*

STANDARD TOWNSHIP CORNERS.

[See Plates III and V.]

When more than one-half of all the standard township and section corners on any 6 miles of a base line or standard parallel are stone corners, the descriptions in paragraphs 1 and 2, if the corners therein described are established, will be modified as follows: Strike out "S. C., on N." After "marked", insert the words:

"S. C., 13 N. on N.,
22 E. on E., and
21 E. on W. faces;"

When under the conditions above specified the corner described in paragraph 1 is established, a stake may be driven in the east pit and marked instead of the stone, and described as exemplified in the last clause of paragraph 6, page 00.

(See Specimen Field Notes, pages 145 and 149).

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, —×—×— ins., — ins. in the ground, for standard cor. of (e. g.) Tps. 13 N., Rs. 21 and 22 E., marked S. C. on N.; with 6 grooves on N., E., and W. faces; dug pits, 30×24×12 ins., crosswise on each line, E. and W., 4 ft., and N. of stone, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, N.* of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, —×—×— ins., — ins. in the ground, for standard cor. of (e. g.) Tps. 13 N., Rs. 21 and 22 E., marked S. C., on N.; with 6 grooves on N., E., and W. faces; and raised a mound of stone†, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, —×—×— ins., — ins. in the ground, for standard cor. of (e. g.) Tps. 13 N., Rs. 21 and 22 E., marked S. C., on N.; with 6 grooves on N., E., and W. faces; from which

A —, — ins. diam., bears N. — ° E., — lks. dist., marked ‡
T. 13 N., R. 22 E., S. 31, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 13 N., R. 21 E., S. 36, B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for standard cor. of (e. g.) Tps. 13 N., Rs. 22 and 23 E., marked
S. C., T. 13 N. on N.,
R. 23 E., S. 31 on E., and
R. 22 E., S. 36 on W. faces; with 6 grooves on N., E., and W. faces; dug pits, 30 × 24 × 12 ins., crosswise on each line, E. and W., 4 ft., and N. of post, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, N. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for standard cor. of (e. g.) Tps. 13 N., Rs. 22 and 23 E., marked
S. C., T. 13 N. on N.,
R. 23 E., S. 31 on E., and
R. 22 E., S. 36 on W. faces; with 6 grooves on N., E., and W. faces, from which

A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 13 N., R. 23 E., S. 31, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 13 N., R. 22 E., S. 36, B. T.

6. *Mound of Earth, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for standard cor. of (e. g.) Tps. 13 N., Rs. 22 and 23 E.; dug pits, 30×24×12 ins., crosswise on each line, N., E., and W. of cor., 5 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, over deposit.

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*The *direction* of the mound, from the corner, will be stated whenever a mound is built. See "Miscellaneous," par. 2, page 48.

†Mound of stone will consist of not less than *four* stones, and will be *at least* 1½ ft. high, with 2 ft. base.

‡All bearing trees, except those referring to quarter section corners, will be marked with the *township, range, and section in which they stand.*

In E. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
S. C., T. 13 N. on N.,
R. 23 E., S. 31 on E., and
R. 22 E., S. 36 on W. faces; with 6 grooves on N., E., and W. faces.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for standard cor. of (c. g.) Tps. 13 N., Rs. 22 and 23 E., I marked
S. C., T. 13 N. on N.,
R. 23 E., S. 31 on E., and
R. 22 E., S. 36 on W. sides; with 6 notches on N., E., and W. sides; dug pits, 24×18×12 ins., crosswise on each line, N., E., and W. of cor., 5 ft. dist.; and raised a mound of earth around tree.

8. *Tree Corner, with Bearing Trees.*

A —, — ins. diam., for standard cor. of (c. g.) Tps. 13 N., Rs. 22 and 23 E., I marked
S. C., T. 13 N. on N.,
R. 23 E., S. 31 on E., and
R. 22 E., S. 36 on W. sides; with 6 notches on N., E., and W. sides; from which
A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 13 N., R. 23 E., S. 31, B. T.
A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 13 N., R. 22 E., S. 36, B. T.

CLOSING TOWNSHIP CORNERS.

[See Plates V and VI.]

When more than one-half of all the township corners are stone corners, the descriptions in paragraphs 1 and 2, if the corners therein described are established, will be modified, as follows: Strike out "C. C., on S.;". After "marked", insert the words
"C. C., 3 N. on S.,
2 W. on E., and
3 W. on W. faces."

When, under the conditions above specified, the corner described in paragraph 1 is established, a stake may be driven in the east pit, and marked instead of the stone, and described as exemplified in the last clause of paragraph 6, page 26.

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, —×—×— ins., — ins. in the ground, for closing cor. of (e. g.) Tps. 4 N., Rs. 2 and 3 W., marked C. C., on S.; with 6 grooves on S., E., and W. faces; dug pits, 30×24×12 ins., crosswise on each line, E. and W., 4 ft., and S. of stone, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, — × — × — ins., — ins. in the ground, for closing cor. of (e. g.) Tps. 4 N., Rs. 2 and 3 W., marked C. C., on S.; with 6 grooves on S., E., and W. faces; and raised a mound of stone, 2 ft. base, 1½ ft. high, S. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, — × — × — ins., — ins. in the ground, for closing cor. of (e. g.) Tps. 4 N., Rs. 2 and 3 W., marked C. C., on S.; with 6 grooves on S., E., and W. faces; from which:

A —, — ins. diam. bears S. —° E., — lks. dist., marked
T. 4 N., R. 2 W., S. 6, B. T.

A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 4 N., R. 3 W., S. 1, B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for closing cor. of (e. g.) Tps. 4 N., Rs. 2 and 3 W., marked
C. C., T. 4 N. on S.,
R. 2 W., S. 6 on E., and
R. 3 W., S. 1 on W. faces; with 6 grooves on S., E., and W. faces; dug pits, 30 × 24 × 12 ins., crosswise on each line, E. and W., 4 ft., and S. of post 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ feet high, S. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for closing cor. of (e. g.) Tps. 4 N., Rs. 2 and 3 W., marked
C. C., T. 4 N. on S.,
R. 2 W., S. 6 on E., and
R. 3 W., S. 1 on W. faces; with 6 grooves on S., E., and W. faces; from which

A —, — ins. diam., bears S. —° E., — lks. dist., marked
T. 4 N., R. 2 W., S. 6, B. T.

A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 4 N., R. 3 W., S. 1, B. T.

6. *Mound of Earth, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for closing cor. of (e. g.) Tps. 4 N., Rs. 2 and 3 W.; dug pits, 30 × 24 × 12 ins., crosswise on each line, S., E., and W. of cor., 5 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, over deposit.

In E. pit, drove a — stake 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
C. C., T. 4 N. on S.,
R. 2 W., S. 6 on E., and
R. 3 W., S. 1 on W. faces; with 6 grooves on S., E., and W. faces.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for closing cor. of (e. g.) Tps. 4 N., Rs. 2 and 3 W., I marked
C. C., T. 4 N. on S.,
R. 2 W., S. 6 on E., and
R. 3 W., S. 1 on W. sides; with 6 notches on S., E., and W. sides; dug pits, 24 × 18 × 12 ins., crosswise on each line, S., E., and W. of cor., 5 ft. dist.; and raised a mound of earth, around tree.

8. *Tree Corner, with Bearing Trees.*

A —, — ins. diam., for closing cor. of (e. g.) Tps. 4 N., Rs. 2 and 3 W., I marked

C. C., T. 4 N. on S.,
R. 2 W., S. 6 on E., and
R. 3 W., S. 1 on W. sides; with 6 notches on S., E., and W. sides; from which
A —, — ins. diam., bears S. —° E., — lks. dist., marked
T. 4 N., R. 2 W., S. 6, B. T.
A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 4 N., R. 3 W., S. 1, B.T.

9. *Connecting lines.*

All closing township corners on base lines or standard parallels, will be connected, by course and distance, with the *nearest* standard corner thereon; closing corners *on all other lines*, will be connected, in a similar manner, with the *nearest* township, section, or quarter section corner, or mile or half-mile monument, as existing conditions may require.

10. *Relative positions of Closing Corners, Pits, Mounds, and Bearing Trees.*

Any line, which by intersection with another *surveyed* line, determines the place for a closing corner, will be called a *closing line;* then in general, the mound and one pit of a closing corner will be placed *on* such "closing line," N., S., E., or W. of the closing corner, as prevailing conditions may require; while said mound and pit, with the two bearing trees (if used), will always be located on the same side of the *line closed upon*, and *on* which the other pits will be established, as directed in the foregoing descriptions, and illustrated on Plate VI.

11. *Positions and dimensions of Pits of Closing Corners on irregular boundaries.*

When a closing line intersects an irregular boundary at an angle less than 75°, and stone or post closing corners are established, the pit on the boundary adjoining the acute angle will be omitted, and the pit on the opposite side of the closing corner will have its dimensions increased, as follows: For a closing township corner, the enlarged pit will measure $42\times36\times12$ ins.; for a closing section corner it will be $30\times24\times12$ ins. (See Plate VI, figs. 2 and 3.)

12. *Township or Section interfering Closing Corners.*

When two closing lines, at right angle to each other, intersect an irregular boundary at points *less than 8 feet apart*, and stone or post corners are established, the pits, that under ordinary circumstances would be placed on the boundary, will be omitted, and the pits *on the closing lines* will have their dimensions increased to $36\times36\times12$ ins. (See Plate VI, fig. 4, at *a* and *b*.)

13. *Positions and dimensions of Pits and Mounds of interfering Closing Corners.*

When, under the conditions stated in paragraphs 11 and 12, the corners "*Mound of Earth, with Deposits and Stake in Pit*" are established, the pits on the boundary line will be omitted when the distance between the closing corners is *less than 10 feet* and *greater than 4 feet*, and the dimensions of the pits on the closing lines will be increased as directed in said paragraphs.

In case the distance between the closing corners is *less than 4 feet*, one mound, 5 ft. base, 2½ ft. high, will cover the deposits of both closing corners. (See Plate VI, fig. 4, at *c*, *d*, and *e*.)

CORNERS COMMON TO FOUR TOWNSHIPS.

[See Plate V.]

When more than one-half of all the corners of a township are stone corners, the descriptions in paragraphs 1 and 2, if the corners therein described are established, will be modified, as follows: After "marked", insert the words

"3 N. on N. E.,
2 E. on S. E.,
2 N. on S. W., and
3 E. on N. W. faces;"

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, —×—×— ins., — ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., Rs. 2 and 3 W., marked with 6 notches on each edge; dug pits, 24×24×12 ins., on each line, N., E., and W., 4 ft., and S. of stone, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, —×—×— ins., — ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., Rs. 2 and 3 W., marked with 6 notches on each edge, and raised a mound of stone, 2 ft. base, 1½ ft. high, S. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, —×—×— ins., — ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., Rs. 2 and 3 W., marked with 6 notches on each edge; from which

A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 3 N., R. 2 W., S. 31, B. T.
A —, — ins. diam., bears S. —° E., —lks. dist., marked
T. 2 N., R. 2 W., S. 6, B. T.
A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 2 N., R. 3 W., S. 1, B. T.
A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 3 W., S. 36, B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., Rs. 2 and 3 W., marked
T. 3 N., S. 31 on N E.,
R. 2 W., S. 6 on S. E.,
T. 2 N., S. 1 on S. W., and
R. 3 W., S. 36 on N. W. faces; with 6 notches on each edge; dug pits, 24×24×12 ins., on each line, N., E., and W., 4 ft., and S. of post, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., Rs. 2 and 3 W., marked
T. 3 N., S. 31 on N. E.,
R. 2 W., S. 6 on S. E.,
T. 2 N., S. 1 on S. W., and

R. 3 W., S. 36 on N. W., faces; with 6 notches on each edge; from which

A —, — ins. diam., bears N. — E., —lks. dist., marked
T. 3 N., R. 2 W., S. 31, B. T.

A —, — ins. diam., bears S. —° E., —lks. dist., marked
T. 2 N., R. 2 W., S. 6, B. T.

A —, — ins. diam., bears S. —° W., —lks. dist., marked
T. 2 N., R. 3 W., S. 1, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 3 W., S. 36, B. T.

6. *Mound of Earth, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., Rs. 2 and 3 W.; dug pits 24×24×12 ins., on each line, N., S., E., and W. of cor., 5 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, over deposit.

In E. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked

T. 3 N., S. 31 on N. E.,
R. 2 W., S. 6 on S. E.,
T. 2 N., S. 1 on S. W., and
R. 3 W., S. 36 on N. W. faces; with 6 notches on each edge.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for cor. of (e. g.) Tps. 2 and 3 N., Rs. 2 and 3 W., I marked

T. 3 N., S. 31 on N. E.,
R. 2 W., S. 6 on S. E.,
T. 2 N., S. 1 on S. W., and
R. 3 W., S. 36 on N. W. sides; with 6 notches facing each cardinal point; dug pits, 24×18×12 ins., on each line, N., S., E., and W. of cor., 5 ft. dist.; and raised a mound of earth around tree.

8. *Tree Corner, with Bearing Trees.*

A —, — ins. diam., for cor. of (e. g.) Tps. 2 and 3 N., Rs. 2 and 3 W., I marked

T. 3 N., S. 31 on N. E.,
R. 2 W., S. 6 on S. E.,
T. 2 N., S. 1 on S. W., and
R. 3 W., S. 36 on N. W. sides; with 6 notches facing each cardinal point; from which

A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 3 N., R. 2 W., S. 31, B. T.

A —, — ins. diam., bears S. —° E., — lks. dist., marked
T. 2 N., R. 2 W., S. 6, B. T.

A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 2 N., R. 3 W., S. 1, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 3 W., S. 36, B. T.

CORNERS COMMON TO TWO TOWNSHIPS ONLY.

[See Plates V and IX.]

When more than one-half of all the corners of a township are stone corners, the descriptions in paragraphs 1 and 2, if the corners therein described are established, will be modified as follows:

After "marked", insert the words:

"2 N. on S. W., and
7 W. on N. W. faces."

When, under the conditions above specified, the corner described in paragraph 1 is established, a stake may be driven in the south pit and marked instead of the stone, and described as exemplified in the last clause of paragraph 6, below.

1. *Stone, with Pits and Mounds of Earth.*

Set a — stone, — × — × — ins., — ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., R. 7 W., on W. bdy. Tp. 3 N., R. 6 W., marked with 6 notches on N., and W. edges; dug pits 30×24×12 ins., on each line, N. and S., 4 ft., and W. of stone, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, W. of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, — × — × — ins., — ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., R. 7 W., on W. bdy. Tp. 3 N., R. 6 W., marked with 6 notches on N., and W. edges; and raised a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, — × — × — ins., — ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., Rs 5 and 6 W., on N. bdy. Tp. 2 N., R. 6 W., marked with 6 notches on N. and W. edges; from which

A —, ins. diam., bears N. —° E., — lks. dist., marked
T. 2 N., R. 5. W., S. 6, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 6 W., S. 36, B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., Rs. 5 and 6 W., on N. bdy. Tp. 2 N., R. 6 W., marked
T. 2 N., R. 5 W., S. 6 on N. E., and
T. 3 N., R. 6 W., S. 36 on N. W. faces; with 6 notches on N. and W. edges; dug pits, 30×24×12 ins., on each line, E. and W., 4 ft., and N. of post, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, N. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., R. 7 W., on W. bdy. Tp. 3 N., R. 6 W., marked
T. 2 N., R. 7 W., S. 1 on S. W., and
T. 3 N., R. 7 W., S. 36 on N. W. faces; with 6 notches on N. and W. edges; from which

A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 2 N., R. 7 W., S. 1, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 7 W., S. 36, B. T.

6. *Mound of Earth, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for cor. of (e. g.) Tps. 2 and 3 N., R. 7 W., on W. bdy. Tp. 3 N., R. 6 W.; dug pits, 30×24×12 ins., on each line, N., E., and W. of cor., 5 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, over deposit.

In S. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
T. 2 N., R. 7 W., S. 1 on S. W., and
T. 2 N., R. 7 W., S. 36 on N. W. faces; with 6 notches on N. and W. edges.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for cor. of (e. g.), Tps. 2 and 3 N., Rs. 5 and 6 W., on N. bdy. Tp. 2 N., R. 6 W., I marked
T. 2 N., R. 5 W. on N. E., and
T. 3 N., R. 6 W. on N. W. sides; with 6 notches facing N. and W.; dug pits 24×18×12 ins., crosswise on each line, N., E., and W. of cor., 5 ft. dist.; and raised a mound of earth, around tree.

8. *Tree Corner, with Bearing Trees.*

A—, — ins. diam., for cor. of (e. g.) Tps. 2 and 3 N., R. 7 W., on W. bdy. Tp. 3 N., R. 6 W., I marked
T. 2 N., R. 7 W., S. 1 on S. W., and
T. 3 N., R. 7 W., S. 36 on N. W., sides; with 6 notches facing N. and W.; from which
A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 2 N., R. 7 W., S. 1, B. T.
A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 7 W., S. 36, B. T.

CORNERS REFERRING TO ONE TOWNSHIP ONLY.

[See Plates V and IX.]

When more than one-half of all corners of a township are stone corners, the descriptions in paragraphs 1 and 2, if the corners therein described are established, will be modified, as follows: After " marked", insert the words:
" 2 N., 6 W. on S. W. face."
When, under the conditions above specified, the corner described in paragraph 1 is established, a stake may be driven in the south pit, and marked instead of the stone, and described as exemplified in the last clause of paragraph 6, page 32.

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, —×—×— ins., —ins. in the ground, for N. E. cor. of (e. g.) Tp. 2 N., R. 6 W., marked with 6 notches on S. and W. edges; dug pits, 36×36×12 ins., on each line, S. and W. of stone, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. W. of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, —×—×— ins.,—ins. in the ground, for N. E. cor. of (e. g.) Tp. 2 N., R. 6 W., marked with 6 notches on S. and W. edges; and raised a mound of stone, 2 ft. base, 1½ ft. high, S. W. of cor. Pits impracticable.

3. *Stone, with Bearing Tree.*

Set a — stone, —×—×— ins., — ins. in the ground for N. E. cor. of (e. g.) Tp. 2 N., R. 6 W., marked with 6 notches on S. and W. edges; from which
A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 2 N., R. 6 W., S. 1, B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for N. E. cor. of (e. g.) Tp. 2 N., R. 6 W., marked
T. 2 N., R. 5 W., S. 6 on N. E.,
S. 6 on S. E.,

T. 2 N., R. 6 W., S. 1 on S. W., and
S. 6 on N. W. faces; with 6 notches on S. and W. edges; dug pits, 36×36×12 ins., on each line, S. and W. of post, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. W. of cor.

5. *Post, with Bearing Tree.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for S. W. cor. of (e. g.) Tp. 3 N., R. 6 W., marked
T. 3 N., R. 6 W., S. 31 on N. E.,
S. 1 on S. E.,
T. 2 N., R. 7 W., S. 1 on S. W., and
S. 1 on N. W. faces; with 6 notches on N. and E. edges; from which
A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 3 N., R. 6 W., S. 31, B. T.

6. *Mound of Earth, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for S. W. cor. of (e. g.) T. 3 N., R. 6 W.; dug pits, 36×36×12 ins., on each line, N. and E. of cor., 5 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, over deposit.
In E. pit drove a — stake, 2 ft. long, 2 in. sq., 12 ins. in the ground, marked
T. 3 N., R. 6 W., S. 31 on N. E.,
S. 1 on S. E.,
T. 2 N., R. 7 W., S. 1 on S. W., and
S. 1 on N. W. faces; with 6 notches on N. and E. edges.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for S. W. cor. of (e. g.) Tp. 3 N., R. 6 W., I marked
T. 2 N., R. 6 W., S. 31 on N. E.,
S. 1 on S. E.,
T. 2 N., R. 7 W., S. 1 on S. W., and
S. 1 on N. W. sides; with 6 notches facing N. and E.; dug pits, 30 × 24 × 12 ins., crosswise on each line, N. and E. of cor., 5 ft. dist.; and raised a mound of earth around tree.

8. *Tree Corner, with Bearing Tree.*

A —, — ins. diam., for S. E. cor. of (e. g.) Tp. 4 N., R. 6 W., I marked
S. 6 on N. E.,
T. 3 N., R. 5 W. S. 6 on S. E.,
S. 6 on S. W., and
T. 4 N., R. 6 W., S. 36 on N. W. sides; with 6 notches facing N. and W.; from which
A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 2 N., R. 6 W., S. 36, B. T.

STANDARD SECTION CORNERS.

[See Plates III and V.]

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, —×—×— ins., — ins. in the ground, for standard cor. of (e. g.) secs. 31 and 32, marked S. C., on N.; with 5 grooves on E., and 1 groove on W. faces; dug pits, 24×18×12 ins., crosswise on

each line, E. and W., 3 ft., and N. of stone, 7 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, N. of cor.

2. *Stone, with mound of Stone.*

Set a — stone, —×—×— ins., — ins. in the ground, for stand. cor. of (e. g.) secs. 35 and 36, marked S. C., on N.; with 1 groove on E., and 5 grooves on W. faces; and raised a mound of stone, 2 ft. base 1½ ft. high, N. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, —×—×— ins., — ins. in the ground, for standard cor. of (e. g.) secs. 33 and 34, marked S. C., on N.; with 3 grooves on E. and W. faces; from which

A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 13 N., R. 21 E., S. 34, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 13 N., R. 21 E., S. 33, B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for standard cor. of (e. g.) secs. 32 and 33, marked

S. C., T. 13 N., R. 21 E. on N.,
S. 33 on E., and
S. 32 on W. faces; with 4 grooves on E., and 2 grooves on W. faces; dug pits, 24×18×12 ins., crosswise on each line, E. and W., 3 ft., and N. of post, 7 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, N. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for standard cor. of (e. g.) secs. 34 and 35, marked

S. C., T. 13 N., R. 21 on N.,
S. 35 on E., and
S. 34 on W. faces; with two grooves on E., and 4 grooves on W. faces; from which

A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 13 N., R. 21 E., S. 35, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 13 N., R. 21 E., S. 34, B. T.

6. *Mound of Earth, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for standard cor. of (e. g.) secs. 33 and 34; dug pits, 24×18×12 ins., crosswise on each line, N., E., and W. of cor., 5 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft high, over deposit.

In E. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked

S. C., T. 13 N., R. 22 E. on N.,
S. 34 on E., and
S. 33 on W. faces; with 3 grooves on E. and W. faces.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for standard cor. of (e. g.) secs. 31 and 32, I marked

S. C., T. 13 N., R. 22 E. on N.,
S. 32 on E., and
S. 31 on W. sides; with 5 notches on E., and 1 notch on W. sides;

dug pits, 18×18×12 ins., N., E., and W. of Cor., 4 ft. dist.; and raised a mound of earth around tree.

8. *Tree Corner, with Bearing Trees.*

A —, — ins. diam., for standard cor. of (e. g.) secs. 35 and 36, I marked
S. C., T. 13 N., R. 22 E. on N.,
S. 36 on E., and
S. 35 on W. sides; with 1 notch on E., and 5 notches on W. sides; from which
A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 13 N., R. 22 E., S. 36, B. T.
A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 13 N., R. 22 E., S. 35, B. T.

CLOSING SECTION CORNERS.

[See Plates V and VI.]

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, — × — × — ins., — ins. in the ground, for closing cor. of (e. g.) secs. 1 and 2, marked C. C., on S.; with 1 groove on E., and 5 grooves on W. faces; dug pits, 24×18×12 ins. crosswise on each line, E. and W., 3 ft., and S. of stone, 7 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, S. of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, — × — × — ins., — ins. in the ground, for closing cor. of (e. g.) secs. 3 and 4, marked C. C., on S.; with 3 grooves on E. and W. faces; and raised a mound of stone, 2 ft. base, 1½ ft. high, S. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, — × — × — ins. — ins. in the ground, for closing cor. of (e. g.) secs. 1 and 2, marked C. C., on S.; with 1 groove on E., and 5 grooves on W. faces; from which
A —, — ins. diam., bears S. —° E., — lks. dist., marked
T. 4 N., R. 3 W., S. 1, B. T.
A —, — ins. diam., bears S.° — W., — lks. dist., marked
T. 4 N., R. 3 W., S. 2, B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for closing cor. of (e. g.) secs. 1 and 2, marked
C. C., T. 4 N., R. 3 W. on S.,
S. 1 on E., and
S. 2 on W. faces; with 1 groove on E., and 5 grooves on W. faces; dug pits, 24×18×12 ins., crosswise on each line, E. and W., 3 ft., and S. of post, 7 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, S. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for closing cor. of (e. g.) secs. 1 and 2, marked
C. C., T. 4 N., R. 3 W. on S.,
S. 1 on E., and

S. 2 on W. faces; with 1 groove on E., and 5 grooves on W. faces; from which

A—, — ins. diam., bears S. —° E., — lks. dist., marked
T. 4 N., R. 3 W., S. 1, B. T.

A—, — ins. diam., bears S. —° W., —lks. dist., marked
T. 4 N., R. 3 W., S. 2, B. T.

6. *Mound of Earth, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for closing cor. of (e. g.) secs. 3 and 4; dug pits, 24×18×12 ins., crosswise on each line, S., E., and W. of cor., 4 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, over deposit.

In E. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked

C. C., T. 4 N., R. 3 W. on S.,
S. 3. on E., and
S. 4. on W. faces; with 3 grooves on E. and W. faces.

7. *Tree Corner, with Pits and Mound of Earth*

A—, — ins. diam., for closing cor. of (e. g.) secs. 1 and 2, I marked
C. C., T. 4 N., R. 3 W. on S.,
S. 1 on E., and
S. 2 on W. sides; with 1 notch on E., and 5 notches on W. sides; dug pits, 18×18×12 ins., S., E., and W. of cor., 5 ft. dist.; and raised a mound of earth around tree.

8. *Tree Corner, with Bearing Trees.*

A —, — ins. diam., for closing cor. (e. g.) secs. 1 and 2, I marked
C. C., T. 4 N.. R. 3 W. on S.,
S. 1 on E., and
S. 2 on W. sides; with 1 notch on E., and 5 notches on W. sides; from which

A —, — ins. diam., bears S. —° E., — lks. dist., marked
T. 4 N., R. 3 W., S. 1, B. T.

A —, —ins. diam., bears S. —° W., — lks. dist., marked
T. 4 N., R. 3 W., S. 2, B. T.

9. All closing section corners, on base lines or standard parallels, will be connected by course and distance with the *nearest* standard corner thereon. (See paragraphs 5 and 9, page 55.)

CORNERS COMMON TO FOUR SECTIONS.

[See Plates V and IX.]

When more than one-half of all the corners in a township are stone corners, the descriptions in paragraphs 1 and 2, if the corners therein described are established for cor. of secs. 15, 16, 21 and 22, will be modified as follows: after "marked," insert the words

"4 N. on N.E., and
3 W. on S.E. faces."

When, under the conditions above specified, the corner described in paragraph 1 is established, a stake may be driven in the southeast pit, and marked instead of the stone, and described as exemplified in the last clause of paragraph 6, page 37.

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, — ×— ×— ins.. — ins. in the ground, for cor. of (e. g.) secs. 14, 15, 22, and 23 [Tp. 4 N., R. 3 W.]*, marked with 3 notches on S.

* When writing these descriptions in the field notes, the angular brackets and the enclosed letters and figures will be omitted.

and E. edges; dug pits, 18×18×12 ins., in each sec. 5½ ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, W. of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, — × — × — ins., — ins. in the ground, for cor. of (e. g.) secs. 14, 15, 22, and 23 [Tp. 4 N., R. 3 W.]*, marked with 3 notches on S. and E. edges; and raised a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, — × — × — ins., — ins. in the ground, for cor. of (e. g.) secs. 9, 10, 15, and 16, marked with 4 notches on S., and 3 notches on E. edges; from which

A —, — ins. diam., bears N. —° E., — lks. dist., marked T. 2 N., R. 2 W., S. 10, B. T.

A —, — ins. diam., bears S. —° E., — lks. dist., marked T. 2 N., R. 2 W., S. 15, B. T.

A —, — ins. diam., bears S. —° W., — lks. dist., marked T. 2 N., R. 2 W., S. 16, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked T. 2 N., R. 2 W., S. 9, B. T.

4. *Post, with Pit and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for cor. of (e. g.) secs. 15, 16, 21, and 22, marked

T. 2 N., S. 15 on N. E.,
R. 2 W., S. 22 on S. E.,
S. 21 on S. W., and
S. 16 on N. W. faces with 3 notches on S. and E. edges; dug pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, W. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground for cor. of (e. g.) secs. 25, 26, 35 and 36, marked

T. 2 N., S. 25 on N. E.,
R. 2 W., S. 36 on S. E.,
S. 35 on S. W., and
S. 26 on N.W. faces; with 1 notch on S. and E. edges; from which

A —, — ins. diam., bears N. —° E., — lks. dist., marked T. 2 N., R. 2 W., S. 25, B. T.

A —, — ins. diam., bears S. —° E., — lks. dist., marked T. 2 N., R. 2 W., S. 36, B. T.

A —, — ins. diam., bears S. —° W., — lks. dist. marked T. 2 N., R. 2 W., S. 35, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked T. 2 N., R. 2 W., S. 26, B. T.

6. *Mound, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for cor. of (e. g.) secs. 25, 26, 35 and 36; dug pits, 18×18×12 ins., in each sec., 4 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, over deposit.

* When writing these descriptions in the field notes, the angular brackets and the enclosed letters and figures will be omitted.

In S. E. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
T. 2 N., S. 25 on N. E.,
R. 2 W., S. 36 on S. E.,
S. 35 on S. W., and
S. 26 on N. W. faces; with 1 notch on S. and E. edges.

7. Tree Corner, with Pits and Mound of Earth.

A—, — ins. diam., for cor. of (e. g.) secs. 29, 30, 31, and 32, I marked
T. 2 N., S. 29 on N. E.,
R. 2 W., S. 32 on S. E.,
S. 31 on S. W., and
S. 30 on N. W. sides; with 1 notch on S., and 5 notches on E. sides; dug pits, 18×18×12 ins., in each sec., 5 ft. dist.; and raised a mound of earth around tree.

8. Tree Corner, with Bearing Trees.

A—, — ins. diam., for cor. of (e. g.) secs. 5, 6, 7, and 8, I marked
T. 2 N., S. 5 on N. E.,
R. 2 W., S. 8 on S. E.,
S. 7 on S. W., and
S. 6 on N. W. sides; with 5 notches on S. and E. sides; from which
A—, — ins. diam., bears N. —° E., — lks. dist., marked
T. 2 N., R. 2 W., S. 5, B. T.
A—, — ins. diam., bears S. —° E., lks. dist., marked
T. 2 N., R. 2 W., S. 8, B. T.
A—, — ins. diam., bears S.—° W., lks. dist., marked
T. 2 N., R. 2 W., S. 7, B. T.
A —, — ins. diam., bears N. —° W. — lks. dist., marked
T. 2 N., R. 2 W., S. 6, B. T.

SECTION CORNERS COMMON TO TWO SECTIONS ONLY.

[See Plates V and VI.]

When more than one-half of all the corners in a township are stone corners, the descriptions in paragraphs 1 and 2, if the corners therein described are established near cor. of secs. 15, 16, 21, and 22, will be modified, as follows:

After "marked", insert the words
"3 N. on S. W., and
7 W. on N. W. faces;".

When, under the conditions above specified, the corner described in paragraph 1 is established, a stake may be driven in the southwest pit, and marked instead of the stone, and described as exemplified in the last clause of paragraph 6, page 38.

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, —×—×— ins., — ins. in the ground, for cor. of (e. g.)* secs. 25 and 36 [Tp. 3 N., R. 7 W.],† marked with 5 notches on N., and 1 notch on S. edges; dug pits, 24×24×12 ins., in each sec., 6 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, W. of cor.

* The corner established on the *range line* and described in paragraph 1, will have notches to indicate the distances to the N. E. and S. E. corners of the township. See plate V, fig.18: and Plate IX, Tp. 3 N., R. 7 W.

† When writing descriptions of corners similar to those described in paragraphs 1 and 2, the angular brackets and the inclosed letters and figures, will be omitted.

2. *Stone, with Mound of Stone.*

Set a — stone, —×—×— ins., — ins. in the ground, for cor. of (e.g.)* secs. 15 and 22 [Tp. 3 N., R. 7 W.], † marked with 3 notches on N., and S. edges; and raised a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, —×—×— ins., — ins. in the ground, for cor. of (e.g.)‡ secs. 28 and 29, marked with 4 notches on E. edge; from which

A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 3 N., R. 7 W., S. 28, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 7 W., S. 29, B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for cor. of (e. g.) 33 and 34,§ marked
T. 2 N., S. 34 on N. E., and
R. 6 W., S. 33 on N. W. faces; with three notches on E. and W. edges; dug pits 24×24×12 ins., in each sec., 6 ft. dist, and raised a mound of earth, 4 ft. base, 2 ft. high, N. of cor.

5. *Post, with Bearing Trees:*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for cor. of (e. g.) secs. 24 and 25,‖ marked
T. 3 N., S. 25 on S. W., and
R. 5 W., S. 24 on N. W. faces; with 4 notches on N., and 2 notches on S. edges; from which

A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 3 N., R. 5 W., S. 25, B. T.

A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 5 W., S. 24, B. T.

6. *Mound of Earth, with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for cor. of (e. g.) secs. 13 and 24;¶ dug pits 24×24×12 ins., in each sec., 4 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, over deposit.

In S. W. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
T. 2 N., S. 24 on S. W., and
R. 6 W., S. 13 on N. W. faces, with 3 notches on N. and S. edges.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for cor. of (e. g.) secs. 24 and 25,** I marked
T. 3 N., S. 25 on S. W. and
R. 6 W., S. 24 on N. W. sides; with 4 notches on N. and S. sides; dug pits, 18 × 18 × 12 ins., in each sec., 5 ft. dist.; and raised a mound of earth around tree.

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* The corner established on a *sectional guide meridian* and described in paragraph 2, will have notches like the corresponding corner on a range line. See Plate IX, Tp. 3 N., R. 7 W.

† When writing descriptions of corners similar to those described in paragraphs 1 and 2, the angular brackets and the inclosed letters and figures, will be omitted.

‡ See Plate IX, N. bdy., sec. 32, Tp. 3 N., R. 7 W.

§ See Plate IX, Tp. 2 N., R. 6 W. ‖ Tp. 3 N., R. 5 W. ¶ Tp. 2 N., R. 6 W.

** On range line; see Plate IX; Tp. 3 N., R. 6 W.

5. *Tree Corner, with Bearing Trees.*

A —, — ins. diam., for cor. of (e. g.) secs. 22 and 27,* I marked
T. 3 N., S. 27 on S. W., and
R. 7 W., S. 22 on N. W. sides; with 4 notches on N., and 2 notches on S. sides; from which
A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 3 N., R. 7 W., S. 27, B. T.
A —, — ins. diam., bears N. —° W., — lks. dist., marked
T. 3 N., R. 7 W., S. 22, B. T.

SECTION CORNERS REFERRING TO ONE SECTION ONLY.

[See Plates V and IX.]

When more than one-half of all corners in a township are stone corners, the descriptions in paragraphs 1 and 2, if the corners therein described, are established near the place for cor. of secs. 15, 16, 21, and 22, will be modified, as follows: After "marked", insert the words:
"2 N., 5 W. on N. E. face;"
When, under the conditions above specified, the corner described in paragraph 1 is established, a stake may be driven in the pit, and marked instead of the stone, and described as exemplified in the last clause of paragraph 6, page 40.

1. *Stone, with Pit and Mound of Earth.*

Set a — stone, —×—×— ins., — ins. in the ground, for S. W. cor. of (e. g.) sec. 12 [Tp. 2 N., R. 5 W.],* marked with 1 notch on E. edge; dug a pit, 36×36×12 ins., in the sec., 8 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, N. E. of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, —×—×— ins., — ins. in the ground, for S. W. cor. of (e. g.) sec. 12 [Tp. 2 N., R. 5 W.],† marked with 1 notch on E. edge; and raised a mound of stone, 2 ft. base, 1½ ft. high, N. E. of cor.

3. *Stone, with Bearing Tree.*

Set a — stone, —×—×— ins., — ins. in the ground, for S. W. cor. of (e. g.) sec. 12, marked with 1 notch on E. edge; from which
A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 2 N., R. 5 W., S. 12, B. T.

4. *Post, with Pit and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for N. W. cor. of (e. g.) sec. 10;‡ marked
T. 3 N., S. 9 on N. E.
R. 5 W., S. 10 on S. E.
S. 9 on S. W., and
S. 9 on N. W. faces; with 5 notches on S. and 3 notches on E. edges; dug a pit, 36×36×12 ins., in the sec., 8 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, S. E. of cor.

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* On sectional guide meridian; see Plate IX, Tp. 3 N., R. 7 W.

† When writing descriptions of corners similar to those described in paragraphs 1 and 2, the angular brackets and the included letters and figures will be omitted. See Plate IX.

‡ See Plate IX; Tp. 3 N., R. 5 W.

5. *Post, with Bearing Tree.*

Set a — post, 3ft. long, 4 ins. sq., 24 ins. in the ground, for S. W. cor. of (e. g.) sec. 12;* marked
T. 2 N., S. 12 on N. E.,
R. 5 W., S. 13 on S. E.,
S. 13 on S. W., and
S. 13 on N. W. faces; with 1 notch on E. edge; from which
A —, — ins. diam., bears N. —° E., — lks. dist., marked
T. 2 N., R. 5 W., S. 12, B. T.

6. *Mound of Earth, with Deposit and Stake in pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for N. W. cor. of (e. g.) sec. 10;† dug a pit, 36×36×12 ins. in the sec., 5 ft. dist.; and raised a mound of earth, 4 ft. base, 2 ft. high, over deposit.

In the pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
T. 3 N., S. 9 on N. E.,
R. 5 W., S. 10 on S. E.,
S. 9 on S. W., and
S. 9 on N. W. faces; with 5 notches on S., and 3 notches on E. edges.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for S. W. cor. of (e. g.) sec. 12,* I marked
T. 2 N., S. 12 on N. E.,
R. 5 W., S. 13 on S. E.,
S. 13 on S. W., and
S. 13 on N. W. sides, with 1 notch on E. side; dug a pit, 24×24×12 ins., in the sec., 5 ft dist.; and raised a mound of earth around tree.

8. *Tree Corner, with Bearing Trees.*

A—, — ins. diam., for N. W. cor. of (e. g.) sec. 10, I marked
T. 3 N., S. 9 on N. E.,
R. 5 W., S, 10 on S. E.,
S. 9 on S. W., and
S. 9 on N. W., sides; with 5 notches on S., and 3 notches on E. sides; from which
A—, — ins. diam., bears S. —° E., — lks. dist., marked
T. 3 N., R. 5 W., S. 10, B. T.

QUARTER SECTION CORNERS.

[See Plates V and VI.]

1. *Stone, with Pits and Mound of Earth.*

Set a — stone, — × — × — ins., — ins. in the ground, for ¼ sec. cor. [(e. g.) bet. secs. 14 and 23],‡ marked ¼, on N. face; dug pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raised a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.

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* See Plate IX; Tp. 2 N., R. 5 W.
† Tp. 3 N., R. 5 W.
‡ When writing descriptions of ¼ section corners, the angular brackets and the letters and figures they inclose, will be omitted. See paragraphs 9, 10, and 11, pages 41, 42.

2. *Stone, with Mound of Stone.*

Set a — stone, — × — × — ins., — ins. in the ground, for ¼ sec. cor. [(e. g.) bet. secs. 14 and 15],* marked ¼ on W. face; and raised a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, — × — × — ins., — ins. in the ground, for ¼ sec. cor. [(e. g.) bet. secs. 16 and 17],* marked ¼, on W. face; from which
A—, — ins. diam., bears N.—° E., —lks. dist., marked
¼ S., B. T.
A —, — ins. diam., bears N.—° W.,— lks. dist., marked
¼ S., B. T.

4. *Post, with Pits and Mound of Earth.*

Set a—post, 3 ft. long, 3 ins. sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for ¼ sec. cor. [(e. g.) bet. secs. 4 and 9],* marked ¼ S., on N. face; dug pits 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raised a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 3 ins. sq., 24 ins. in the ground, for ¼ sec. cor. [(e. g.) bet. secs. 21 and 22],* marked ¼ S., on W. face; from which
A —, — ins. diam., bears S. —° E., — lks. dist., marked
¼ S., B. T.
A —, — ins. diam., bears S. —° W., — lks. dist., marked
¼ S., B. T.

6. *Mound, with Deposit and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for ¼ sec. cor. [(e. g.) bet. secs. 21 and 28];* dug pits, 18×18×12 ins., E. and W. of cor., 4 ft. dist.; and raised a mound of earth, 3½ ft. base, 1½ ft. high, over deposit.
In E. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
¼ S. on N. face.

7. *Tree Corner, with Pits and Mound of Earth.*

A —,— ins. diam., for ¼ sec. cor. [(e. g.) bet. secs. 7 and 8],* I marked ¼ S., on W. side; dug pits, 18×18×12 ins., N. and S. of cor., 4 ft. dist.; and raised a mound of earth around tree.

8. *Tree Corner, with Bearing Trees.*

A —, — ins. diam., for ¼ sec. cor. [(e. g.) bet. secs. 20 and 29],* I marked ¼ S., on N. side; from which
A —, — ins. diam., bears N. —° W., — lks. dist., marked
¼ S., B. T.
A —, — ins. diam., bears S. —° W., — lks. dist., marked
¼ S., B. T.

9. *Pits and Mounds of Quarter Section Corners.*

On *meridional* lines, the pits will be dug N. and S., and the mound will be placed on the *west* side of the corner; on *latitudinal* lines, the pits will be located E. and W., and the mound will be built on the *north* side of the corner. See Plate VI.

* When writing descriptions of ¼ section corners, the angular brackets and the letters and figures they inclose will be omitted. See paragraphs 9, 10, and 11, pages 41, 42.

10. *Markings on Quarter Section Corners.*

On *meridional* lines, the markings will be placed on the *west* side, and on *latitudinal* lines, on the *north* side of the stone, post, or other corner.

11. *Stakes in Pits of Quarter Section Corners.*

On *meridional* lines the stakes will be driven in the S. pit, and on *latitudinal* lines, in the E. pit.

STANDARD QUARTER SECTION CORNERS.

[See Plate V and VI.]

All standard quarter section corners, on base lines or standard parallels, will have the letters S. C. (for standard corner), precede the marking "¼" or "¼ S.", as the case may be; such corners will be established in all other respects like other quarter section corners.

When bearing trees are described for standard quarter section corners, each tree will be marked, S. C., ¼ S., B. T.

QUARTER SECTION CORNERS COMMON TO TWO QUARTERS OF ONE SECTION.

These corners will be similar in all respects to those that are common to four quarters of two sections. See notes on Plates VII and VIII.

MEANDER CORNERS.

[See Plates V and VI.]

1. *Stone, with Pit and Mound of Earth.*

Set a —stone,—×—×—ins.— ins. in the ground for meander cor. of (e. g.) fracl. secs. 26 and 35,* marked

M. C. on E. face; with 1 groove on S. face; dug a pit,* 36×36×12 ins., 8 ft. W. of stone; and raised a mound of earth, 4 ft. base, 2 ft. high, W. of cor.*

2. *Stone, with Mound of Stone.*

Set a —stone,—×—×—ins.,—ins. in the ground, for meander cor. of (e. g.) fracl. secs. 17 and 18,† marked

M. C. on S. face; with 5 grooves on E. face; and raised a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone —×—×— ins., — ins. in the ground, for meander cor. of (e. g.) fracl. secs. 26 and 35, with 1 groove on S. face;† marked:

M. C. on W. face; from which

A—, — ins., diam., bears N. —° E., — lks. dist., marked T. 15 N., R. 20 E., S. 26, M. C. B. T.

A—, — ins., diam., bears S. —° C. — lks., dist., marked T. 15 M., R. 20 E., S. 35, M. C. B. T.

4. *Post, with Pit and Mound of Earth.*

Set a — post, 3 ft. long, 4 ins., sq., with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for meander cor. of (e. g.) fracl. secs. 19 and 20,† marked

M. C. on N.,

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* See page 56, and paragraphs 9 and 10, pages 43, 44.

† See Plate IV, and pages 192, 209 and 210.

T. 15 N. on S.,
R. 20 E., S. 20 on E., and
S. 19 on W. faces; dug a pit, 36×36×12 ins., 8 ft. S. of post; and raised a mound of earth, 4ft. base, 2 ft. high, S. of cor.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for meander cor. of (e. g.) fracl. secs. 25 and 26,* marked
M. C. on N.,
T. 15 N. on S.,
R. 20 E., S. 25 on E., and
S. 26 on W. faces; from which
A —, — ins. diam., bears S. —° E., — lks. dist., marked
T. 15 N., R. 20 E., S. 25, M. C. B. T.
A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 15 N., R. 20 E., S. 26, M. C. B. T.

6. *Mound with Deposit, and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for meander cor. of (e. g.) fracl. secs. 25 and 26;* dug a pit, 36×36×12 ins., 5 ft. N. of cor.; and raised a mound of earth, 4 ft. base, 2 ft. high, over deposit.

In the pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
M. C. on S.,
T. 15 N. on N.,
R. 20 E., S. 26 on W., and
S. 25 on E. faces.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., from meander cor. of (e. g.) fracl. secs. 17 and 20,* I marked
M. C. on W.,
T. 15 N. on E.,
R. 20 E., S. 17 on N., and
S. 20 on S. sides dug a pit, 36×36×12 ins., 8 ft. E. of tree; and raised a mound of earth, 4 ft. base, 2 ft. high, E. of cor.

8. *Tree Corner, with Bearing Trees.*

A —, — ins. diam., for a special meander cor. of (e. g.) fracl. E. and W. halves of sec. 33,† I marked
S. M. C. on N.,
T. 15 N. on S.,
R. 20 E., S. 33 on E., and
S. 33 on W. sides; from which
A —, — ins. diam., bears S. —° E. — lks. dist., marked
T. 15 N., R. 20 E., S. 33, S. M. C. B. T.
A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 15 N., R. 20 E., S. 33, S. M. C. B. T.

9. *Pits and Mounds of Meander Corners.*

When a pit is dug as an accessory to a meander corner, it will be located 8 feet from such corner (except as otherwise provided for in paragraph 6), on the side opposite the stream or lake meandered;

* See Plate IV and page 188.
† See Plate IV, and page 201. See paragraphs 11 and 12, page 44, and footnote, page 57.

while the mound will be placed midway between the corner and nearest side of the pit.

10. *Markings on Meander Corners.*

On all meander corners, the letters "M. C." (for meander corner) will be cut into the side facing the stream or lake to be meandered. On post or tree meander corners, *within township exteriors*, additional marks will be placed, as follows: the *township* number will be marked on the side opposite "M. C."; the proper *range* and *section* number will be placed on the *right-hand side* (when looking along line toward the stream or lake), and the appropriate *section* number on the opposite side.

All meander corners on base lines or standard parallels will be marked S. C. on the *north* side or face.

On principal or guide meridians, and on *meridional* township lines, the letters "M. C." will be placed as above directed; the *township* number will be marked on the opposite side; while the proper *range* and *section* numbers will be marked on the sides facing the east and west cardinal points.

On base lines or standard parallels and on *latitudinal* township lines, the *township* numbers will be marked on the sides facing the north and south cardinal points; while the *range* and *section* numbers will be placed on the side opposite the marking "M. C."

In all the markings provided for in this paragraph, the *numbers* indicating townships, ranges, and sections, will be preceded by the initial letters "T." "R." and "S.", respectively.

11. *Descriptions will be modified in certain cases.*

When a tree is marked for a *regular* meander corner, the descriptions in paragraphs 8 will be modified, as follows: strike out "*special*"; in place of "E. and W. halves of sec. 33", write "secs. — and —,"; and omit the letter "S.", preceding "M. C.", in the marking on corner and bearing trees.

The descriptions in paragraphs 1 to 7, inclusive, will be modified to describe *special* meander corners, as illustrated in paragraph 8, by writing "special" before meander cor. and "S." before "M. C.," when conditions require the change.

12. *Special Meander Corners and Auxiliary Meander Corners.*

Regular meander corners are those established on standard, township, or section lines. See Plate V, for plans of meander corners, and the specimen plat, Plate IV, sections 17, 18, 19, 20, 25, 26, and 35, for locations of the meander corners described in Specimen Field Notes, pages 208 to 210.

The meander corners, on lines of legal subdivisions, other than standard, township, or section lines, will be designated *special meander corners*, (e. g.) those located on the Specimen Plat, Plate IV, in section 33.

Meander corners, *not* on a line belonging to the system of rectangular surveying, will be called *auxiliary meander corners*, (e. g.) the meander corner on Diamond Rock, in section 18.

13. *Meander Corners on unsafe ground will be witnessed.*

When a Meander Corner falls at a point where prevailing conditions would insure its destruction by natural causes, a *witness corner* to such meander corner will be established, as provided for in the article "Witness Corners", page 47.

CORNERS ON RESERVATION OR OTHER BOUNDARIES NOT CONFORMING TO THE SYSTEM OF RECTANGULAR SURVEYING.

[See Plate VI.]

1. *Stone, with Mound of Earth.*

Set a — stone, — × — × — ins.,* — ins. in the ground, for the (e. g.) 17 mile cor., marked
17 M. on S.,
N. P. on E., and
P. L. on W. faces; dug pits, 36×36×12 ins., E. and W. of stone, 4 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. of cor.

2. *Stone, with Mound of Stone.*

Set a — stone, — × — × — ins.,* — ins. in the ground, for the (e. g.) 38 mile cor., marked
38 M. on N. E.,
N. P. on N. W., and
P. L. on S. E. faces; and raised a mound of stone, 3 ft. base, 2 ft. high,† N. E. of cor. Pits impracticable.

3. *Stone, with Bearing Trees.*

Set a — stone, — × — × — ins.,* — ins. in the ground, for the (e. g.) 35 mile cor., marked
35 M. on E.,
N. P. on N., and
8 W. on S. faces; from which
A —, — ins. diam., bears N. —° E., — lks. dist., marked
N. P. I. R., 35 M. B. T.
A —, — ins. diam., bears S. —° E.,‡ — lks. dist., marked
T. 6 N., R. 8 W., S. 9, 35 M. B. T.
A —, — ins. diam., bears S. —° W.,‡ — lks. dist., marked
T. 6 N., R. 8 W., S. 8, 35 M. B. T.
A —, — ins. diam., bears N. —° W., — lks. dist., marked
N. P. I. R., 35 M. B. T.

4. *Post, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 5 ins. sq.,§ with marked stone (charred stake or quart of charcoal), 24 ins. in the ground, for the (e. g.) 17 mile cor., marked
17 M. on S.,
N. P. I. R. on E., and
P. L. on W. faces; dug pits, 36×36×12 ins., E. and W. of post, 4 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. of cor.

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* Stones for corners on Indian Reservation or other boundaries will not be less than 20 ins. long, or less than 6 ins. thick, and will measure at least *one cubic foot* in volume; consequently, a stone 20 × 14½ ×6 ins., will be about *minimum* size; and 32 × 9 × 6 ins., represents satisfactory proportions. "N. P." for "Nez Perces" (Indian Reservation), on the east, and "P. L." for "Public Land" (unsurveyed), on the west, applies to paragraph 1 only.

† The above are *minimum* dimensions for mounds of stone on reservation boundaries.

‡ The bearing trees, "S. —° E." and "S. —° W." from the corner, are supposed to stand on *surveyed* land, near the line between sections 8 and 9.

§ The stated dimensions of posts are *minimum;* if posts are longer than 3 feet, the extra length will be placed *in the ground;* the posts will in no case project more than 12 ins. above the natural surface of the earth.

5. *Post, with Bearing Trees.*

Set a — post, 3 ft. long, 5 ins. sq.,* 24 ins. in the ground, for the (e. g.) 35 mile cor., marked
35 M. on E.,
N. P. I. R. on N., and
T. 6 N., R. 8 W., S. 9, on S.; from which
A —, — ins. diam., bears N. —° E., — lks. dist., marked
N. P. I. R., 35 M. B. T.
A —, — ins. diam., bears S. —° E.,† — lks. dist., marked
T. 6 N., R. 8 W., S. 9, 35 M. B. T.
A —, — ins. diam., bears S. —° W.,† — lks. dist., marked
T. 6 N., R. 8 W., S. 8, 35 M. B. T.
A —, — ins. diam., bears N. —° W., — lks. dist., marked
N. P. I. R., 35 M. B. T.

6. *Mound, with Deposit and Stake in Pit.*

Deposited a marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for the (e. g.) 33 mile cor.; dug pits, 36×36×12 ins., N. E. and S. W. of cor., 5 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, over deposit.

In N. E. pit drove a — stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
33 M. on S. E.,
N. P. I. R. on N. E., and
T. 6 N., R. 8 W., S. 15 on S. W. faces.

7. *Tree Corner, with Pits and Mound of Earth.*

A —, — ins. diam., for the (e. g.) 29 mile cor., I mark
29 M. on E.,
N. P. I. R. on N., and
T. 5 N., R. 7 W., S. 8 on S. sides; dug pits, 36×36×12 ins., N. and S. of tree, 5 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, E. of cor.

8. *Tree Corner, with Bearing Trees.*†

A —, — ins. diam., for the (e. g.) 35 mile cor., I mark
35 M. on E.,
N. P. I. R. on N., and
T. 6 N., R. 8 W., S. 9 on S. sides; from which
A —, — ins. diam., bears N. —° E., — lks. dist., marked
N. P. I. R., 35 M., B. T.
A —, — ins. diam., bears S. —° E., — lks. dist., marked
T. 6 N., R. 8 W., S. 9, 35 M., B. T.
A —, — ins. diam., bears S. —° W., — lks. dist., marked
T. 6 N., R. 8 W., S. 8, 35 M., B. T.
A —, — ins. diam., bears N. —° W., — lks. dist., marked
N. P. I. R., 35 M., B. T.

9. *Corner Monument of Stone, with Deposit.*

Deposited a marked stone (charred stake, quart of charcoal, or vial with record‡ inclosed), 12 ins. in the ground, for the S. W. cor. of

*The stated dimensions of posts are *minimum;* if posts are longer than 3 feet, the extra length will be placed *in the ground;* the posts will in no case project more than 12 ins. above the natural surface of the earth.

†The bearing trees, "S. —° E." and "S. —° W." from the corner, are supposed to stand on *surveyed* land, near the line between sections 8 and 9.

‡The "record" will consist of a brief description of the corner, with the date of its construction.

(e. g.) the Nez Perces Indian Reservation; and built a monument of stone, 3 ft. sq. at base, 2 ft. sq. on top, 3 ft. high, over deposit; marked
S. W. cor., N. P. I. R. on N. E.,*
P. L., — † M. — † chs. on S. E.,
P. L., — ‡ on S. W., and
P. L. on N. W. faces.

10. *A Post for Corner Monument, with Pits and Mound of Earth.*

Set a — post, 3 ft. long, 5 ins. sq., 24 ins. in the ground, for the N. W. cor. of (e. g.) the Nez Perces Indian Reservation, marked
P. L. on S. E.,
N. W. cor. N. P. I. R. on S. E.,
P. L. — † M. — † chs. on S. W., and
P. L. — ‡ on N. W. faces; dug pits, 36×36×12 ins., S. and N. E. of post, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. E. of cor.

11. *A Stone for Corner Monument, with Pits and Mound of Earth.*

Set a — stone, 36×10×7 ins., 27 ins. in the ground, for the N. E. cor. of (e. g.) the Nez Perces Indian Reservation; marked
P. L. on N. E.,
P. L. on S. E.,
N. E. cor., N. P. I. R. on S. W., and
P. L. on N. W. faces; dug pits 36×36×12 ins., S. and W. of stone, 8 ft. dist.; and raised a mound of earth, 5 ft. base, 2½ ft. high, S. W. of cor.

12. *Modifications of descriptions.*

When a stone or post is established for a corner monument (i. e.) at a *corner of a reservation*, and four (4) bearing trees are available, the descriptions in paragraph 10 and 11 will be modified, as follows: Replace all that refers to pits and mound of earth, by correct descriptions of four properly marked bearing trees, for each corner. (See paragraphs 3 and 5, pages 47, 48.)

The dimensions and arrangement of pits and mounds, described in the last two paragraphs, are similar to those described for "Corners referring to one township only." (See paragraphs 1 and 4, page 31.)

WITNESS CORNERS.§

1. *Witness Corners will be established in certain cases.*

When the true point for any corner described in these instructions falls where prevailing conditions would insure its destruction by natural causes, a witness corner will be established in a secure position, *on a surveyed line if possible*, and *within twenty chains* of the corner point thus witnessed.

2. *Markings on Witness Corners.*

A witness corner will bear the same marks that would be placed upon the corner for which it is a witness, and in addition, will have the letters "W. C." (for witness corner), *conspicuously* displayed above the

* The markings will be cut into large stones, inserted in the middle of the lowest course on each side of the monument.
† The proper number of miles and chains, from the initial point, will be stated.
‡ The year in which the monument is established will be placed in the blank.
§ See page 56.

regular markings; such witness corners will be established, *in all other respects*, like a regular corner.

3. *Markings on Bearing Trees of Witness Corners.*

When bearing trees are described as accessories to a witness corner, the prescribed markings on each tree will be preceded by the letters "W. C.," *distinctly* cut into the wood.

The true bearing and distance of witness corners, from the true point for the corner, will always be clearly stated in the field notes.

4. *Witness Corners to corner points falling in roads, etc.*

The point for a corner falling on a railroad, street, or wagon road, will be perpetuated by a marked stone (charred stake or quart of charcoal), deposited 24 inches in the ground,* and *witnessed by two witness corners*, one of which will be established on each limiting line of the highway.

In case the point for any regular corner falls at the *intersection* of two or more streets or roads, it will be perpetuated by a marked stone (charred stake or quart of charcoal), deposited 24 inches in the ground, and *witnessed by two witness corners* established on opposite sides of the corner point, and at the mutual intersections of the lines limiting the roads or streets, as the case may be.

WITNESS POINTS.

Witness points will be perpetuated by corners similar to those described for quarter section corners, with the marking "W. P." (for witness point), in place of "¼," or "¼ s.", as the case may be.

If bearing trees are available as accessories to *witness points*, each tree will be marked W. P. B. T. (See "Insuperable objects on line—Witness Points," page 22.)

MISCELLANEOUS.

1. *Corners on Rock in place, or on Boulders.*†

When a corner falls on rock *in place*, or on a *boulder*, a cross (×), will be made at the exact corner point, and witnessed by the proper number of bearing trees, if they are available; in the absence of suitable trees, a mound of earth will be raised, if size of the boulder or form of the rock in place permits the excavation of pits. As a last resort, a mound of stone will be built to attract attention to the point, if loose rock can be obtained in the vicinity.

2. *Location of Mounds.*

When mounds of earth or other material are raised as accessories to corners, they will be placed as specified in the foregoing Description of Corners, and in every case the *direction* of the mound from the corner will be carefully stated. The use of the indefinite description "alongside" will be discontinued.

In case the character of the land is such that the mound can not be placed as hereinbefore described, the deputy will state in his notes, by bearing and distance, exactly where the mound is located with reference to the corner, and will give his reasons for placing it as described.

* The deposit will not be practicable in the case of railroads; but the witness corners will be established on the lines limiting the right of way. See pages 198, 209, and Plate IV.

† See pages 146, 147, 157, and 164.

3. *Mounds of Stone, covered with Earth.*

In a case where pits are practicable and the deputy prefers raising a mound of stone, or a mound of stone covered with earth,* he will use the form given for "*Stone with mound of stone.*" when the corner thus described is established; but when the corner "*Stone, with mound of stone covered with earth,*" is constructed, the description will be modified as follows: Strike out the words "Pits impracticable"; in place of "mound of stone, 2 ft. base, 1½ ft. high," write "mound of stone covered with earth, — ft. base, — ft. high," inserting in the blank spaces the dimensions of the mound given in paragraph 1, following the designation of each class of corners, pages 24 to 45.

4. *Bearing Trees.*

Bearing trees marked as accessories to standard corners, either township, section, or quarter section, will be selected on the *north* side of base lines or standard parallels, and bearing trees referring to the closing corners on said lines, will be located on the *south* side; in general, the bearing trees referring to any particular closing corner, together with one pit and the mound belonging to such corner, will be located on *the same side of the line closed upon*, and on the side *from which the surveys have been closed.*

When the requisite number of trees can be found within 300 links of the corner point, two (2) bearing trees will be marked and described for every standard or closing township or section corner, or corner common to two townships or sections, only; four (4) for every corner common to four townships or four sections; one (1) for a corner referring to one township or one section, only; two (2) for every quarter section corner or meander corner, and four (4) for each mile or half mile corner, or corner monument on a reservation or other boundary, not conforming to the system of rectangular surveying.

In case the prescribed number of trees can not be found within limits, the deputy will state in his field notes, after describing those marked, "no other trees within limits," and add "dug pits — × — × — ins.," etc., or "raised a mound of stone, — ft. base, — ft. high, — of cor.," as prevailing conditions may require.

Bearing trees, being the most important accessories to the corners, will have their exact bearings from the true meridian taken with the instrument used in running the lines of survey; and the distance *from the middle of each bearing tree to the middle point of the corner* will be carefully measured, and recorded in the field notes.

A *plain blaze* will be made at the usual or most convenient height, on each bearing tree, on the side facing the corner. The height of all other markings on the tree will in no case exceed the limit of *two and one-half feet* above the ground.

5. *Stones for corners.*

Stones 18 ins. long, or less, will be set with two-thirds of their length in the ground, and those more than 18 ins. long will have three-fourths of their length in the ground.

No stones measuring less than 504 cubic inches, or less than 12 ins. in length, will be used for corners.

* The base and height of a "mound of stone, covered with earth," will be the same as prescribed for mound of earth. The dimensions of "mound of stone" on reservation boundaries will conform to those prescribed in paragraph 2, page 45, The *direction* of the mound from the corner will be stated.

6. *Objects to be noted.*

Particular attention is directed to the "Summary of objects and data required to be noted." See page 58 of these instructions; and the deputy will thoroughly comply with the same in his work and field notes.

7. *Lines discontinued at Legal Corners.*

No mountainous lands, or lands not classed as surveyable, will be meandered, and all lines approaching such lands will be discontinued at the section or quarter-section corner nearest the unsurveyed land.

8. *Marks to be cut.*

All letters and figures on posts, trees, or stones, etc., will be *cut into* the object upon which they are placed. Arabic figures and plain letters will be used for all markings.

9. *Orientation of Corners.*

Corners referring to one, two, or four townships or sections, not identical with standard or closing corners, will be set with their faces *directed* NE. and SW., and NW. and SE., while all other corners will be set with their sides *facing the cardinal points;* except corners on boundaries of reservations and private land claims, which will be set squarely on line.

10. *Size of Posts, Mounds, etc.*

The sizes of wooden posts, mounds, and pits, noted in the foregoing descriptions, will be regarded as *minimum*, and their dimensions will be increased whenever practicable.

11. *Corner Materials.*

In establishing corners, *durable* stones will be used when obtainable; then, posts; and lastly, mounds, with stake in pit.

Wood of a perishable nature will not be used for posts or stakes.

12. *Instructions will be examined.*

Deputy surveyors will carefully read, study, and familiarize themselves with all instructions contained in this volume, and will instruct their assistants as to their duties before commencing work. An extra copy of this Manual may be furnished each deputy, for the use of his assistants.

INITIAL POINTS.

Initial points from which the lines of the public surveys are to be extended will be established whenever necessary, under such special instructions as may be prescribed in each case by the Commissioner of the General Land Office. The locus of such initial points will be selected with great care and due consideration for their prominence and easy identification, and must be established astronomically.

The lines of the public surveys are classified as follows:

Class 1. Base lines and standard parallels.

Class 2. Principal and guide meridians.

Class 3. Township exteriors (or meridional and latitudinal township boundaries).

Class 4. Subdivision and meander lines.

The initial point having been established, the line of the public surveys will be extended therefrom, as follows:

BASE LINE.

1. From the initial point the base line will be extended east and west on a parallel of latitude, by the use of transit or solar instruments, as may be directed by the surveyor general in his written special instructions. The *transit* should be designated for the alinement of all important lines.

2. The direction of base lines will conform to parallels of latitude and will be controlled by true meridians; consequently the correct determination of true meridians by *observations on Polaris at elongation** is a matter of prime importance.

3. When transits are employed, certain reference lines † having a known position and relation to the required parallel of latitude will be prolonged as straight lines, by two back and two fore sights at each setting of the instrument, the horizontal limb being revolved 180° in azimuth between the observations.

4. Where solar apparatus is used, the deputy will test the instrument, whenever practicable, by comparing its indications with a meridian determined by Polaris observations; ‡ and in all cases where error is discovered he will make the necessary corrections of his line before proceeding with the survey.‡ All operations will be fully described in the field notes.

5. The proper township, section, and quarter section corners will be established at lawful intervals, and meander corners at the intersection of the line with all meanderable streams, lakes, or bayous.

6. In order to detect errors and insure accuracy in measurement, two sets of chainmen will be employed; one to note distances to intermediate points and to locate topographical features, the other to act as a check. Each will measure 40 chains, and the proper corner will be placed midway between the ending points of the two measurements.

The deputy will be present when said corner is thus established, and will record in the body of his field notes the distances to the same, according to the measurement by each set of chainmen.§

To obviate collusion between the sets of chainmen, the second set should commence at a point in advance of the beginning corner of the first set, the initial difference in measurement thus obtained being known only to the deputy.

PRINCIPAL MERIDIAN.

1. This line shall *conform to a true meridian* and will be extended from the initial point, either north or south, or in both directions, as the conditions may require, by the use of transit or solar instruments, as may be directed by the surveyor general in his special written instructions.

2. The methods used for determination of directions, and the precautions to be observed to secure accuracy in measurement, are fully stated above under the title "Base Line", and will be complied with in every particular.

3. In addition to the above general instructions, it is required that

* See page 105.
† For details see pages 120 to 127.
‡ See specimen field notes, page 172.
§ See pages 142 to 167.

in all cases where the establishment of a new principal meridian seems to be necessary to the surveyor general, he shall submit the matter, together with his reasons therefor, to the Commissioner of the General Land Office, and the survey of such principal meridian shall not be commenced until written authority, together with such special instructions as he may deem necessary, shall have been received from the Commissioner.

STANDARD PARALLELS.

1. Standard parallels, which are also called correction lines, shall be extended east and west from the principal meridian, at intervals of every 24 miles north and south of the base line, in the manner prescribed for running said line, and all requirements under the title "Base Line" will be carefully observed. (See page 51.)

2. Where standard parallels have been placed at intervals of 30 or 36 miles, regardless of existing instructions, and where gross irregularities require additional standard lines, from which to initiate new, or upon which to close old surveys, an intermediate correction line should be established to which a *local* name may be given, (e. g.) "Cedar Creek Correction Line;" and the same will be run, in all respects, like the regular standard parallels.

GUIDE MERIDIANS.

1. Guide meridians shall be extended north from the base line, or standard parallels, at intervals of every 24 miles east and west from the principal meridian, in the manner prescribed for running the principal meridian, and all the provisions for securing accuracy of alinement and measurement found, or referred to under the title "Principal Meridian," will apply to the survey of said guide meridians. (See page 51.)

2. When existing conditions require that such guide meridians shall be run *south* from the base or correction lines, they will be initiated at properly established closing corners on such lines.

3. Where guide meridians have been improperly placed at intervals greatly exceeding the authorized distance of 24 miles, and standard lines are required to limit errors of old, or govern new surveys, a new guide meridian may be run from a standard, or properly established closing corner, and a local name may be assigned to the same, (e. g.) "Grass Valley Guide Meridian". These additional guide meridians will be surveyed in all respects like the regular guide meridians.

TOWNSHIP EXTERIORS.

1. Whenever practicable, the township exteriors in a tract of land 24 miles square, bounded by standard lines, will be surveyed successively through the block, beginning with those of the *southwestern* township.

2. The *meridional* boundaries of townships will have precedence in the *order* of survey and will be run from south to north on *true meridians*, with permanent corners at lawful distances; the latitudinal boundaries will be run *from east to west* on *random* or trial lines, and corrected back on true lines.

The falling of a *random*, north or south of the township corner to be closed upon, will be carefully measured, and, with the resulting true return course, will be duly recorded in the field notes.

Should it happen, however, that such *random* intersects the meridian of the objective corner, north or south of said corner, or falls short of, or overruns the length of the south boundary of the township by more than *three chains* (due allowance being made for convergency), said random, and, if necessary, all the exterior boundaries of the township, will be retraced and remeasured to discover and correct the error.

When running random lines from east to west, temporary corners will be set at intervals of 40.00 chains, and proper *permanent* corners will be established upon the true line, corrected back in accordance with these instructions, thereby throwing the excess or deficiency against the west boundary of the township, as required by law.

3. Whenever practicable, the exterior boundaries of townships belonging to the *west* range, in a tract or block 24 miles square, will first be surveyed in succession, through the range, from south to north; and in a similar manner, the other three ranges will be surveyed in regular sequence.

4. In cases *where impassable objects occur* and the foregoing rules *can not be complied with*, township corners will be established as follows:

In extending the *south* or *north* boundaries of a township to the *west*, where the *southwest* or *northwest* corners can not be established in the regular way by running a north and south line, such boundaries will be run *west on a true* line, allowing for convergency on the west half mile; and from the township corner established at the end of such boundary, the west boundary will be run *north* or *south*, as the case may be. In extending *south* or *north* boundaries of a township to the *east*, where the *southeast* or *northeast* corner can not be established in the regular way, the same rule will be observed, except that such boundaries will be run *east on a true line*, and the *east* boundary run *north* or *south*, as the case may be.

5. Allowance for the convergency of meridians will be made whenever necessary.

METHOD OF SUBDIVIDING.

1. The exterior boundaries of a full township having been properly established, the subdivision thereof will be made as follows:

At or near the *southeast* corner of the township, a *true meridian* will be determined by Polaris or solar observations, and the deputy's instrument will be tested thereon; then from said corner the first mile of the east and south boundaries will be retraced, if subdivisions and survey of the exteriors have been provided for in *separate* contracts; but, if the survey of the exterior and subdivisional lines are included in the *same* contract, the retracements referred to will be omitted. All discrepancies resulting from disagreement of bearings or measurements will be carefully stated in the field notes.

2. After testing his instrument on the true meridian thus determined, the deputy will commence at the corner to sections 35 and 36, on the south boundary, and run a line *parallel to the range line*,* establishing at 40.00 chains, the quarter section corner between sections 35 and 36, and at 80.00 chains the corner for sections 25, 26, 35, and 36.

3. From the last-named corner, a random line will be run eastward, without blazing, *parallel to the south boundary of section* 36, to its inter-

* The meridional section lines will be made parallel to the range line or east boundary of the township, by applying to the bearing of the latter a small correction, dependent on the latitude, taken from the following table, which gives, to the nearest whole minute, the *convergency* of two meridians 6 miles long and from 1 to 5 miles apart; and supplies directly the deviation of meridional section lines *west of north*, when the range line is a *true meridian*. Add the correction to the bearing

section with the east boundary of the township, placing at 40.00 chains from the point of beginning, a post for temporary quarter section corner. If the random line intersects said township boundary exactly at the corner for sections 25 and 36, it will be blazed back and established as the true line, the permanent quarter section corner being established thereon, *midway* between the initial and terminal section corners.

If, however, the random intersects said township boundary to the north or south of said corner, the falling* will be carefully measured, and from the data thus obtained, the true return course will be calculated,† and the true line blazed and established and the position of the quarter section corner determined, as directed above.

The details of the entire operation will be recorded in the field notes.

4. Having thus established the line between sections 25 and 36; from the corner for sections 25, 26, 35, and 36, the *west* and *north* boundaries of sections 25, 24, 13, and 12, will be established as directed for those of section 36; with the exception that the random lines of said north boundaries will be run *parallel to the established south boundaries of the sections to which they belong*, instead of the south boundary of section 36; e. g. the random line between sections 24 and 25 will be run parallel to the established south boundary of section 25, etc.

5. Then, from the last established section corner, i. e. the corner for sections 1, 2, 11, and 12, the line between sections 1 and 2, will be projected northward, on a random line, *parallel* to the east boundary of the township, setting a post for temporary quarter section corner at 40.00 chains, to its intersection with the north boundary of the township. If the random intersects said north boundary exactly at corner for sections 1 and 2, it will be blazed back and established as the true line, the temporary quarter section corner being established permanently in its original position, and the fractional measurement thrown

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of the range line, if the same is *west* of north, but subtract when it bears *east* of north.

TABLE A.—*Corrections for Convergency, within a Township.*

Latitude.	Correction to be applied to bearing of range lines at a distance of—				
	1 mile.	2 miles.	3 miles.	4 miles.	5 miles.
° °	′	′	′	′	′
30 to 35	1	1	2	2	3
35 to 40	1	1	2	3	3
40 to 45	1	2	2	3	4
45 to 50	1	2	3	4	5

Example.—Latitude, 47°. Range line bears N. 0° 2′ E.; then *parallel* meridional section lines will be run as follows:

From the corner for sections—
35 and 36, N. 0° 1′ E.
34 and 35, north.
33 and 34, N. 0° 1′ W.
32 and 33, N. 0° 2′ W.
31 and 32, N. 0° 3′ W.

* See "Prescribed Limits." page 59.

† See Table VII, and rules, page 128. *Random* bearings, determined as directed above, are actually the *true* bearings of fractional true lines and are so used for running them. 'Any deviation from random bearings, derived from the application of the falling [Table VII], changes the random bearing by an amount due to unavoidable errors, and should give for a final result a bearing *as near the true bearing* as the field work will permit. A *true* bearing means the angular deviation from the *true meridian* in contradistinction to the *magnetic* bearing, or angle made with the *magnetic meridian*. A true line will be understood to refer to *the line upon which the corners are established.*

into that portion of the line between said corner and the north boundary of the township.

If however, said random intersects the north boundary of the township, to the east or west of the corner for sections 1 and 2, the consequent falling will be carefully measured, and from the data thus obtained the true return course will be calculated* and the true line established, the permanent quarter section corner being placed upon the same at 40.00 chains from the initial corner of the random line, thereby throwing the fractional measurement in that portion lying between the quarter section corner and the north boundary of the township.

When the north boundary of a township is a base line or standard parallel, the line between sections 1 and 2 will be run *parallel to the range line* as a *true line*, the quarter section corner will be placed at 40.00 chains, and a *closing corner* will be established at the point of intersection with such base or standard line; and in such case, the distance from said closing corner, to the nearest standard corner on such base or standard line, will be carefully measured and noted as a *connection line.*

6. Each successive range of sections progressing to the west, until the fifth range is attained, will be surveyed in a similar manner; then, from the section corners established on the west boundary of said range of sections, random lines will be projected to their intersection with the west boundary of the township, and the true return lines established as prescribed for the survey of the first or most eastern range of sections, with the exception that on the true lines thus established the quarter section corners will be established at 40.00 chains from the the initial corners of the randoms, the fractional measurements being thereby thrown into those portions of the lines situated between said quarter section corners and the west boundary of the township.

7. The following general requirements are reiterated for emphasis:

The *random* of a latitudinal section line will always be run *parallel to the south boundary of the section to which it belongs, and with the true bearing of said boundary; and when a section has no linear south boundary, the random will be run parallel to the south boundary of the range of sections in which it is situated, and fractional true lines will be run in a similar manner.*†

8. The deputy is not required to complete the survey of the first range of sections from south to north before commencing the survey of the second or any subsequent range of sections, but the corner on which any random line closes shall have been previously established by running the line which determines its position, except as follows: Where it is impracticable to establish such section corner in the regular manner, it will be established by running the latitudinal section line as *a true line*, with a *true bearing*, determined as above directed for *random* lines, setting the quarter section corner at 40.00 chains and the section corner at 80.00 chains.‡

9. Quarter section corners, both upon meridional and latitudinal section lines, will be established at points *equidistant* from the corresponding section corners, *except* upon the lines closing on the north and west boundaries of the township, and in those situations the quarter section corners will always be established at precisely *forty chains* to the north or west (as the case may be) of the respective section corners from which those lines respectively *start*, by which procedure the

* See Table VII and rules, page 128.

† See Plate IV, between sections 7 and 18, and 17 and 20.

‡ See Plate IV, between sections 8 and 17.

excess or deficiency in the measurements will be thrown, according to law, on the extreme tier or range of quarter sections, as the case may be.

10. Where by reason of impassable objects only a portion of the south boundary of a township can be established, an auxiliary base line (or lines,* as the case may require) will be run through the portion which has no linear south boundary, first random, then corrected, connecting properly-established corresponding section corners (either interior or exterior) and as far south as possible, and from such line or lines, the section lines will be extended northwardly in the usual manner, and any fraction *south* of said line will be surveyed in the opposite direction from the section corners on the auxiliary base thus established. (See Plate I, figs. 3, 4, and 5.)

11. Where by reason of impassable objects *no portion of the south boundary* of a township can be regularly established, the subdivision thereof will proceed from *north to south* and from east to west, thereby throwing all fractional measurements and areas against the west boundary, and the meanderable stream or other boundary limiting the township on the south.

If the *east* boundary is without regular section corners and the north boundary has been run eastwardly as a true line, with section corners at regular intervals of 80.00 chains, the subdivision of the township will be made from *west to east*, and fractional measurements and areas will be thrown against the irregular east boundary.

12. When the proper point for the establishment of a township or section corner is inaccessible, and a witness corner can be erected upon each of the two lines which approach the same, at distances not exceeding twenty chains therefrom, said witness corners† will be properly established, and the half miles upon which they stand will be recognized as *surveyed lines.*

The witness corner will be marked as conspicuously as a section corner, and bearing trees will be used wherever possible.

The deputy will be required to furnish good evidence that the section corner is actually inaccessible.

MEANDERING.

1. Proceeding *down* stream, the bank on the *left* hand is termed the *left bank* and that on the *right* hand the *right bank.* These terms will be universally used to distinguish the two banks of a river or stream.

2. Navigable rivers, as well as all rivers not embraced in the class denominated "navigable," the right-angle width of which is three chains and upwards, will be meandered on both banks, at the ordinary *mean high water mark*, by taking the general courses and distances of their sinuosities, and the same will be entered in the field book. Rivers not classed as navigable will not be meandered above the point where the average right-angle width is less than three chains. Shallow streams, without any well-defined channel or permanent banks, *will not be meandered*; except tide-water streams, whether more or less than three chains wide, which should be meandered at ordinary high-water mark, as far as tide-water extends.

At every point where either standard, township, or section lines intersect the bank of a navigable stream, or any meanderable line, corners will be established at the time of running these lines. Such corners

*Section corners will be established by correct alinement and measurement of *meridional* sectional lines whenever practicable.

†See "Witness Corners," page 47.

are called meander corners,* and the deputy will commence at one of these corners, follow the bank or boundary line, and measure the length of each course from the beginning corner to the next "meander corner." Compass courses, by the needle or solar, will be used in meanders. Transit angles are not allowed.

The crossing distance between meander corners on same line and the true bearing and distance between corresponding meander corners will be ascertained by triangulation, or direct measurement, in order that the river may be protracted with entire accuracy. The particulars will be given in the field notes.

In meandering water courses or lakes, where a distance is more than *ten chains* between successive stations, whole chains only should be taken; but if the distance is *less* than ten chains, and it is found convenient to employ chains and links, the number of links should be *a multiple of ten*, thereby saving time and labor in testing the closings, both in the field and office.

3. The meanders of all lakes, navigable bayous, and deep ponds, of the area of twenty-five acres and upwards, will be commenced at a meander corner and continued, as above directed for navigable streams; from said corner, the courses and distances of the entire margin of the same, and the intersections with all meander corners established thereon, will be noted.

All streams falling into the river, lake, or bayou will be noted, and the width at their mouths stated; also, the position, size, and depth of springs, whether the water be pure or mineral; also, the heads and mouths of all bayous; all islands, rapids, and bars will be noted, with intersections, to their upper and lower ends, to establish their exact situation. The elevation of the banks of lakes, bayous, and streams, the height of falls and cascades, and the length and fall of rapids will be recorded in the field notes.

To meander a lake or deep pond lying entirely within the boundaries of a section, two lines will be run from the two nearest corners on different sides of such lake or pond, the courses and length of which will be recorded, and if coincident with unsurveyed lines of legal subdivisions, that fact will also be stated in the field notes, and at each of the points where said lines intersect the margin of the pond or lake, a *special*† meander corner will be established as above directed. (See example, page 201.)

The relative position of these points being thus definitely fixed in the section, the meandering will commence at one of them and be continued to the other, noting the intersection, and thence to the beginning. The proceedings are to be fully entered in the field notes.

4. Meander lines will not be established at the segregation line between dry and swamp or overflowed land, but at the *ordinary high-water mark* of the actual margin of the rivers or lakes on which such swamp or overflowed lands border.

5. The precise relative position of an island, in a township made fractional by a river or lake in which the island is situated, will be determined by triangulation from a special and carefully measured base line, initiated upon the surveyed lines, on or near the lake or river bank on the main land, so as to connect by course and distance on a direct

* These corners are the *regular* meander corners, and designated "meander corners;" they are distinguished from *special* and *auxiliary* meander corners; see paragraphs 11 and 12, page 44, and pages 42 and 43.

† A "*Special* Meander Corner" is one established on a line of legal subdivision, *not* a standard, township, or section line. See pages 201 and 202.

line, the meander corner on the mainland with the corresponding point on the island, where the proper meander corner will be established.

6. In making the connection of an island lying entirely within a section, with the mainland, a special base will be measured from the most convenient meander corner, and from such base, the location of an *auxiliary** meander corner will be determined by triangulation, at which the meanders of the island will be initiated.

7. In the survey of lands bordering on *tide water*, "meander corners" will be established at the points where surveyed lines intersect *high-water mark*, and the meanders will follow the *high-water line.*

8. The field notes of meanders will show the dates on which the work was performed, as illustrated in the specimen notes, page 216. The field notes of meanders will state and describe the corner from which the meanders commenced, and upon which they closed, and will exhibit the meanders of each fractional section separately; following, and composing a part of such notes, will be given a description of the land, timber, depth of inundation to which the bottom is subject, and the banks, current, and bottom of the stream or body of water meandered. The utmost care will be taken to pass no object of topography, *or change therein*, without giving a particular description thereof in its proper place in the notes of the meanders.

SUMMARY OF OBJECTS AND DATA REQUIRED TO BE NOTED.

1. The precise length of every line run, noting all necessary offsets therefrom, with the reason for making them, and method employed.

2. The kind and diameter of all bearing trees, with the course and distance of the same from their respective corners; and the precise relative position of witness corners to the true corners.

3. The kind of materials of which corners are constructed.

4. *Trees on line.* The name, diameter, and distance on line to all trees which it intersects.

5. Intersections by line of *land objects.* The distance at which the line intersects the *boundary lines* of every reservation, settler's claim, improvement, or rancho; prairie, bottom land, swamp, marsh, grove, and windfall, with the course of the same at all points of intersection; also, the distances at which the line begins to ascend, arrives at the top, begins to descend, and reaches the foot of all *remarkable* hills and ridges, with their courses, and *estimated height in feet*, above the level land of the surrounding country, or above the bottom lands, ravines, or waters near which they are situated. Also, distance to and across *large* ravines, their depth and course.

6. Intersections by line of *water objects.* All rivers, creeks, and smaller streams of water which the line crosses; the distances measured on the *true* line to the bank *first arrived at*, the course *down* stream at *points of intersection*, and their *widths on line.* In cases of *navigable* streams, their width will be ascertained between the *meander corners*, as set forth under the proper head.†

7. The land's *surface*—whether level, rolling, broken, hilly, or mountainous.

8. The *soil*—whether first, second, third, or fourth rate.

9. *Timber*—the several kinds of timber and undergrowth, in the order in which they predominate.

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*An "auxiliary meander corner" is one not on a line belonging to the system of rectangular surveying. See page 212.

†See "Meandering," third clause of paragraph 2, page 57.

11. *Springs of water*—whether fresh, saline, or mineral, with the course of the streams flowing from them.

12. *Lakes and ponds*—describing their banks and giving their height, and also depth of water, and whether it be pure or stagnant.

13. *Improvements.* Towns and villages; houses or cabins, fields, or other improvements with owners' names; mill sites, forges, and factories, mineral monuments, and all corners not belonging to the system of rectangular surveying; will be located by bearing and distance, or by intersecting bearings from given points.

14. *Coal* banks or beds; *peat* or turf grounds; *minerals* and ores; with particular description of the same as to quality and extent, and all *diggings* therefor; also *salt* springs and licks. All reliable information that can be obtained respecting these objects, whether they be on the line or not, will appear in the general description.

15. *Roads* and *trails*, with their directions, whence and whither.

16. Rapids, cataracts, cascades, or falls of water, with the estimated height of their fall in feet.

17. Precipices, caves, sink holes, ravines, stone quarries, ledges of rocks, with the kind of stone they afford.

18. *Natural curiosities*, interesting fossils, petrifactions, organic remains, etc.; also all ancient works of art, such as mounds, fortifications, embankments, ditches, or objects of like nature.

19. The *magnetic declination* will be *incidentally* noted at all points of the lines being surveyed, where any *material change* in the same indicates the probable presence of iron ores; and the position of such points will be perfectly identified in the field notes.

PRESCRIBED LIMITS FOR CLOSINGS AND LENGTHS OF LINES.

1. If in running a *random* township exterior, such random falls short of or exceeds its proper length by more than *three chains*, or falls more than *three chains* north or south of its objective corner, it will be re-run, and if found correct, so much of the remaining boundaries of the township will be retraced or resurveyed,* as may be found *necessary* to locate the error.

2. Every meridional section line, except those terminating in the north boundary of the township, shall be *eighty chains* in length.†

3. The *random* meridional section lines through the north tier of sections shall fall within *fifty links* east or west of the section corners established on the north boundary of the township, *except* when closing on a base line or standard parallel.

4. The actual length of meridional section lines through the north tier of sections shall be within *one hundred and fifty links* of their theoretical length. The latter will be determined from the meridional boundaries of the north tier of sections.

5. All *random* latitudinal section lines shall fall within *fifty links* north or south of their objective section corners.

In any range of sections, the difference between the true bearing of a latitudinal section line and that of the south boundary of the range, shall not exceed 21 minutes of arc.

The *latitudinal* section lines, except those terminating in the west boundary of the township, shall be within *fifty links* of the actual distance established on the south boundary line of the township for the width of the range of sections to which they belong.

6. The north boundary and the south boundary of *any one section*,

*See "Explanations," p. 71 to 78. † See exception on p. 76.

except in the extreme western range of sections, shall be within *fifty links* of equal length.

7. The meanders within each fractional section, or between any two successive meander corners, or of an island in the interior of a section, should close within a limit to be determined by allowing *five-eighths of a link* for *each chain* of said meander line. Where the meander corners marking the ends of a meander line in a fractional section are located on standard, township, or section lines, the above limit, increased by *one-fourth of the regular perimeter of the fractional section, expressed in miles, multiplied by 71 links, will be allowed.**

The extreme limit, however, will in no case be permitted to exceed *one hundred and fifty links.*

FIELD NOTES.

1. The proper blank books for *original field notes* will be furnished by the surveyor general, and in such books the deputy surveyor will make a faithful, distinct, and minute record of everything done and observed by himself and his assistants, pursuant to instructions, in relation to running, measuring, and marking lines, establishing corners, etc., and present, as far as possible, full and complete topographical sketches of all standard and exterior lines, drawn to the usual scale for township exteriors. These "original field notes" are not necessarily the entries made in the field, in the deputy's pocket note books called tablets; but they are to be fully and correctly written out in ink, from such tablets, for the permanent record of the work. Tablets should be so fully written as to verify the "original field notes" whenever the surveyor general requires them for inspection.

2. A full description of all corners belonging to *old* surveys, from which the lines of *new* surveys *start*, or upon which they *close*, will in all cases be furnished the deputy from the surveyor general's office, when authority is given for commencing work; then, if the old corners are found to agree with said descriptions, the deputy will describe any one of them in this form, "which is a stone firmly set, marked, and witnessed, as described by the surveyor general"; but, should a corner *not* answer the description supplied, the deputy will give a *full description* of such corner and its accessories, following the proper approved form given in these instructions.

A full description of each corner established under any one contract will be given *once* only; subsequent reference to such corner will be made in the form, "heretofore described", or (e. g.) "the corner for sections 2, 3, 10, and 11," as the case may require.

In all cases where a corner is *reëstablished*, the *original field notes* will describe fully the manner in which it is done.

3. The *original field notes* of the survey of base, standard, and meridian lines will describe all corners established thereon, how established, the crossings of streams, ravines, hills, and mountains; character of soil, timber, minerals, etc.; and after the description of each township corner established in running such lines, the deputy will note particularly in the "general description" the character of townships on each side of the lines run.

4. The *original field notes* of the survey of exterior boundaries of townships will describe the corners and topography, as above required, and the "general description" at the end of such notes will describe the townships as fully as possible, and also state whether or not they should be subdivided.

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* See Plate I, figs. 8, 9, 10, 11, and 12.

5. The *original field notes* of the subdivisional survey of townships will describe the corners and topography as above required, and the "general description" at the end of such notes will state minutely the character of the land, soil, timber, etc., found in such townships.

The topography will be given on the *true line* in all cases, and will be taken correctly, not estimated or approximated.

6. With the *original field notes* of the survey of base lines and standard parallels, and principal and guide meridians forming a tract 24 miles square,* including those of the township exteriors therein, the deputy will submit a diagram of the lines surveyed, drawn to a scale of half an inch to one mile, upon which will be written the *true bearings and lengths of all surveyed lines*, except the lengths of those which are actually 40.00 or 80.00 chains. These diagrams will exhibit all water courses, with the direction of each indicated by an arrow head pointing *down stream;* also, the intersection of the lines with all prairies, marshes, swamps, ravines, lakes, ponds, mountains, hills, and all other natural or artificial topographical features mentioned in the *original field notes*, to the fullest extent possible.

7. With the *special instructions* for making subdivisional surveys of townships into sections, the deputy will be furnished by the surveyor general with *blank township diagrams* drawn to a scale of *one inch to forty chains*, upon which the *true bearings and lengths of the township and section lines, from which the surveys are to be projected, or upon which they are to close, will be carefully marked;* and on such diagrams the deputy who subdivides will make appropriate sketches of the various objects of topography as they occur on his lines, so as to exhibit not only the points of intersection therewith, but also the directions and relative positions of such objects between the lines, or within each section, as far as practicable, so that every topographical feature may be properly completed and connected in the showing.

8. Triangulations, offsets, or traverses, made to determine distances that can not be directly measured, such as those over (e. g.) deep streams, lakes, impassable swamps, cañons, etc., will be made on the *random lines*,† when random lines are run. All particulars will be fully stated in the field notes.

The exhibition of every mile of surveying, whether on standard, township, or subdivision lines, and the meanders in each section, will be complete in itself, and will be separated from other records by a black line drawn across that part of the page containing the body of notes. The description of the surface, soil, minerals, timber, undergrowth, etc., on *each mile* of line will follow the notes of survey of such line, and *not be mingled with them.*

Particular care will be taken to record at the end of each mile the number of chains of *mountainous* land, *heavily timbered* land, or land covered with *dense undergrowth.* (*See* page 224.)

The date of each day's work will immediately follow the notes thereof.

9. Near the end of the *original field notes* and immediately before the "general description", the deputy surveyor will add, in the form shown in specimen field notes (page 177), a tabular statement of the latitude and departure of all boundary lines of the township, derived from a traverse table, and will give the *totals*, and the *errors* in latitude and departure; said errors shall in no case exceed *three chains*, the prescribed limit for the falling of the *random* north boundary of a township. If a part or the whole of one or more boundaries is made up of meander lines, the northings, southings, eastings, and westings of the

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* See page 52 and Plate III. † See pages 136 and 188.

full section lines, nearest said meanders, will replace the missing N., S., E., or W. township lines, as the case may require, thereby presenting the *errors* of said boundaries of a closed survey.

If all the exterior lines have been surveyed by the deputy, the bearings and distances for the table will be taken from his own notes. In a case where some of the boundaries have been surveyed under another contract, the deputy will use the bearings and distances supplied by the surveyor general, in connection with those of his own lines; and, if errors exceed the allowance of *three chains*, specified in paragraph 1 of the "Prescribed Limits",* the deputy will determine *where the error occurs, correct the same before he leaves the field, and place the table in his original field notes.*

Besides the ordinary notes taken on line (and which will always be written down on the spot, leaving nothing to be supplied by memory), the deputy will subjoin, at the conclusion of his book, such further description or information touching any matter or thing connected with the township (or other) survey which he may be able to afford, and may deem useful or necessary to be known—with a *general description* of the township in the *aggregate*, as respects the face of the country, its soil and geological features, timber, minerals, waters, etc.

10. Following the general description of the township will be placed "A list of the names of the individuals employed to assist in running, measuring, and marking the lines and corners described in the foregoing field notes of township No. ——— of the base line of range No. ——— of the ——— meridian, showing the respective capacities in which they acted."

AFFIDAVITS TO FIELD NOTES.

The following are the forms of official oaths to be taken by deputy surveyors and their assistants. The original oaths will be affixed to the *original field notes* forwarded to the surveyor general by the deputy surveyor; the preliminary oaths being placed on the page following the index of the first book, and the final oaths at the end of the last book of field notes of the survey of *each class of lines*† to which they refer:

PRELIMINARY OATHS OF ASSISTANTS.

We, ——— ——— and ——— ———, do solemnly swear that we will well and faithfully execute the duties of chainmen; that we will level the chain upon even and uneven ground and plumb the tally pins, either by sticking or dropping the same; that we will report the true distance to all notable objects, and the true length of all lines that we assist in measuring, to the best of our skill and ability, and in accordance with instructions given us, in the survey of the ——— ———.

——— ———, *Chainman.*
——— ———, *Chainman.*

Subscribed and sworn to before me this —— day of ———, 189—.
[SEAL.]

——— ———,
———.

We, ——— ——— and ——— ———, do solemnly swear that we will well and truly perform the duties of moundmen in the establishment of corners, according to the instructions given us, to the best of our skill and ability, in the survey of ——— ———.

——— ———, *Moundman.*
——— ———, *Moundman.*

Subscribed and sworn to before me this —— day of ———, 189—.
[SEAL.]

——— ———,
———.

* See page 59, and retracement article, page 72.
† See page 50, and par. 13 (*a*) page 64.

We, ——— ——— and ——— ———, do solemnly swear that we will well and truly perform the duties of axmen, in the establishment of corners and other duties, according to instructions given us, to the best of our skill and ability, in the survey of ——— ———.

——— ———, *Axman.*
——— ———, *Axman.*

Subscribed and sworn to before me this —— day of ———, 189—.
[SEAL.] ——— ———,
———.

I, ——— ———, do solemnly swear that I will well and truly perform the duties of flagman, according to instructions given me, to the best of my skill and ability, in the survey of ——— ———.

——— ———, *Flagman.*

Subscribed and sworn to before me this —— day of ———, 189—.
[SEAL.] ——— ———,
———.

FINAL OATHS OF DEPUTY SURVEYORS AND THEIR ASSISTANTS.

List of names.

A list of the names of the individuals employed by ——— ———, United States deputy surveyor, to assist in running, measuring, and marking the lines and corners described in the foregoing field notes of the survey of ——— ———, showing the respective capacities in which they acted.

——— ———, *Chainman.*
——— ———, *Chainman.*
——— ———, *Chainman.*
——— ———, *Chainman.*
——— ———, *Moundman.*
——— ———, *Moundman.*
——— ———, *Axman.*
——— ———, *Axman.*
——— ———, *Flagman.*

FINAL OATHS OF ASSISTANTS.

We hereby certify that we assisted ——— ———, United States deputy surveyor, in surveying all those parts or portions of the ——— of the ——— base and ——— meridian, ——— of ———, which are represented in the foregoing field notes as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of our knowledge and belief, well and faithfully surveyed, and the corner monuments established according to the instructions furnished by the United States surveyor general for ———.

——— ———, *Chainman.*
——— ———, *Chainman.*
——— ———, *Chainman.*
——— ———, *Chainman.*
——— ———, *Moundman.*
——— ———, *Moundman.*
——— ———, *Axman.*
——— ———, *Axman.*
——— ———, *Flagman.*

Subscribed and sworn to before me this —— day of ———, 189—.
[SEAL.] ——— ———,
———.

FINAL OATH OF UNITED STATES DEPUTY SURVEYOR.

I, ——— ———, United States deputy surveyor, do solemnly swear that in pursuance of instructions received from ——— ———, United States surveyor general for ———, bearing date of the —— day of ———, 189—, I have well, faithfully, and truly, in my own proper person, and in strict conformity with the instruction furnished by the United States surveyor general for ———, the Manual of Surveying Instructions, and the laws of the United States, surveyed all those parts or portions of ———

——— of the ——— base and ——— meridian in the ——— of ———, which are represented in the foregoing field notes as having been surveyed by me and under my directions; and I do further solemnly swear that all the corners of said survey have been established and perpetuated in strict accordance with the Manual of Surveying Instructions, and the special written instructions of the United States surveyor general for ———, and in the specific manner described in the field notes, and that the foregoing are the *true* field notes of such survey; and should any fraud be detected, I will suffer the penalty of perjury, under the provisions of an act of Congress approved August 8, 1846.

———— ————,
United States Deputy Surveyor.

Subscribed by said ——— ————, U. S. deputy surveyor, and sworn to before me this —— day of ———, 189—.
[SEAL.]
———— ————,
———— ————.

11. The *final oath of the deputy surveyor* will be taken before the *U. S. Surveyor General* for the State or Territory in which the survey is executed, or before any other officer authorized by the laws of the United States or by the municipal authorities, to administer land oaths, except notaries public.

It is preferable that *both* preliminary and final oaths of *assistants* should be taken before some officer duly authorized to administer oaths other than the deputy surveyor. In cases, however, where great delay, expense, or inconvenience would result from a strict compliance with this rule, the deputy surveyor is authorized to administer the necessary oaths to his assistants, but in each case where this is done, he will submit to the proper surveyor general, a full written report of the circumstances which required his stated action.

12. The deputy will transmit the *original field notes* and the required sketches to the surveyor general at the earliest practicable date after completion of his work in the field. *Said original field notes will be filed in the office of the surveyor general as a part of its permanent records, subject only to the direction of the Commissioner of the General Land Office; and no changes whatever will be made in said original field notes, after they have been filed in the surveyor general's office.*

13. The *original field notes*, each bearing the *written approval* of the surveyor general, will be substantially bound in volumes of suitable size and retained in the surveyor general's office. *Certified transcripts* of said *original field notes* will be prepared at the earliest practicable date, as follows:

(*a*) The field notes of the survey of base lines and standard parallels, of principal and guide meridians, of township exteriors, and of subdivision and meander lines will be written in *separate books.* A *complete set* of preliminary and final oaths will be attached to the field notes of *each class of lines.** No adhesive material of any kind will be used to fasten leaves or covers. Cut or mutilated leaves, or slips, will not be inserted.

(*b*) The field notes of *subdivisions* will be written in *a separate book for each township;* the preliminary oaths of the assistants employed in making said *subdivisions* will be prefixed to the *first* book, and their final oaths will be attached to the *last* book of the series, arranged in the order of dates.

(*c*) The *first* or title page of *each book of field notes* will describe the subject matter of the same, the locus of the survey, by whom surveyed, number and date of contract, and the dates of commencement and completion of the work.

* See classification of lines, page 50.

(*d*) The *second* page of *each book of field notes* will contain the names and duties of *the assistants employed on the surveys recorded therein;* the index will be placed on the same or following page.

(*e*) Whenever a new assistant is employed, or the duties of any one of them changed, such fact will be stated in an appropriate entry immediately preceding the notes taken under such changed arrangements.

(*f*) No abbreviations or contractions of words are allowable, except such words as are *constantly* occurring, and a few others, additional to those enumerated on page 23, as follows:

astron.	for astronomical.	l. m. t.	for local mean time.
chs.	for chains.	long.	for longitude.
corr.	for correction.	m.	for minutes.
decl.	for declination.	mag. decl.	for magnetic declination.
diff. lat.	for difference of latitude.	red.	for reduce or reduction.
dep.	for departure.	temp.	for temporary.
h.	for hours.	U. C.	for upper culmination.
lat.	for latitude.	w. corr.	for watch correction.
L. C.	for lower culmination.	w. t.	for watch time.

Proper names will never be abbreviated, however often they recur.

(*g*) All transcripts of field notes, made out as herein directed, will be written on official field-note paper, foolscap size (pages $13\frac{1}{2} \times 8\frac{1}{2}$ inches), in a bold, legible hand, or type-written, and as nearly as possible without erasures or interlineations; such transcripts of any series of surveys, included in one account forwarded to the General Land Office, will be securely put up in *one package*, at the office of the surveyor general, prior to transmission.

SPECIAL INSTRUCTIONS ISSUED BY UNITED STATES SURVEYORS GENERAL TO UNITED STATES DEPUTY SURVEYORS.

One of the most important duties to be performed by the surveyor general is to provide the deputy surveyor with *Special Instructions*, in connection with the contract, prepared in accordance with law, which instructions will not consist of directing attention to certain paragraphs in this Manual, reiteration of its requirements, and printed directions of a *general* nature; but they will in all cases be *specific* in character, with all necessary *detailed statements* setting forth *what* the deputy is to do and *how* the work is to be performed. Before making out special instructions, the surveyor general will cause a thorough examination to be made of the field notes and plats of older surveys of standard and township lines upon which the deputy is to base his work, and give him *full* information—both *written* and *graphic*—of the exact condition of adjoining surveys, with all *irregularities* that may be found, carefully and clearly noted; with all necessary instructions for his guidance if he finds everything *as it should be*, and, in addition, full advice as far as practicable what to do in case the surveys on the ground are *not as represented* in the old notes.

If the contract includes exterior lines, the surveyor general will specify in detail *where* the deputy is to commence, in what *order* and in what *direction* he is to run the lines, and provide for his use a *diagram*, drawn to a scale of one inch to one mile, giving full and accurate information in regard to lengths and bearings of all lines of old surveys, *from* which he is to work, or *upon* which he is to close. The diagrams will be made in triplicate, one copy for the General Land Office, one for the deputy, and one to be retained; they may be either original drawings, or blue prints or tracings therefrom. *In no case must the deputy be sent*

into the field without full and accurate information in regard to all irregularities on the records which will affect the extent or accuracy of his survey.

SPECIMEN FIELD NOTES.

[See Plates III and IV.]

Specimen field notes Nos. 1, 2, 3, 4, and 5, illustrate, respectively, the method and order to be followed in the survey of standard parallels, guide meridians, and township exteriors; *resurvey* of township exteriors; and the subdivision of a township into sections and quarter sections.

The attention of every deputy surveyor is particularly directed to these specimens, as indicating not only the method by which his work will be conducted, but also the form, order, language, etc., in which his field notes will be prepared for the office of the surveyor general, and such specimens will be deemed a part of these instructions; and any *departure from their details*, in cases where the circumstances are analogous in practice, *will be regarded as a violation of his contract and oath.*

DIAGRAM OF TOWNSHIP EXTERIORS.

[See Plate III.]

The title, certificate, and remarks on Plate III, with the specimen field notes Nos. 1, 2, and 3, will fully explain the drawing designated "Township Exteriors."

In all cases the *true bearing and length* of each township boundary will be clearly stated on the diagram; and, when any township boundary entered on the diagram, surveyed under the current contract, or a prior contract, departs from the true meridian, or proper latitude curve (as the case may be), or falls short of or overruns its proper length, by an amount in excess of the prescribed limits of *three chains* (page 59, paragraph 1), the *actual position and extent* of said township boundary will be *graphically* exhibited on the diagram, as well as by bearing and length recorded in the field notes.

SPECIMEN TOWNSHIP PLAT.

[See Plate IV.]

Plate IV illustrates the subdivision of a township into sections and quarter sections; the record of said subdivision being given in detail in specimen field notes No. 5.

The subdivision of fractional sections into forty-acre lots (as near as may be) will be so laid down on the official township plat in broken black lines as to admit of giving to each a *specific designation by word description*, if possible, according to its relative position in the fractional section, as per examples on Plate IV; or by a number, in all cases where the lot can not properly be designated as a quarter quarter. Those fractional lots which are not susceptible of being described according to relative local position will be numbered in a regular series; those bordering on the north boundary of a township to be numbered progressively from east to west, and those bordering on the west boundary of a township to be numbered progressively from north to south, in each regular section. As section 6 borders on both the north and west boundaries of the township, the fractional lots in the

same will be numbered as follows: commencing with No. 1 in the northeast, thence progressively west to No. 4 in the northwest, and south to No. 7 in the southwest corner of the section.

To secure a uniform system for numbering lots of fractional sections, including those above specified, imagine the section divided by three equidistant parallel latitudinal lines into four strips or tiers, numbered from north to south; then, beginning with the *eastern lot* of the north tier, call it No. 1, and continue the numbering *west* through the tier, then *east* in the second, *west* in the third, and *east* in the fourth tier. A lot extending north and south through two, or part of two tiers, will be numbered in the tier containing its greater area. In case any tier is *without* numbered lots, the numbering will be continued in the next tier to the south. (Plate IV, section 18.)

This method of numbering will apply to any part of a section, regardless of the relative situation of a part or parts surveyed and lotted under a prior contract; in this case the lot numbers will be a continuation of the series already initiated.

Interior lots will be, as nearly as possible, 20.00 chains long by 20.00 chains wide; and the excess or deficiency of measurement will always be thrown against the northern or western boundary of the section, or meander line, or irregular boundary, as the case may be.

When, by reason of irregular surveys or from other causes, the length of a township from south to north exceeds the lawful length of 480.00 chains, or the width from east to west exceeds 480.00 chains *minus* the proper convergency, to such extent as to require two or more tiers of lots along the north boundary, or two or more ranges of lots along the west boundary, as the case may be, the entire north or west halves of said sections will be properly lotted, and to each lot will be assigned its proper number; and in such cases the area of each lot will be stated on the plat.

In case the length or width of the township falls so far short of legal dimensions as to *eliminate* the north or west half of any section situated as above specified, that part of the section remaining will be treated in a similar manner.

In a regular township (Plate IV) the southeast quarter of the northwest quarter of section 6 will have its proper area in acres (40) inserted in all cases. The half quarter sections in north tier and west range of sections will exhibit their proper areas in acres (80); while the areas of *quarter sections* will be omitted, except as follows:

When two lines of legal subdivision of either 160, 80, or 40 acre tracts intersect each other on or so near a meander or boundary line that the ordinary inaccuracies of drawing would leave the areas of said tracts in doubt, the plats will, for the sake of clearness and a full showing of the facts, exhibit the proper areas of such quarter, half quarter, and quarter quarter sections. See examples, Plate IV, in sections 13, 17, 25, and 35.

Plats shall not be trimmed. A margin of *three inches for binding* will be preserved on the left-hand side of each plat. Each plat will be certified by the surveyor general, with table annexed, according to the form on Plate IV, and will exhibit the area of public land, water surface, townsite, private land claims, and mineral claims, with the total area of the township.

Each township plat will be prepared in *triplicate;* one for the General Land Office, one for the United States district land office, and the third will be retained as the record in the office of the surveyor general.

The plat for the local land office will not be forwarded until notice is

received by the surveyor general from the Commissioner of the General Land Office that the survey represented on said plat has been accepted, and that he is authorized to file the triplicate plat.

The plats will be prepared as nearly as possible in accordance with the specimen plat designated "Plate IV." The use of all fluids, except a preparation of India ink of good quality, must be avoided by the draughtsman in delineations relating to the public surveys. All lines, figures, etc., will be sharply defined. All lettering on the plats must be clear and sharp in outline and design, and *black;* ornamentation of any kind is prohibited. These requirements are necessary in order that everything shown upon original plats may be fairly reproduced in making photolithographic copies of the same.

All towns, settlements, permanent buildings, private claims, reservations, water courses, ditches, lakes, islands, mountains, buttes, cañons, roads, railroads, telegraph lines, canals, etc., will be shown upon the plats and designated by proper names where such are known.

All township plats are to be drawn to a uniform scale of 1 inch to 40 chains, United States standard, and diagrams of exteriors to a scale of 1 inch to 160 chains.

Surveyors general will require that the specimen plat shall be closely followed, in order that uniformity of appearance and expression of drawing representing the public land surveys may be attained.

With the copy of each township plat furnished to a district land office, the surveyor general is required by law to furnish *descriptive notes* of the character and quality of the soil and timber found on and in the vicinity of each surveyed line, and to give a description of each corner.

Printed blank forms of such notes are furnished by the General Land Office. The forms provide eighteen spaces for *meander corners*, which, in most cases, will be sufficient; but when the number shall exceed eighteen, the residue will have to be inserted on the supplemental blank form.

A series of meander corners are shown on Plate IV, viz: From No. 1 to No. 8, on Yellowstone River; No. 9 to No. 10, on Clear Lake; No. 11 to No. 15, on Lin's Lake; No. 16 to No. 17, on Ivy Island; and No. 18, on Diamond Rock.

COMPUTATION OF THE AREAS OF LOTS ADJOINING THE NORTH AND WEST BOUNDARIES OF REGULAR TOWNSHIPS.

1. In regular townships, the tracts of land in each section adjoining the north and west boundaries of such townships, in excess of the regularly subdivided 480 acres (except in section 6), will, in general, be in the form of trapezoids, 80.00 chains in length by about 20 chains in width.

On the plats of such townships, each of said tracts will be divided into four lots, by drawing broken lines at intervals of 20.00 chains, parallel to the ends of the tracts, which will be regarded as parallel to each other.

With the exception of section 6, the south boundaries of sections of the north tier, when within prescribed limits, will be called 80.00 chains.

When the above-named conditions obtain, the areas of the lots in any one tract (except in section 6) may be determined, as follows:

Divide the *difference* between the widths of the ends of the tract by 4; if 3 remains, increase the hundredth figure of the quotient by a unit; in *all other cases* disregard the fraction; call the quotient thus obtained,

"d"; then, taking the end widths of the tract in *chains and decimals of a chain*, the areas of the lots, in *acres*, will be:

Of the *smallest* lot: *twice* the width of the *lesser* end, *plus* "d";
Of the *largest* lot: *twice* the width of the *greater* end, *minus* "d";
Of the *smaller middle* lot: *sum* of the widths of the ends, *minus* "d";
Of the *larger middle* lot: *sum* of the widths of the ends, *plus* "d".

A check on the computation may be had by multiplying the *sum* of the widths of the ends of the tract by 4; the product should agree *exactly* with the total area of the four lots.

The proper application of the above rules will always give areas correct *to the nearest hundredth of an acre;* and, as the use of fractions is entirely avoided, the method is recommended for its simplicity and accuracy.

Example 1. (See Plate IV, section 31.)

The $\frac{1}{4}$ difference of latitudinal boundaries is $0.03\frac{3}{4}$ chains; consequently, "d" is .04 chains; then,

18.35 × 2	+.04 =	36.74	acres, the area of lot 1;
18.50 × 2	−.04 =	36.96	acres, the area of lot 4;
18.50 + 18.35	−.04 =	36.81	acres, the area of lot 2;
18.50 + 18.35	+.04 =	36.89	acres, the area of lot 3;
Check: [18.35 + 18.50] ×	4 =	147.40	acres, the area of the four lots.

The arithmetical operations are here written in detail, for the purpose of illustration; but the practical computer will perform all the work mentally.

2. Section 6. (See Plate I, figs. 6 and 7; and Plate IV.) The areas of lots 5, 6, and 7 may be obtained by the foregoing rules in all cases, *except* when the township closes on a base line or standard parallel; also, the area of lot 4, *provided* both meridional boundaries are 80.00 chains in length; when the last condition obtains, the areas of lots 1, 2, and 3 will be equal, and each will contain 40.00 acres.

In any case where the *west* boundary of sec. 6, is 80.00 chains, and the *east* boundary either *greater or less than 80.00* chains, the areas of lots 1, 2, 3, and 4 will be computed as follows:

Refer to figures 6 and 7 and determine the difference, "q", between the *east* boundaries of lots 1 and 4 by the following proportion:

N. bdy. sec. 6. : diff. of meridional bdrs. sec. 6. :: 60 chs. : q; then will E. bdy. lot 4 = E. bdy. lot 1 ± q; in which, "q" will be *added* when the *east* boundary of sec. 6 is *less than 80.00 chains* (fig. 7.); but *subtracted* when said east boundary is *greater than 80.00 chains* (fig. 6).

Now take *one third* of "q", and add it to the *shorter east boundary* of lots 1 or 4, as conditions may require, and thereby determine the length of one of the *meridional* boundaries of lot 2; to which, again add "one third of q", and thus obtain the length of the opposite side of lot 2. The areas of lots 1, 2, and 3, in *acres*, will be found by taking the sum of their respective *meridional boundaries*, expressed in *chains and decimals of a chain.*

The area of lot 4 may be had by multiplying its *mean width* by its *mean length.*

Finally, to test the entire work, multiply the sum of the *latitudinal* boundaries by 4, and to the product *add* the area of the small triangle C A B, if the east boundary is *greater* than 80.00 chains (fig. 6); but *subtract* the area of said small triangle if the east boundary is *less* than 80.00 chains (fig. 7). These operations, correctly performed,

will give *the true area of the section*, which should agree *exactly* with the total area of its legal subdivisions, obtained as directed in the preceding paragraphs.

Example 2. (See Plate I, figs. 6 and 7, and Plate IV.)

Compute areas of lots 5, 6, and 7 of sec. 6, as directed in paragraph 1, and illustrated by the example; then write:

chs. chs. chs chs. chs.
77.75 : 0.05 :: 60.00 : 0.0386=q; $\frac{1}{3}$ q=0.0129

chs. chs. chs.
20.0500—0.0386=20.01,* the E. bdy. of lot 4;
20.0114+0.0129=20.02, the E. bdy. of lot 3;
20.0243+0.0129=20.04, the E. bdy. of lot 2.

Then, for the areas of lots 1, 2, 3, and 4, we have:

chs. chs. acres.
20.05+20.04 .....= 40.09, the area of lot 1;
20.04+20.02 .....= 40.06, the area of lot 2;
20.02+20.01 .....= 40.03, the area of lot 3;

$\frac{20.00+20.01}{2} \times \frac{17.75+17.78}{2}$ = 35.54, the area of lot 4.

Also [17.78+17.87]×3 =106.95, the area of lots 5, 6, and 7.
Area of regular subdivisions =360.00

Total....=622.67, the area of Sec. 6.

chs. chs.
Check: [77.87+77.75]×4=622.48
77.75× 0.025 = 0.19, the area of triangle C A B (fig. 6).

Total....=622.67, which agrees with the area of section 6, before determined.

3. The area in acres of a tract 40.00 chains long, adjoining north or west township boundaries (except in N. W. $\frac{1}{4}$ sec. 6), is equal to the sum of its *parallel boundaries* (expressed in chains and decimals thereof) multiplied by 2; (e. g.) the area of lots 6 and 7 (Plate I, fig. 6), is [17.87+17.81]×2=71.36 acres.

The area in acres of a tract 60.00 chains long, situated as above described (excluding lot 4, of sec. 6), may be found by multiplying the sum of its *parallel boundaries* (expressed in chains and decimals of a chain) by 3; (e. g.) fig. 6; south boundary lot 4=17.78 chs.; area of lots 5, 6, and 7 is [17.78+17.87]×3=106.95 acres. (See example 2.)

The area in acres of quarter sections adjoining north and west township boundaries (excluding N. W. $\frac{1}{4}$ sec. 6), may be obtained by multiplying the sum of their *parallel boundaries* (taken in chains and decimals of a chain), by 2; (e. g.) the area of S. W. $\frac{1}{4}$ sec. 6 (fig. 6), is [37.87+37.81]×2=151.36 acres.

The area in acres of any section along the north and west boundaries of regular townships (except sec. 6) may be had by multiplying the sum of its *parallel boundaries* (expressed in chains and decimals of a chain) by 4; (e. g.) the area of sec. 1 (Plate IV) is [80.00+79.77] ×4=639.08 acres.

The area in acres of a *theoretical township* may be obtained by multiplying the sum of its *latitudinal boundaries* (expressed in chains and

* These measures are taken to the nearest hundreth only.

decimals of a chain) by 24; (e. g.) the area of the township represented by Plate I, fig. 1 is $[480.00+479.34]\times24=23,024.16$ acres.

EXPLANATIONS OF ARTICLES ON PAGES 72 to 78, WITH GENERAL DEFINITIONS OF A "RETRACEMENT" AND A "RESURVEY."

When new surveys are to be initiated from, or closed upon the lines of old surveys, which although reported to have been executed correctly, are found to be actually defective in alinement, measurement, or position, it is manifest that the employment of the regular methods prescribed for surveying normal township exteriors and subdivisions would result in extending the imperfections of the old surveys into the new, thereby producing irregular townships bounded by exterior lines not in conformity with true meridians or parallels of latitude, and containing trapezium-shaped sections which may or may not contain 640 acres each, as required by law.

Therefore, in order to extend such new surveys without incorporating therein the defects of prior erroneous work, special methods, in harmony as far as practicable with the following requirements, should be employed, viz:

The establishment of township boundaries conformable to true meridian and latitude lines.

The establishment of section boundaries by running two sets of parallel lines governed respectively by true meridians and parallels of latitude, and intersecting each other approximately at right angles at such intervals as to produce tracts of square form containing 640 acres each.

The reduction to a minimum of the number of fractional lots in a township, and consequently of the amount of field and office work.

Such special methods are based upon certain limits of allowable error in the alinement, measurement, and position of old township boundaries, as prescribed in the following article entitled "DEFINITIONS OF DEFECTIVE TOWNSHIP BOUNDARIES," page 72, which will be determined and rectifications made, if necessary, under the provisions of the article entitled "RETRACEMENT OR RESURVEY OF TOWNSHIP LINES AND LINEAR BOUNDARIES NOT ESTABLISHED IN CONFORMITY WITH THE RECTANGULAR SYSTEM OF SURVEYING," page 72, prior to the execution of new surveys under the methods prescribed by the article entitled "METHODS OF EXECUTING NEW SURVEYS, WHEN INITIATED FROM OR CLOSED UPON DEFECTIVE OLD SURVEYS," page 75, and illustrated on Plate VII, by figures 1 to 15; on Plate VIII, figures 1 to 7, and on Plate IX.

In order to prevent any misunderstanding relative to the *modus operandi* indicated by the terms "retracement" and "resurvey," the following definitions of the same are here presented:

The *retracement* of a township boundary, or other line of survey, consists in the determination of the true bearings and distances between the successive corners along the entire length of such a line; and the data thus obtained will be embodied in the field notes together with detailed particulars of the methods employed.

The *resurvey* of a township boundary or other line of survey consists of a retracement of such a line accompanied by the reconstruction of defective original corners and the establishment thereon of all the necessary new corners, and the detailed particulars of the entire operation will be embodied in the field notes.

DEFINITIONS OF DEFECTIVE TOWNSHIP BOUNDARIES.

1. Upon retracement thereof, an old township boundary may be found to be defective in one or all of three qualifications, viz: *alinement*, *measurement*, and *position*, as follows:

2. In *alinement;* when any portion thereof deviates more than twenty-one minutes of arc from a true meridian or latitude line.

3. In *measurement;* in the case of a meridional line, or a *latitudinal* line which is identical with a standard parallel; when its length is greater or less than six miles by more than three chains; or when the length of any portion thereof between two successive corners, is greater or less than forty chains; excepting that portion between the last established corner and the limiting line, which may be greater or less than forty chains, when such a boundary has been closed upon the bank of a meanderable body of water, a military or Indian reservation, or State boundary, etc., as the case may be.

4. In *measurement;* in the case of a *latitudinal* line *not* identical with a portion of a standard parallel; when its length is greater or less than *six miles minus the proper correction for convergency*, by more than three chains; or when the length of any portion thereof between two successive corners is greater or less than forty chains; except, when such a boundary has been run as a *true line* to an intersection with any line of limitation, that portion thereof, between the last established subdivisional corner and the limiting line, may be greater or less than forty chains; and also, when it has been established in the regular manner, i. e. by random and true lines, that portion thereof in which the fractional measurement was originally allowed for may be greater or less than forty chains.

5. In *position;* when the corners originally established on such a boundary can not be connected with the corners on the opposite regularly established boundary, by lines which *do not* deviate more than twenty-one minutes of arc from true meridian or latitude lines.

6. The limits prescribed in the foregoing paragraphs are to be considered *only* in determining the necessity of *resurveying* old township boundaries when new surveys are to be initiated from or closed upon the same, *and will not be construed in any way as establishing limits of allowable error in the execution of new surveys.*

RETRACEMENT OR RESURVEY OF TOWNSHIP LINES AND LINEAR BOUNDARIES NOT ESTABLISHED IN CONFORMITY WITH THE RECTANGULAR SYSTEM OF SURVEYING.*

If in subdividing a township, it is found that any boundary thereof is defective in excess of the limits of allowable error prescribed in the article entitled "Definitions of Defective Township Boundaries," above, or that the corners originally established thereon had been incorrectly marked, or have been obliterated, the deputy surveyor will resurvey so much of said boundaries as may be necessary, as follows:

1. When subdivisional lines have *not* been closed upon either side of, or mineral claims tied to, a township boundary, it will be corrected (if necessary), in point of alinement, as well as measurement, by establishing regular new corners at lawful distances (*minus the northing or plus the southing of the south boundary; or minus the westing or plus the easting of the east boundary*), from said boundaries respectively (as the case may be), upon a right line connecting the proper township corners,

* Regarding permission to resurvey, see page 224.

provided said line *does not* deviate more than twenty-one minutes of arc from a true meridian or latitude line (as the case may be). (See Plate VII, figs. 1, 2, 3.)

But, if the bearing of said line exceeds the limit prescribed above, the new corners will be placed on a line run *due north or west*, from the southeast corner of the township, to intersection with the township or range line (as the case may be), where a closing corner will be established, and the old township corner properly changed to a corner common to two townships.

The old corners on all township boundaries rectified under the provisions of this paragraph will be destroyed. (See Plate VII, figs. 4 and 5.)

2. Where subdivisional lines *have* been closed upon one side of, or mineral claims tied to, a township boundary prior to the subdivision of the township on the other side, *its alinement will not be changed;* all obliterated old corners will be *reëstablished in* their original places; new regular corners common to two townships, sections, or quarter sections, will be established upon it at lawful distances, *minus the northing or plus the southing of the south boundary; or minus the westing or plus the easting of the east boundary*, from said boundaries respectively (as the case may be), marked with reference to the township being subdivided, and the marks on the old corners upon such boundary which refer to the new work will be effaced.

Marks on bearing trees will be corrected (if necessary) to indicate the township, range, and section in which they stand, but the pits and mounds will remain as originally established. (See Plate VII, figs. 6 and 7.)

3. Where subdivisional lines *have* been closed upon one side of, or mineral claims tied to, the northern portion of a range line prior to the subdivision of the township on the other side (see paragraph 2), while upon the southern portion of the same such attachments have not been made on either side (see paragraph 1), said southern portion will be resurveyed and proper new corners established thereon, at lawful distances from the south boundary, as follows:

If the bearing of said *southern* portion *does not* deviate more than twenty-one minutes of arc from a true meridian line, it will be rectified under the provisions of the first clause of paragraph 1, and the rectifications will be continued on the *northern* portion under the provisions of paragraph 2. (See Plate VII, fig. 8.)

If, however, said bearing exceeds the specified limit, from the northern terminal corner of said southern portion, the range line will be extended *due south on a random* to its intersection with the south boundary where a corner common to two townships will be established, all the necessary changes made in the markings on the original corner common to four townships situated in its immediate vicinity, and regular new corners placed upon the respective portions of the entire range line as specified in the foregoing clause. (See Plate VII, fig. 9.)

Similar cases involving the rectification of the northern portion of a range line when the southern portion of the same can not be rectified in bearing, will be treated in conformity with the rules prescribed in the foregoing clauses, with the exception, that where such northern portion deviates more than twenty-one minutes of arc from a true meridian line, its alinement will be rectified by extending the same from its southern terminal corner, due north on a true line to its intersection with the north boundary, where a proper closing corner will be

established and the necessary corrections applied to the old corner common to four townships in its immediate vicinity, so as to change it to a corner common to two townships. (See Plate VII, figs. 10, 11, and 12.)

In the treatment of *latitudinal* township lines the rule prescribed in the foregoing clauses will be applied, observing, however, that the stated designations *north* or *south* will correspond in such cases to *west* or *east*, respectively.

4. When subdivisional lines have been closed upon one or both sides of, or mineral claims tied to, the northern and southern portions of a range line, while the middle portion thereof is free from such attachments, said portion will be resurveyed and new regular corners will be established thereon at intervals of forty chains from its southern terminal corner, upon a right line connecting the original terminal corners thereof, the fractional measurement being thrown against the northern terminal corner. (See Plate VII, figs. 13, 14, and 15.)

In such cases all the original corners, excepting the terminal corners, of the portion of the lines thus resurveyed, will be destroyed.

The rectification of the middle portions of latitudinal township lines, on which the conditions specified above obtain, will be executed in a similar manner, observing, however, that the designations *north* or *south* in the foregoing clauses will in such cases correspond to *west* or *east*, respectively.

5. Under the foregoing paragraphs, the fact that mineral claims have been tied to a defective township boundary as therein specified, will act as a bar to the rectification of such a boundary in alinement, only when the number of claims involved is great; while in cases where a few such claims have been connected with a few of the corners on such a boundary, said boundary will be rectified in alinement and new corners placed thereon, care being taken, however, to perpetuate in a proper manner such old corners as are found to be connected with the claims; and the methods employed to accomplish the same, together with the bearings and distances of such old corner from the new, will be briefly and accurately recorded in the field notes.

New corners on defective township boundaries must be established by an actual survey of such lines, and in no case will such corners be established from data acquired in running lines closing upon the same.

In the retracement or resurvey of base lines, standard parallels, principal meridians and guide meridians, two sets of chainmen will be employed, while for similar work on township lines, not of the character specified above, only one set of chainmen is required, and in cases where conditions such as specified in paragraph 2 obtain, the bearings and distances between successive old corners and the connections of all new corners with the nearest old corners will be carefully determined and recorded in the field notes.

When township or subdivisional lines intersect the boundaries of confirmed private land claims, or any other linear boundaries established at variance with the rectangular system of surveying, as much of said boundaries will be retraced as may be necessary, temporary stakes being set at intervals of *ten chains* thereon, and also at each angle formed by a change in the direction of the same.

All obliterated boundary corners will be reëstablished in their original places, and the regular surveys will be closed upon the retraced line as prescribed for "closings" in the last clause of par. 5, page 55.

NOTE.—Regarding restoration of lost corners, by *private* and *county* surveyors, see page 224.

METHODS OF EXECUTING NEW SURVEYS, WHEN INITIATED FROM OR CLOSED UPON OLD SURVEYS, AND EXPLANATION OF FIGURES ON PLATE VII.

Such methods are illustrated by the several figures on Plate VII, the rectification of the lines of *old* surveys, and the establishment of *new* township exterior and subdivisional lines connected with such old lines, being based upon the rules prescribed in the article entitled "Retracement or Resurvey of Township Lines," &c., page 72.

In considering the several cases, the probable obtaining conditions relative to a *range line* have been adopted in order to reduce the number of figures on said plate, and, to curtail also as much as practicable, the amount of reiterative verbal explanations; it being definitely understood, however, that whatever conditions may obtain relative to a *latitudinal line* similar to those illustrated and explained *in extenso* in the cases relative to the *range line*, the necessary rectifications will be made by the application of similar methods, subject, however, to the proper modifications due to the difference in the direction of the respective lines.

The character of such modifications, when not obvious, are expressed in detail under the various clauses of the several paragraphs of the article on retracements referred to above.

It will also be clearly understood that, in order to avoid unnecessary structural complications, the figures on Plate VII exhibit only the positions of township and section corners after rectification, while in actual practice the quarter section corners will also be properly affected.

Fig. 1. The *east* boundary is assumed as *irregular in bearing* and *defective in measurement;* the township corners on the same, however, being susceptible of connection by a line *not* deviating more than twenty-one minutes of arc from a true meridian line.

It will be rectified under the rules prescribed by clause 1, paragraph 1, while from the proper corners the *west* and *north* boundaries will be established in the regular manner, as well as the subdivisions within the exteriors thus rectified and established.

Fig. 2. The *east* boundary *defective in measurement.* It will be rectified under clause 1, paragraph 1, while the *west* and north boundaries will be established, and the subdivisions executed in the regular manner.

Fig. 3. The *east* boundary *defective in position.* Since the south boundary deviates from a true east and west line by *more* than twenty-one minutes of arc, said *east* boundary will be rectified under clause 1, paragraph 1; the *west* and *north* boundaries will be established in the regular manner; and the subdivisions will be executed from *north* to *south*, and from *east* to *west*, commencing at the corner to sections 1, 2, 35, and 36, and closing the fractional measurements on the *south* and *west* boundaries, as such closings are made in regular subdivisions on the north and west boundaries.

Fig. 4. The *east* boundary *defective in alinement.* It will be rectified under clause 2, paragraph 1; while the *west* and *north* boundaries will be established, and the subdivisions executed, in the regular manner.

Fig. 5. The east boundary *defective in alinement* and *measurement.* It will be rectified under clause 2, paragraph 1; the *west* boundary will be rectified in the regular manner, while from the corner common to two townships on the rectified east boundary, the *north* boundary will be run west on random and east on true line, permanent corners

common to sections and quarter sections of the township to be subdivided being established on the same.

The subdivisions will be executed in the regular manner.

Fig. 6. The *south* and *east* boundaries being *defective in alinement*, *measurement*, and *position*, will be rectified under clause 1, paragraph 2; the *west* boundary will be established in the regular manner, and the *north* boundary by *east on random*, and west on true line, throwing the fractional measurement against the old east boundary; while the subdivisions will be executed from *north to south*, and from *west to east*, commencing at the corner to sections 5, 6, 31, and 32, and closing the fractional measurements on the old *south* and *east* boundaries, as such closings are made in regular subdivisions on the north and west boundaries.

Fig. 7. The *north*, *south*, *east* and *west* boundaries being defective in *alinement*, *measurement*, and *position*. The *south* and *east* boundaries will be rectified under clause 1, paragraph 2; while the *west* and *north* boundaries will be retraced for length and bearing, any obliterated old corners being reëstablished in their original places.

The subdivisions will be executed as follows:

From the corners to sections 35 and 36, and 25 and 36, the lines between said sections will be extended due north and west, respectively, to their mutual intersection, where the corner to sections 25, 26, 35 and 36, will be established.

From said corner, the line between sections 26 and 35, 27 and 34, 28 and 33, 29 and 32, and 30 and 31 will be projected due west on a true line to its intersection with the west boundary of the township, where a closing corner will be established.

A line thus established is termed a Sectional Correction Line; and when such an auxiliary line, thus projected, intersects its objective limiting line in such proximity to its objective corner that the accessories of the two corners would interfere, that portion of the auxiliary line situated between the last-established section corner and the limiting line will be changed in alinement to close upon the corner found, thus avoiding placing two corners in close proximity.

From the initial point of the *sectional correction line*, which, in this case, is the corner to sections 25, 26, 35, and 36, the line between sections 25 and 26, 23 and 24, 13 and 14, 11 and 12, and 1 and 2, will be projected *north on a true line* to its intersection with the north boundary, where a closing corner will be established. A line thus established is termed a SECTIONAL GUIDE MERIDIAN.

South of the sectional correction line, and east of the sectional guide meridian, the subdivisions will be closed upon the south and east boundaries by random and true lines, throwing the fractional measurements against the same, as such closings are made in regular surveys on the north and west boundaries; while that portion of the township situated to the north and west respectively, of said auxiliary lines, will be subdivided in the regular manner, the parallelism of the latitudinal section lines being referred to the sectional correction line, and that of the meridional section lines to the sectional guide meridian.

Closings on the west and north boundaries will be made by random and true lines, when the fallings are less than 50 links per mile, and by true lines run to closing corners when the fallings exceed said limit.

Fig. 8. The *east* boundary *defective in measurement*, the *northern portion* of the same being unchangeable, while the southern portion admits of rectification.

The east boundary will be rectified under clause 2, paragraph 2, the

west and *north* boundaries will be established, and the subdivisions executed, in the regular manner.

Fig. 9. The *east* boundary defective in *alinement* and *measurement*, the *northern portion* thereof being unchangeable, while the *southern portion* of the same admits of rectification.

The *east* boundary will be rectified under clause 3, paragraph 3, the *south* boundary, under clause 1, paragraph 2; the *west* boundary will be established in the regular manner; while the north boundary will be run *east* on random, and west on true line, throwing the fractional measurement against the *east* boundary.

The subdivisions will be executed from *south* to *north*, and from *west* to *east*, closing the fractional measurements on the *north* and *east* boundaries, as such closings are made in regular surveys, on the north and west boundaries.

Fig. 10. The *east* boundary *defective in measurement*, the *southern portion* thereof being unchangeable, while the northern portion admits of rectification.

The *east* boundary will be rectified under clause 4, paragraph 3; while the *west* and *north* boundaries will be established, and the subdivisions executed in the regular manner.

Fig. 11. The *east* boundary defective in *alinement* and *measurement*, the *southern portion* thereof being unchangeable, while the *northern portion* admits of rectification.

The east boundary will be rectified under clause 4, paragraph 3; the *west* boundary will be established in the regular manner; the *north* boundary by east on true line to closing corner, the fractional measurement being thrown against the old east boundary; while the subdivisions will be executed from *north to south*, and from *west* to *east*, the fractional measurements being thrown against the old *south* and *east* boundaries, as such closings are made in regular surveys against the north and west boundaries.

Fig. 12. The *east* boundary *defective in measurement*; the *northern and southern portions* thereof being unchangeable, while the middle portion admits of rectification.

The *east* boundary will be rectified under clause 1, paragraph 4, the *west* and *north* boundaries will be established, and the subdivisions executed in the regular manner.

Fig. 13. The *east* boundary defective in *alinement* and *measurement;* the *northern and southern portions* thereof being unchangeable; while the middle portion admits of rectification.

The *east* boundary will be rectified under clause 1, paragraph 4; the *west* boundary will be established in the regular manner; the *north* boundary by *east on random* and west on true line, the fractional measurement being thrown against the old east boundary; while the subdivisions will be executed from *north to south* and from *west to east*, closing the fractional measurements against the old south and *east* boundaries, as such closings are made in regular surveys against the *north* and *west* boundaries.

Fig. 14. The *east* boundary defective in *alinement* and *measurement;* the *northern* and *southern portions* thereof not admitting of rectification in any way, since subdivisional surveys have been closed upon *both sides* of the same; while the middle portion admits of rectification in *measurement.*

The *east* boundary will be rectified under clause 1, paragraph 4; the *west* boundary will be established in the regular manner, the township corner at the end of six miles thereon being *temporarily* established.

From said temporary corner, the *fractional north* boundary will be run *east on random* to the nearest old established corner on the same, at which point if the falling of the random is *within 50 links per mile*, said boundary will be corrected westward on true line, setting corners common to the sections and quarter sections on the *north*, at regular intervals from the initial point of the true line, and throwing the consequent fractional measurement in its normal place against the *new west* boundary, while the temporary township corner previously established thereon will be made permanent.

If, however, the falling defined above exceeds the stated limit from the last established corner of the old surveys, the fractional north boundary will be projected *due west* to its intersection with the west boundary, at which point the proper township corner will be permanently established, and the temporary corner *destroyed.*

In establishing the corners on said north boundary under the latter procedure, the requirements prescribed in the former relative to the allowance for fractional measurement will be strictly observed.

In subdividing, the methods prescribed under Fig. 6 will be applied as far as practicable. The details of the case under consideration are clearly exhibited by fig. 14.

Fig. 15. All of the boundaries are assumed to be defective in *alinement*, *measurement*, and *position;* also portions of each as being closed upon by subdivisional surveys and consequently unchangeable relative to the old surveys, while other portions of the same being free from such attachments, admit of rectification.

This figure is constructed on a larger scale than those explained in the preceding paragraphs, in order to illustrate in detail the *modus operandi* to be pursued in rectification, under the rules of the article on retracements applicable to each of the obtaining conditions, and also in subdividing within the rectified exteriors.

HIATUSES AND OVERLAPS.

[Plate VIII.]

The several figures on Plate VIII illustrate in detail the methods to be employed in connecting the unsurveyed portions of two or more township boundaries, when four of such fractional lines, upon being projected towards each other in the direction of the cardinal points by lines not deviating more than twenty-one minutes of arc from true meridian or latitudinal lines, do not form a common intersection.

Said methods, in addition to the reasons embodied in the article entitled "Explanations of Articles," etc., page 71, are based upon the following desiderata, viz:

1. The adjustment of such township boundaries so as to maintain section 36 in a condition theoretically and practically perfect, according to the requirements of the rectangular system of surveying.

2. That in accomplishing the above, the resultant fractional excess or deficiency (which for brevity of explanation is termed "the rectangular fraction") will be thrown into, or taken out of section 6, whenever practicable.

3. That all incidental fractional measurements developed in the establishment of township boundaries or subdivisional lines by such methods shall be thrown against the old surveys whenever practicable.

In considering said methods it will be observed that the conditions

to be dealt with are either hiatuses or overlaps, the former possessing three characteristic features, which are named as follows:

Simple hiatus. See figures 1 and 2.

Meridional hiatus. See figure 3.

Latitudinal hiatus. See figure 4; while overlaps are shown by figure 5.

As the application of said methods, when the conditions exhibited obtain, gives similar results with but a few exceptions, which will be specifically detailed hereafter, the condition represented by A, figure 3, will be considered and the method of connection described as an example, upon the following assumptions, viz:

That, of the boundaries of townships 1 and 2 north, ranges 3 and 4 west, those portions indicated by broken lines *are unsurveyed;*

That it is required to connect said portions in order to complete the subdivisions in one or more of the townships.

Beginning at the established terminal corners on the *south* and *east* boundaries of T. 2 N., R. 4 W., *blank* lines will be projected due east and due south, respectively, with temporary stakes at intervals of ten chains, to an intersection, which point will be marked by a temporary stake;

Then, from the established terminal corners on the *west* and *north* boundaries of T. 1 N., R. 3 W., *true* lines will be projected due north and due west, respectively, with regular corners for two sections and quarter sections, to an intersection, which point will be marked by a temporary stake;

Then, by proper measurements, the character of the resulting condition will be determined, and by comparison with diagrams A, of the figures on Plate VIII, the particular method of connection will be obtained and applied.

Said condition in the case under consideration, it will be observed, is a "*meridional hiatus*"; therefore, from the temporary stake marking the intersection of the extended south and east boundaries of T. 2 N., R. 4 W., which will be replaced by a permanent corner (common to two townships) for T. 1 N., R. 3 W., and T. 2 N., R. 4 W., the south boundary of the latter will be extended due east to its intersection with the west boundary of the former, where a corner for (one township only) T. 1 N., R. 4 W., will be permanently established;

Then, from the corner for T. 1 N., R. 3 W., and T. 2 N., R. 4 W., the south and east boundaries of the latter will be corrected back west and north, respectively, on true lines, establishing regular corners common to two quarter sections and sections of said township, to the initial points of the blank lines, against which the resulting fractional measurements will be thrown, while the stakes temporarily established on the blank lines at intervals of ten chains will be destroyed;

Then, from the stake temporarily marking the intersection of the north and west boundaries of T. 1 N., R. 3 W., which will be destroyed, the former boundary will be extended due west to its intersection with the east boundary of T. 2 N., R. 4 W., where a proper closing corner will be established, the resulting fractional measurement thrown against the same, and the distance to the nearest corner on said boundary carefully determined and recorded in the field notes.

Thus section 36 is made *full*, serving as a perfect base from which to initiate the subdivisional work in T. 2 N., R. 4 W.; the "rectangular fraction," which in this case indirectly represents an excess, is incorporated in section 6, which being lotted on two sides in its normal con-

dition, absorbs the excess without deranging materially those portions of the same usually defined as regular subdivisions; while the unsurveyed portions of the entire group of townships are arranged in such a manner as to admit of completing the subdivisional work therein on the approved rectangular basis.

Relative to incorporating an excess in, or supplying a deficiency from, section 6, *simple hiatuses* are noted as exceptions to the general rule; therefore, when such hiatuses are square, or longer meridionally (see 1, diagrams A, fig. 1), the "rectangular fraction" will be taken out of section 31, and incorporated in section 1; but if the length thereof (see 1, diag. A, fig. 2) lie in a latitudinal direction, said "rectangular fraction" will be taken out of section 1 and incorporated in section 31.

If the surveys contemplated, within a group of four townships, consist of the completion of the southeast unsurveyed portion of the northwest township only, the method detailed in the foregoing paragraphs will be employed in all particulars, with the exception that the extension of the north and west boundaries of the southeast township will be omitted; but the completion of the unsurveyed portions of any of the other three demands of the deputy surveyor the performance of the whole operation, and the complete connection of all the boundaries.

When, of four township boundaries whose directions tend to an approximate common point, two of the same have been carried to a mutual intersection, and are closed upon by subdivisional and other lines (see paragraph 2, article on "Retracements," etc.,) the unsurveyed portion of the remaining boundaries will be connected with them by the application of these methods, sufficiently modified to preserve intact the prior subdivisional surveys.

FRAGMENTARY SUBDIVISION.

Plate IX illustrates the general methods to be employed in the execution of fragmentary subdivisions within townships, portions of which have been subdivided from fractional township boundaries extended from various directions and not connected with each other.

These conditions obtain to a large extent in mountainous regions, where in accordance with the existing provisions, relative to the survey of agricultural lands, in the acts of Congress making appropriations for public land surveys, such surveys are extended along the valley and bottom lands, leaving the mountainous areas unsurveyed at the time of the execution of the original work; but which, at a later date, in view of other considerations are placed under contract for survey.

It is obvious that the number and character of such cases would be too great and varied to be considered in detail; therefore, when the deputy surveyor meets with a case which is not covered exactly by these instructions, or the special instructions from the surveyor general, his thorough understanding of the preceding articles on this subject, and of the conditions illustrated on Plates VI and VIII, it is expected will point out to him the proper method to be employed.

It is possible, however, that cases may arise so complex in their character as to produce a feeling of doubt relative to the proper solution of the problem; in which case he will at once communicate with this office through the surveyor general, submitting information, by *letter* and *diagrams*, of the exact condition as found by him, and the necessary instructions will be forwarded as soon as practicable.

NOTE.—A quarter section is held to be surveyed only when three of its corners have been officially established.

GEOGRAPHICAL POSITIONS OF BASE LINES AND PRINCIPAL MERIDIANS GOVERNING THE PUBLIC SURVEYS.

The system of rectangular surveying, authorized by law May 20, 1785, was first employed in the survey of United States public lands in the State of Ohio.

The boundary line between the States of Pennsylvania and Ohio, known as "Ellicott's line," in longitude 80° 32′ 20″ west from Greenwich, is the meridian to which the first surveys are referred. The *townships* east of the Scioto River, in the State of Ohio, are numbered from south to north, commencing with No. 1 on the Ohio River, while the *ranges* are numbered from east to west, beginning with No. 1 on the east boundary of the State, *except* in the tract designated "U. S. military land," in which the townships and ranges are numbered, respectively, from the south and east boundaries of said tract.

During the period of one hundred and nine years since the organization of the system of rectangular surveying, numbered and locally named principal meridians and base lines have been established, as follows:

The first principal meridian begins at the junction of the Ohio and Big Miami rivers, extends north on the boundary line between the States of Ohio and Indiana, and roughly approximates to the meridian of longitude 84° 48′ 50″ west from Greenwich. The ranges of the public surveys in the State of Ohio, west of the Scioto River, are, in part, numbered from this meridian. For further information in regard to numbering of townships and ranges of the early surveys in Ohio, the reader is referred to the State map prepared in the General Land Office.

The second principal meridian coincides with 86° 28′ of longitude west from Greenwich, starts from a point two and one-half miles west of the confluence of the Little Blue and Ohio rivers, runs north to the northern boundary of Indiana, and, with the base line in latitude 38° 28′ 20″, governs the surveys in Indiana and part of those in Illinois.

The third principal meridian begins at the mouth of the Ohio River and extends north to the northern boundary of the State of Illinois, and with the base line in latitude 38° 28′ 20″, governs the surveys in the State *east* of the third principal meridian, with the exception of those projected from the *second principal meridian*, and the surveys on the *west*, to the Illinois River. This meridian is nearly coincident with 89° 10′ 15″ of west longitude from Greenwich.

The fourth principal meridian begins at a point on the right bank of the Illinois River, in latitude 40° 00′ 30″ north, and longitude 90° 28′ 45″ west from Greenwich, and with the base line running west from the initial point, governs the surveys in Illinois west of the Illinois River and west of that part of the *third* principal meridian which lies north of the river.

The fourth principal meridian also extends north through Wisconsin and northeastern Minnesota, and, with the south boundary of Wisconsin as its base line, governs all the surveys in the former and those in the latter State lying east of the Mississippi River, and the third guide meridian west (of the fifth principal meridian system), north of the river.

The fifth principal meridian starts from the old mouth of the Arkansas River, and with the base line running west from the old mouth of the St. Francis River, governs the surveys in Arkansas, Missouri, Iowa, North Dakota; those in Minnesota, west of the Mississippi River and west of the third guide meridian north of the river; and in South Dakota

all east of the Missouri River, and the surveys on the west side of the river to a limiting line following the third guide meridian (of the sixth principal meridian system), White River, and the west and north boundaries of the Lower Brulé Indian Reservation. This meridian is nearly coincident with 91° 03′ 42″ longitude west from Greenwich.

The sixth principal meridian, which is approximately the meridian of 97° 23′ west longitude from Greenwich, extends from the base line coincident with the north boundary of Kansas in latitude 40° north, *south* through the State to its south boundary, in latitude 37° north, and *north* through Nebraska to the Missouri River; and governs the surveys in Kansas and Nebraska; the surveys in Wyoming, except those referred to the *Wind River meridian* and base line, which intersect in latitude 43° 01′ 20″ north, and longitude 108° 48′ 40″ west from Greenwich; the surveys in Colorado, except those projected from the *New Mexico* and *Ute meridians*, the latter intersecting its base line in latitude 39° 06′ 40″ north and longitude 108° 33′ 20″ west from Greenwich; and the surveys in South Dakota extended, or to be extended, over the tract embracing the Pine Ridge and Rosebud Indian reservations.

In addition to the above mentioned *numbered* principal meridians, other principal meridians with *local names* have been established, as follows:

The Michigan meridian, in longitude 84° 22′ 24″ west from Greenwich, with a base line in latitude 42° 26′ 30″ north (eight miles north of Detroit), governs the surveys in Michigan.

The Tallahassee meridian, in longitude 84° 16′ 42″ west from Greenwich, runs north and south from the initial point on the base line at Tallahassee, in latitude 30° 28′ north, and governs the surveys in Florida.

The Saint Stephens meridian, in longitude 88° 02′ west from Greenwich, begins at the initial point (Ellicott's corner), on the base line, in latitude 31° north, extends south to Mobile Bay and north to latitude 33° 06′ 20″, and governs the surveys in the southern district of Alabama, and in Pearl River district lying east of the river and south of the Choctaw base line, in latitude 31° 52′ 40″ north, in the State of Mississippi.

The Huntsville meridian begins on the northern boundary of Alabama, in latitude 34° 59′ north, longitude 86° 34′ 45″ west from Greenwich, extends south to latitude 33° 6′ 20″ north, and governs the surveys in the northern district of Alabama.

The Choctaw meridian begins on the Choctaw base line, latitude 31° 54′ 40″ north, longitude 90° 14′ 45″ west from Greenwich, runs north to the south boundary of the Chickasaw cession, in latitude 34° 19′ 40″ north, and governs the surveys east and west of the meridian, and north of the base line.

The Chickasaw meridian begins on the north boundary of Mississippi in latitude 34° 59′ north, longitude 89° 15′ west from Greenwich, extends south to latitude 33° 48′ 45″ north, and governs the surveys in north Missisippi.

The Washington meridian begins on the base line in latitude 31° north, longitude 91° 9′ 15″ west from Greenwich, extends *north* to the Mississippi River, and governs the surveys in the southwestern angle of the State of Mississippi.

The Saint Helena meridian begins at the initial point of the *Washington meridian*, in latitude 31° north, and longitude 91° 09′ 15″ west of Greenwich, extends *south* to the Mississippi River, and governs the sur-

veys in the Greensburg and southeastern districts of Louisiana, east of the Mississippi River.

The Louisiana meridian, in longitude 92° 24′ 15″ west of Greenwich, extends from the Gulf of Mexico to the north boundary of Louisiana, and, with the base line through the initial point, conforming to the parallel of 31° north latitude, governs all the surveys in the state west of the Mississippi River.

The New Mexico meridian, in longitude 106° 53′ 40″ west from Greenwich, extends through the Territory, and with the base line, in latitude 34° 15′ 25″ north, governs the surveys in New Mexico, *except* those in the northwest corner of the territory, referred to *Navajo meridian* and base line, which have their initial point in latitude 35° 45′ north, longitude 108° 32′ 45″ west from Greenwich.

The Salt Lake meridian, in longitude 111° 54′ 00″ west from Greenwich, has its initial point at the corner of Temple Block, in Salt Lake City, Utah, extends north and south through the Territory, and, with the base line, through the initial, and coincident with the parallel of 40°, 46′ 04″ north latitude, governs the surveys in the Territory, except those referred to the *Uintah meridian* and base line projected from an initial point in latitude 40° 26′ 20″ north, longitude 109° 57′ 30″ west from Greenwich.

The Boisé meridian, longitude 116° 24′ 15″ west from Greenwich, passes through the initial point established south 29° 30′ west, nineteen miles distant from Boisé City, extends north and south through the State, and, with the base line in latitude 43° 46′ north, governs the surveys in the State of Idaho.

The Mount Diablo meridian, California, coincides with the meridian of 121° 54′ 48″ west from Greenwich, intersects the base line on the summit of the mountain from which it takes its name, in latitude 37° 51′ 30″ north, and governs the surveys in the State of Nevada, and the surveys of all central and northern California, *except* those belonging to the Humboldt meridian system.

The Humboldt meridian, longitude 124° 8′ west from Greenwich, intersects the base line on the summit of Mount Pierce, in latitude 40° 25′ 12″ north, and governs the surveys in the northwestern corner of California, lying west of the Coast range of mountains, and north of township 5 south, of the *Humboldt meridian system*.

The San Bernardino meridian, California, longitude 116° 56′ 15″ west from Greenwich, intersects the base line on Mount San Bernardino, latitude 34° 07′ 10″ north, and governs the surveys in southern California, lying *east* of the meridian, and that part of the surveys situated *west* of it which is *south* of the eighth standard parallel south, of the *Mount Diablo meridian system*.

The Willamette meridian, which is coincident with the meridian of 122° 44′ 20″ west from Greenwich, extends *south* from the base line, in latitude 45° 31′ north, to the north boundary of California, and *north* to the international boundary, and governs all the public surveys in the States of Oregon and Washington.

The Black Hills meridian, longitude 104° 03′ west from Greenwich, with the base line in latitude 44° north, governs the surveys in the State of South Dakota, north and west of White River, and west of the Missouri River (between latitudes 45° 55′ 20″ and 44° 17′ 30″), the north and west boundaries of the Lower Brulé Indian Reservation, and the west boundary of range 79 west, of the fifth principal meridian system.

The Montana meridian extends north and south from the initial

monument on the summit of a limestone hill, eight hundred feet high, longitude 111° 38′ 50″ west from Greenwich, and with the base line on the parallel of 45° 46′ 48″ north latitude, governs the surveys in the State of Montana.

The Gila and Salt River meridian intersects the base line on the south side of Gila River, opposite the mouth of Salt River, in latitude 33° 22′ 40″ north, longitude 112° 17′ 25″ west from Greenwich, and governs the surveys in the Territory of Arizona.

The Indian meridian, in longitude 97° 14′ 30″ west from Greenwich, extends from Red River to the south boundary of Kansas, and with the base line in latitude 34° 30′ north, governs the surveys in the Indian Territory, and in Oklahoma Territory all surveys *east* of 100° west longitude from Greenwich.

The Cimarron meridian, in longitude 103° west from Greenwich, extends from latitude 36° 30′ to 37° north, and with the base line in latitude 36° 30′ north, governs the surveys in Oklahoma Territory *west* of 100° west longitude from Greenwich.

DECLINATION OF THE MAGNETIC NEEDLE

For the following article, with tables, charts, and their explanation, relating to the use of the compass in surveying, the Commissioner of the General Land Office is indebted to Dr. T. C. Mendenhall, Superintendent of the U. S. Coast and Geodetic Survey. It was furnished at the request of the Commissioner.

The paper, originally written in 1878 by Assistant C. A. Schott, chief of the computing division, has been revised and enlarged by him in order to present the latest information on the subject in possession of the C. and G. Survey, June, 1893. It is also accompanied by three charts taken from the C. and G. Survey report for 1889 and amended to date; they show the distribution of the magnetic declination for the year 1890, and in connection with the tables, for any year within their range.

This paper takes the place of the chapter commencing at the foot of page 25 and ending in the middle of page 29 of the "Manual of Instructions to Surveyors General of the United States" printed in 1871, part of which in the course of time had become obsolete. The present article will be found of great interest and value as an aid in the prosecution of the surveys of the public lands.

AN ACCOUNT OF THE PRESENT GEOGRAPHICAL DISTRIBUTION AND OF THE ANNUAL CHANGE OF THE MAGNETIC DECLINATION WITHIN THE LIMITS OF THE UNITED STATES.*

Introductory remarks.—The magnetic declination at any place is the angle contained between two vertical planes, one being that of the astronomical or true meridian of the place and the other the plane in which the axis of a freely suspended horizontal magnetic needle lies at the time. The former is a fixed plane, the latter is variable, as is shown by the regular or irregular, and the greater or less oscillations of a needle when delicately suspended; these fluctuations are subject to different laws depending on geographical position. Since the magnetic

* Commonly known as the *variation* of the compass; in scientific treatises on terrestrial magnetism the term magnetic *declination* is always employed, in order to avoid any confusion which would arise when treating of such motions of the needle as the diurnal, annual, and secular variations.

declination is found to vary with respect to place and time, it is necessary on the part of the observer to give with his statement of the declination the geographical position or the latitude and longitude* of his station (expressed to the nearest minute of arc will suffice in general), and to accompany the record by the local time when the observation was made; the nearest hour (or quarter of an hour) should be stated, also whether sidereal time, mean time, local, or standard time is used.

The declination is called "west" when the north-seeking end of the magnet or needle points to the westward of the true meridian, and is called "east" when the same end points to the eastward. Roughly speaking, the north end of a needle tends approximately towards the geographical north, or, rather towards a region which surrounds the magnetic pole, situated in the vicinity of King William Land, and supposed to be in about latitude 70½° and longitude 100° W. Here the horizontal needle has lost its directive force, and the dip needle will point vertically up and down; in other words, at the pole the magnetic and gravitational forces agree in direction. The magnetic declination presents great extremes in value within the limits of the United States; thus for the year 1893, we have at Eastport, Me., 19° W.; at the northeastern end of Lake Michigan, at the west end of Lake Erie, and in St. Helena Sound, S. C., 0° (needle pointing due north); at Galveston, Tex., 7⅛° E.; at San Diego, Cal., 13¼° E.; at Cape Flattery, Wash., 23° E.; at Sitka, Alaska, 29° E.; the maximum of 43⅓° E. is reached at the mouth of Firth River, near where the meridional boundary line of 141° strikes the Arctic Ocean; at Bering Strait, the declination has diminished to 21° E., and at the extreme western point of our territory, at Attu Island, it is but 8½° E. The general distribution of the declination (for the given epoch, 1890), is shown by the isogonic charts appended to this manual, taken from the Coast and Geodetic Survey Report for 1889, Appendix No. 11; they are reproduced and amended to bring them up to the present state of our knowledge, and appear here transferred to the new base map of 1893 (scale $\frac{1}{7\,000\,000}$). The third chart referred to appears for the first time in the manual, it represents the magnetic meridians, i. e. lines which show directly the direction of the needle, this being a tangent to the curve at any point in it. These curves, therefore, may be said to represent a physical fact, while the isogonic curves are wholly artificial, but better adapted for practical application. The meridional system converges toward the magnetic pole without any special relation to the geographical pole, whereas in the isogonic system all curves must pass through the latter pole as well. It is a matter of great importance for surveyors to recognize the fact of the local deviations from the general trend of the isogonic lines; these local irregularities of the distribution are more conspicuous in regions of igneous rocks, but they appear also in regions of sedimentary deposits, the intensity of the disturbance depending on that of the local cause and its depth below the surface. The disturbing local poles or ridges are in general of the same polarity as that of the north magnetic pole. Disturbed regions may range from a fraction of a square mile to hundreds of square miles, but as yet little has been done in this inviting field for research.

In consequence of the secular variation of the declination the magnetic charts require to be reconstructed from time to time, though for a few years from the date of an isogonic chart the declination for any

* Reckoned from Greenwich westward to 180°.

position can readily be assigned by means of our knowledge of the annual change, which is sufficiently constant for a few years to produce no appreciable error. The secular variation is by far the greatest of the great number of changes in the direction of the needle. Thus at Albany, N. Y., the declination changed from 12° W. in the year 1650 to nearly 5½° W. about the year 1795, and is now again about 10¾° W.; at New York the change was similar; at Baltimore, Md., the declination changed from nearly 6° W. about 1680 to nearly ½° W. in 1802, the present value being near 5° W.; at San Diego, Cal., the declination was about 7⅛° E. in 1710, and is now a little over 13° E.; at Chamisso Island, Kotzebue Sound, Alaska, the declination was 33½° E. in 1750, but is now only 26½° E. The results of the latest investigation of this subject published by the Survey are contained in Appendix No. 7, Coast and Geodetic Survey Report for 1888. What is known as the *annual change* of the declination is nothing else than the effect of the secular variation during one year, and must be carefully distinguished from the *annual variation*, which has but a small range and depends on the season of the year.

The isogonic and magnetic meridian charts.—Referring to the two isogonic charts appended to this article, the larger comprises the compact area of the United States and the smaller one the territory of Alaska. If for any selected epoch we connect by curves all positions at which the needle was observed to have the same given declination, we trace out an isogonic curve for that value of declination. On the charts they are laid down for the equal difference of 1°, with every fifth curve drawn heavier for better distinction, and they answer to the epoch January 1, 1890. For their construction more than 3,200 observed declinations (reduced to epoch) were employed, the latest observation only being used at stations occupied more than once. The isogonic curve of zero declination, also called the agonic line, at which the needle points due north and south, is seen to pass from the island of Michipicoten to the extreme west end of Lake Erie and close to Charleston, S. C., where it leaves the coast and turns toward the Bahama Islands. This curve has been conveniently used as a representative line to mark out the changes which in the course of time the magnetic system in its vicinity undergoes.

On the Atlantic coast it reached its highest position* near Cape Henry, Va., about the year 1800 and has since been moving southward. All localities to the northeast of this line have *west* declination, indicated by a + sign to the index number; localities to the westward of it and comprising the greater part of the United States have now *east* declination, as marked by a negative index. To take up the declination for any given position on this chart, we resort to simple graphical interpolation; it is best done by dropping a perpendicular (curved) from the position to the nearest isogonic on either side of it and measuring the length of the shorter one, also that of the two together; the proportion of the distance with respect to the whole difference of 60′ is readily ascertained. The result answers to the year 1890 (January), and by applying the effect of the annual change, as tabulated further on, the declination may be had for any time before or after that epoch. This annual change is at present manifested by the apparent movement of the isogonic lines to the southward or downward along the Atlantic coast and to the westward or left on the Gulf coast and in the interior to the north of it; on the Pacific coast this movement has

*See Plate No. 25, Appendix No. 7, Coast and Geodetic Survey Report for 1888.

either ceased or is very inconspicuous at present. The charts show two shaded bands, one crossing the northern part of Maine where the direction of the needle has reached a limiting *westerly* position and is about ready to reverse its secular motion; the other band skirts the Pacific coast from Washington to Point Conception, Cal., where it passes out to sea. Here the needle is about stationary at the easterly limit of its grand secular swing. For intermediate points this same condition was reached at corresponding times during the present century.

It will be seen that the irregularities in the local distribution of magnetism can only be brought out and specially delineated by a large addition to the observations so far accumulated.*

The degree of accuracy of the charts depends in the first place on that of the original observation, secondly on that of the change in the interval between observation and epoch, and lastly on the density of observations about the locality or the degree of generalization required in the construction of the curves. The meridional chart has already been sufficiently explained and the additional dip and intensity curves shown on it do not come within the scope of this paper.

The secular variation of the magnetic declination.—This variation, as already pointed out, is a matter of great importance to the surveyor who is frequently called upon to recover or re-run old compass lines or to decide between conflicting claims as to position of old boundary lines originally traced out by compass but lost or obliterated in the course of time. As its name implies, this angular motion extends over so long a period and is so utterly unknown as to its origin that the recognition of its law is a matter of much difficulty and uncertainty. To represent it a periodic function is employed; but from this it should not be inferred that the motion is repeated at stated intervals; on the contrary we are fully aware of the complexity of the phenomenon and of the necessity of continually watching year by year the changes resulting from observations and correcting or remodeling our analytical representations accordingly. It should be fully understood that this process is a wholly tentative one and that the mathematical inferences due to the *form* of the function are not meant thereby to represent or become a physical reality. Thus we are forced to reconstruct our secular change tables at suitable intervals. The period found most in accord with observations is about 250 years with variations of about 50 years longer or shorter, at various stations. This holds only for the United States. The earlier setting in of the secular variation phases in the east and spreading westward over the country has already been referred to; for instance the easternmost position or eastern elongation occurred at places in eastern Maine about the year 1760, this phase reached the Hudson River about 1790, the Mississippi River about 1820, Salt Lake about 1870, and the west coast, as at San Francisco Bay, probably next year or not far from it. Whether this phenomenon will be repeated with the present incoming opposite phase in northern Maine remains to be seen. The results from a discussion of 1,062 observations at 94 stations are given in the following table of decennial values, and after 1850 for 5-year intervals. The average number of observations for each station is 11.

Table of the secular variation of the magnetic declination at stations in the United States, computed by means of periodic functions and based

* The results of any new and satisfactory observation sent to the Superintendent of the Coast and Geodetic Survey will be duly credited in a subsequent publication.

upon all available observations from the earliest to the present time.—The table is subdivided into three groups, viz: Group I comprises the stations located east of the Apalachian Range, and the Atlantic coast from Maine to Florida, inclusive; Group II, the stations situated between the Rocky Mountains and the Apalachian Range, from Canada to the Gulf; Group III contains the stations located between the Rocky Mountains and the Pacific coast, from California to Washington, also those in Alaska. Within each group the stations are arranged in the order of their latitudes.

The tabular values are of various degrees of accuracy, as is indicated by the entry, giving either whole degrees, or degrees and tenths, or degrees, tenths, and hundredths—the latter relatively the most reliable. The results, dating back to the seventeenth century, are in many cases but approximations more or less reliable. *West* declination is indicated by the sign + prefixed, *east* declination by the sign — prefixed. All values for 1900 are mere rough predictions and depend upon the precarious supposition of a continuation of the law implied by the formulæ.

TABLE B.—*Secular Variation of Magnetic Declination—Eastern Group of Stations.*

Year (January 1.)	Eastport, Me.	Bangor, Me.	Burlington, Vt.	Hanover, N. H.	Portland, Me.	Rutland, Vt.	Portsmouth, N. H.	Chesterfield, N. H.	Newburyport, Mass.	Williamstown, Mass.
	°	°	°	°	°	°	°	°	°	°
1600	+19	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	19	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	19	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	18.5	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	18	.....	.....	.....	.....	.....	.....	.....	.....	.....
1650	+17.5	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	17	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	16	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	15	.....	.....	.....	.....	.....	.....	.....	.....	.....
90	14.5	.....	.....	.....	.....	.....	.....	.....	.....	.....
1700	+13.7	.....	.....	.....	+12.1	.....	.....	.....	.....	.....
10	13.0	.....	.....	.....	11.4	.....	.....	.....	.....	.....
20	12.3	.....	.....	.....	10.6	.....	.....	.....	.....	.....
30	11.9	.....	.....	.....	9.9	.....	.....	.....	.....	.....
40	11.6	.....	.....	.....	9.3	.....	.....	.....	.....	.....
1750	+11.4	.....	.....	.....	+8.8	.....	.....	.....	+8.0	+7.5
60	11.4	.....	.....	+6.6	8.41	.....	.....	.....	7.5	6.8
70	11.6	.....	.....	6.1	8.18	.....	+7.8	.....	7.21	6.3
80	12.0	.....	.....	5.7	8.12	+6.8	7.6	.....	7.07	5.9
90	12.6	.....	+7.1	5.6	8.23	6.5	7.5	.....	7.07	5.7
1800	+13.2	+10.8	+7.2	+5.7	+8.50	+6.4	+7.6	.....	+7.26	+5.7
10	14.0	11.4	7.4	6.1	8.92	6.44	7.9	+5.9	7.60	5.9
20	14.8	12.1	7.78	6.6	9.46	6.71	8.3	6.2	8.07	6.3
30	15.6	12.9	8.29	7.3	10.10	7.18	8.87	6.98	8.65	6.8
40	16.4	13.7	8.90	8.1	10.82	7.80	9.55	7.97	9.31	7.4
1850	+17.1	+14.5	+9.58	+9.0	+11.56	+8.55	+10.28	+8.60	+10.02	+8.1
55	17.4	14.9	9.93	9.45	11.92	8.96	10.66	8.86	10.37	8.5
60	17.79	15.3	10.27	9.90	12.29	9.38	11.03	9.16	10.72	8.8
65	18.08	15.6	10.62	10.36	12.64	9.80	11.40	9.59	11.06	9.2
70	18.32	16.0	10.96	10.79	12.97	10.22	11.75	10.09	11.39	9.6
1875	+18.53	+16.27	+11.28	+11.20	+13.29	+10.64	+12.09	+10.59	+11.70	+10.0
80	18.71	16.54	11.58	11.59	13.58	11.05	12.40	11.01	11.99	10.3
85	18.84	16.79	11.86	11.94	13.85	11.44	12.69	11.27	12.25	10.6
90	18.92	16.99	12.11	12.26	14.08	11.80	12.94	11.38	12.48	10.9
95	19.0	17.15	12.3	12.5	14.3	12.1	13.16	11.4	12.7	11.2
1900	+19.0	+17.3	+12.5	+12.8	+14.4	+12.4	+13.3	+11.5	+12.8	+11.4

TABLE B.—*Secular Variation of Magnetic Declination—Eastern Group of Stations—Continued.*

Year (January 1).	Albany, N. Y.	Salem, Mass.	Oxford, N. Y.	Cambridge, Mass.	Boston, Mass.	Provincetown, Mass.	Providence, R. I.	Hartford, Conn.	New Haven, Conn.	Nantucket, Mass.
	°	°	°	°	°	°	°	°	°	°
1600	+10.5	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	11.	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	11.5	.....	.....	.....	.....	+13.	.....	.....	.....	.....
30	11.8	.....	.....	.....	.....	13.	.....	.....	.....	.....
40	12.0	.....	.....	.....	.....	12.8	.....	.....	.....	.....
1650	+12.1	.....	.....	.....	.....	+12.6	.....	.....	.....	.....
60	12.0	.....	.....	.....	.....	12.3	.....	.....	.....	.....
70	11.7	.....	.....	.....	.....	11.85	.....	.....	.....	.....
80	11.3	.....	.....	.....	.....	11.3	.....	.....	.....	.....
90	10.8	.....	.....	.....	.....	10.6	.....	.....	.....	.....
1700	+10.2	.....	.....	+9.8	+10.1	+9.9	.....	.....	.....	+9.1
10	9.5	.....	.....	9.2	9.4	9.2	+10.4	+9.3	.....	8.4
20	8.76	.....	.....	8.7	8.7	8.55	9.5	8.66	.....	7.8
30	8.07	.....	.....	8.2	8.1	7.9	8.8	7.96	.....	7.3
40	7.38	.....	.....	7.82	7.6	7.4	8.4	7.27	.....	6.8
1750	+6.76	+7.8	.....	+7.46	+7.1	+7.0	+7.8	+6.62	+6.8	+6.4
60	6.23	7.1	.....	7.17	6.8	6.7	7.0	6.05	6.1	6.2
70	5.82	6.6	.....	6.96	6.6	6.6	6.3	5.59	5.6	6.1
80	5.55	6.2	.....	6.86	6.5	6.6	6.0	5.27	5.1	6.2
90	5.43	6.1	+3.01	6.90	6.65	6.8	6.2	5.10	4.8	6.4
1800	+5.48	+6.3	+2.96	+7.10	+6.90	+7.2	+6.46	+5.10	+4.7	+6.8
10	5.67	6.6	3.10	7.46	7.29	7.7	6.54	5.26	4.7	7.2
20	6.02	7.2	3.40	7.97	7.78	8.25	6.71	5.58	5.0	7.7
30	6.49	7.9	3.87	8.60	8.37	8.91	7.29	6.02	5.39	8.34
40	7.07	8.7	4.46	9.29	9.01	9.61	8.24	6.59	5.95	8.96
1850	+7.73	+9.64	+5.14	+9.99	+9.67	+10.32	+9.18	+7.24	+6.61	+9.57
55	8.08	10.11	5.51	10.33	10.00	10.67	9.53	7.58	6.97	9.87
60	8.44	10.58	5.89	10.63	10.33	11.00	9.78	7.93	7.35	10.15
65	8.80	11.04	6.26	10.92	10.64	11.31	10.00	8.27	7.72	10.40
70	9.17	11.48	6.65	11.17	10.94	11.61	10.21	8.62	8.10	10.64
1875	+9.52	+11.90	+7.02	+11.40	+11.22	+11.88	+10.47	+8.97	+8.47	+10.86
80	9.87	12.29	7.38	11.59	11.47	12.12	10.79	9.29	8.84	11.04
85	10.21	12.7	7.72	11.74	11.71	12.34	11.17	9.60	9.19	11.19
90	10.52	13.0	8.05	11.85	11.91	12.51	11.56	9.89	9.52	11.31
95	10.82	13.2	8.35	11.9	12.08	12.65	11.9	10.16	9.8	11.4
1900	+11.1	+13.5	+8.6	+12.0	+12.2	+12.8	+12.1	+10.4	+10.1	+11.5

TABLE B.—*Secular Variation of Magnetic Declination—Eastern Group of Stations—Continued.*

Year (January 1).	Cold Spring Harbor, N. Y.	New York, N. Y.*	South Bethlehem, Pa.	Huntingdon, Pa.	New Brunswick, N. J.	Jamesburg, N. J.	Harrisburg, Pa.	Hatboro, Pa.	Philadelphia, Pa.	Chambersburg, Pa.
	°	°	°	°	°	°	°	°	°	°
1600	.....	+8.	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	8.5	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	9.	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	9.5	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	9.6	.....	.....	.....	.....	.....	.....	.....	.....
1650	.....	+9.7	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	9.7	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	9.7	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	9.6	.....	.....	.....	.....	.....	+8.3	.....	.....
90	.....	9.1	.....	.....	.....	.....	.....	8.2	.....	.....
1700	.....	+8.5	.....	.....	.....	.....	.....	+7.9	+8.2	.....
10	.....	7.8	.....	.....	.....	.....	.....	7.5	7.8	.....
20	.....	7.3	.....	.....	.....	.....	.....	7.0	7.4	.....
30	.....	6.8	.....	.....	.....	.....	.....	6.4	6.8	+4.45
40	.....	6.3	+6.1	.....	.....	.....	.....	5.7	6.2	3.83
1750	+5.8	+5.6	+5.3	+3.9	.....	.....	.....	+4.8	+5.3	+3.18
60	5.4	5.0	4.5	3.2	.....	+4.5	.....	3.9	4.4	2.45
70	5.0	4.6	3.8	2.5	.....	3.9	.....	3.1	3.6	1.64
80	4.77	4.4	3.2	1.8	.....	3.5	.....	2.4	2.8	0.82
90	4.67	4.4	2.7	1.33	+2.3	3.21	−0.1	2.0	2.3	+0.12
1800	+4.72	+4.3	+2.4	+0.99	+2.54	+3.09	+0.0	+1.8	+2.1	−0.35
10	4.90	4.5	2.2	0.84	2.93	3.15	0.3	2.0	2.16	−0.48
20	5.21	4.61	2.3	0.88	3.43	3.38	0.8	2.5	2.44	−0.28
30	5.63	4.98	2.5	1.11	4.02	3.77	1.4	3.0	2.91	+0.17
40	6.13	5.61	2.96	1.52	4.66	4.28	2.2	3.7	3.46	0.75
1850	+6.69	+6.31	+3.53	+2.07	+5.32	+4.91	+2.94	+4.35	+4.07	+1.38
55	6.99	6.62	3.86	2.40	5.66	5.25	3.33	4.6	4.39	1.70
60	7.28	6.91	4.22	2.74	5.98	5.60	3.71	5.0	4.73	2.02
65	7.58	7.16	4.59	3.10	6.29	5.96	4.08	5.3	5.08	2.35
70	7.87	7.40	4.98	3.48	6.59	6.32	4.43	5.7	5.44	2.70
1875	+8.15	+7.64	+5.36	+3.85	+6.87	+6.67	+4.75	+6.2	+5.81	+3.06
80	8.41	7.90	5.75	4.23	7.12	7.01	5.05	6.7	6.20	3.44
85	8.66	8.18	6.12	4.60	7.35	7.35	5.30	7.1	6.59	3.84
90	8.89	8.49	6.49	4.95	7.55	7.65	5.52	7.6	7.0	4.25
95	9.1	8.8	6.83	5.3	7.72	7.94	5.7	7.9	7.4	4.65
1900	+9.3	+9.1	+7.2	+5.6	+7.9	+8.2	+5.8	+8.0	+7.7	+5.0

*To reduce to Sandy Hook, N. J., subtract 0°.33.

TABLE B.—*Secular Variation of Magnetic Declination—Eastern Group of Stations—Concluded.*

Year (January 1.)	West Creek, N. J.	Baltimore, Md.	Cape May, N. J.	Washington, D. C.	Cape Henlopen, Del.	Williamsburg, Va.	Cape Henry, Va.	Newbern, N. C.	Milledgeville, Ga.	Charleston, S. C.	Savannah, Ga.
	°	°	°	°	°	°	°	°	°	°	°
1600	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1650	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	+6.	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	+8.	6.	.....	.....	.....	.....	.....	.....	.....	.....	.....
90	8.	6.	.....	.....	.....	+4.7	.....	.....	.....	.....	.....
1700	+8.0	+5.4	.....	.....	+6.4	+4.6	+4.6	.....	.....	+0.0	.....
10	7.6	5.0	.....	.....	5.8	4.4	4.3	.....	.....	−0.5	.....
20	7.0	4.5	.....	.....	5.2	4.0	3.9	.....	.....	1.2	.....
30	6.4	3.9	.....	.....	4.4	3.5	3.4	.....	.....	1.8	.....
40	5.7	3.2	.....	.....	3.7	2.9	2.9	.....	.....	2.5	.....
1750	+4.9	+2.6	.....	+1.6	+2.9	+2.3	+2.3	.....	.....	−3.1	.....
60	4.2	2.0	.....	1.0	2.3	1.65	1.8	.....	.....	3.7	.....
70	3.6	1.46	.....	0.5	1.7	1.05	1.2	−1.6	.....	4.1	.....
80	3.2	1.04	.....	+0.2	1.2	0.52	0.8	1.9	.....	4.4	.....
90	2.9	0.76	.....	−0.0	0.9	+0.10	0.45	2.1	.....	4.55	.....
1800	+2.7	+0.64	.....	−0.1	+0.8	−0.17	+0.24	−2.11	−5.0	−4.55	.....
10	2.8	0.68	.....	−0.0	0.9	0.28	0.17	1.96	5.3	4.37	−4.7
20	3.0	0.88	.....	+0.3	1.1	−0.22	0.25	1.66	5.6	4.05	4.7
30	3.4	1.23	.....	0.7	1.5	+0.01	0.47	1.23	5.6	3.59	4.5
40	4.0	1.70	+2.65	1.19	2.00	0.38	0.82	0.70	5.55	3.03	4.2
1850	+4.62	+2.27	+3.22	+1.78	+2.64	+0.88	+1.27	−0.09	−5.33	−2.39	−3.78
55	4.97	2.58	3.59	2.10	2.99	1.16	1.53	+0.22	5.17	2.06	3.54
60	5.34	2.90	3.79	2.42	3.36	1.47	1.80	0.54	4.98	1.73	3.27
65	5.70	3.23	4.08	2.74	3.73	1.78	2.08	0.86	4.76	1.39	2.98
70	6.06	3.55	4.36	3.06	4.11	2.10	2.37	1.17	4.51	1.07	2.68
1875	+6.41	+3.87	+4.65	+3.37	+4.49	+2.43	+2.66	+1.46	−4.24	−0.75	−2.37
80	6.76	4.17	4.93	3.66	4.86	2.75	2.94	1.74	3.96	0.45	2.06
85	7.06	4.47	5.21	3.93	5.2	3.06	3.22	2.01	3.66	−0.17	1.76
90	7.35	4.74	5.50	4.18	5.6	3.3	3.5	2.25	3.36	+0.09	1.45
95	7.6	5.0	5.8	4.40	5.9	3.6	3.7	2.45	3.1	0.3	1.2
1900	+7.8	+5.2	+6.1	+4.6	+6.2	+3.9	+3.9	+2.6	−2.7	+0.5	−0.9

TABLE C.—*Secular Variation of Magnetic Declination—Middle Group of Stations.*

Year (January 1).	Duluth, Minn. (and Superior, Wis.).	Sault de Ste. Marie, Mich.	Pierrepont Manor, N. Y.	Toronto, Canada.	Grand Haven, Mich.	Milwaukee, Wis.	Buffalo, N. Y.	Dunkirk, N. Y.	Ithaca, N. Y.	Detroit, Mich.	Kalamazoo, Mich.
	°	°	°	°	°	°	°	°	°	°	°
1650	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	+9.9	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	10.1	.....	.....
90	.....	.....	.....	.....	.....	.....	.....	.....	10.2	.....	.....
1700	.....	.....	.....	.....	.....	.....	.....	.....	+10.1	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	9.8	.....	.....
20	.....	.....	.....	.....	.....	.....	.....	.....	9.3	.....	.....
30	.....	.....	.....	.....	.....	.....	.....	.....	8.6	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	7.8	.....	.....
1750	.....	.....	.....	.....	.....	.....	.....	.....	+7.0	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	6.1	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	5.2	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	4.4	.....	.....
90	.....	+0.0	.....	.....	.....	.....	+0.44	−0.47	3.76	.....	.....
1800	.....	−0.5	.....	.....	.....	.....	+0.22	−0.55	+3.26	−3.1	.....
10	.....	0.9	.....	.....	.....	.....	0.21	0.46	2.89	3.06	.....
20	.....	1.1	+2.6	.....	−5.0	.....	0.41	−0.21	2.74	2.84	−5.7
30	.....	1.16	3.05	+0.8	5.2	.....	0.79	+0.20	2.80	2.49	5.84
40	.....	1.04	3.72	1.32	5.2	.....	1.35	0.73	3.05	2.04	5.71
1850	−9.8	−0.76	+4.52	+1.60	−4.95	−7.4	+2.05	+1.36	+3.52	−1.55	−5.33
55	9.9	0.57	4.96	1.85	4.74	7.2	2.43	1.70	3.81	1.22	5.06
60	10.02	0.34	5.41	2.17	4.45	6.9	2.84	2.05	4.13	0.93	4.74
65	10.08	−0.07	5.87	2.39	4.11	6.6	3.25	2.40	4.49	0.64	4.37
70	10.11	+0.21	6.33	2.66	3.71	6.2	3.67	2.75	4.88	0.34	3.96
1875	−10.10	+0.52	+6.79	+3.14	−3.25	−5.8	+4.09	+3.10	+5.29	−0.05	−3.52
80	10.06	0.84	7.23	3.62	2.73	5.4	4.51	3.43	5.71	+0.23	3.04
85	9.98	1.18	7.6	3.88	2.15	5.0	4.91	3.75	6.14	0.49	2.55
90	9.9	1.52	8.0	4.12	1.5	4.5	5.30	4.05	6.58	0.74	2.04
95	9.7	1.9	8.4	4.5	−1.0	4.1	5.66	4.3	7.03	0.96	1.53
1900	−9.5	+2.2	+8.8	+4.8	.....	−3.6	+6.0	+4.5	+7.5	+1.2	−1.0

TABLE C.—*Secular Variation of Magnetic Declination—Middle Group of Stations—Continued.*

Year (January 1).	Ypsilanti, Mich.	Erie, Pa.	Chicago, Ill.	Michigan City, Ind.	Cleveland, Ohio.	Omaha Neb.	Beaver, Pa.	Pittsburg, Pa.	Denver, Colo.	Marietta, Ohio.	Athens, Ohio.
	°	°	°	°	°	°	°	°	°	°	°
1650	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	+0.2	.....	.....	.....	.....	−0.42	.....	.....	.....	.....
90	.....	−0.2	.....	.....	−1.73	.....	0.85	.....	.....	.....	−4.0
1800	.....	−0.46	.....	.....	−1.76	.....	−1.15	.....	.....	.....	−4.1
10	−4.15	0.52	.....	.....	1.66	−12.6	1.30	.....	.....	−2.9	4.1
20	3.65	0.39	−6.12	.....	1.43	12.6	1.28	.....	.....	2.8	3.9
30	3.01	−0.09	6.28	−5.6	1.10	12.6	1.11	.....	.....	2.7	3.60
40	2.25	+0.36	6.25	5.4	0.66	12.33	0.78	+0.18	.....	2.33	3.15
1850	−1.44	+0.94	−6.04	−5.0	−0.16	−11.96	−0.32	+0.68	.....	−1.86	−2.61
55	1.03	1.26	5.88	4.8	+0.11	11.73	−0.06	0.96	.....	1.57	2.31
60	0.62	1.60	5.67	4.6	0.39	11.47	+0.23	1.26	−15.14	1.27	2.00
65	−0.21	1.94	5.42	4.3	0.67	11.19	0.54	1.56	15.02	0.94	1.68
70	+0.18	2.30	5.15	4.0	0.96	10.89	0.86	1.87	14.88	0.60	1.36
1875	+0.55	+2.65	−4.84	−3.8	+1.25	−10.56	+1.19	+2.18	−14.71	−0.26	−1.04
80	0.89	2.99	4.52	3.5	1.52	10.23	1.52	2.49	14.52	+0.10	0.73
85	1.20	3.32	4.17	3.2	1.79	9.89	1.85	2.78	14.30	0.45	0.43
90	1.48	3.62	3.81	2.9	2.05	9.56	2.18	3.06	14.06	0.79	−0.14
95	1.7	3.9	3.45	2.6	2.3	9.2	2.49	3.3	−13.8	1.1	+0.12
1900	+1.9	+4.2	−3.1	−2.3	+2.5	−8.9	+2.8	+3.5	.....	+1.4	+0.4

TABLE C.—*Secular Variation of Magnetic Declination—Middle Group of Stations—Concluded.*

Year (January 1).	Cincinnati, Ohio.	St. Louis, Mo.	Nashville, Tenn.	Florence, Ala.	Mobile, Ala.	Pensacola, Fla.	Austin, Tex.	New Orleans, La.	San Antonio, Tex.	Galveston, Tex.	Key West, Fla.
	°	°	°	°	°	°	°	°	°	°	°
1650	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1700	.....	.....	.....	.....	.....	.....	.....	−2.2	.....	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	2.2	.....	.....	.....
20	.....	.....	.....	.....	.....	.....	.....	2.4	.....	.....	.....
30	.....	.....	.....	.....	.....	.....	.....	2.7	.....	.....	.....
40	.....	.....	.....	.....	.....	.....	.....	3.1	.....	.....	.....
1750	.....	.....	.....	.....	.....	.....	.....	−3.7	.....	.....	.....
60	.....	.....	.....	.....	.....	−4.1	.....	4.4	.....	.....	.....
70	.....	.....	.....	.....	.....	4.87	.....	5.1	.....	.....	.....
80	.....	.....	.....	.....	.....	5.61	.....	5.8	.....	.....	.....
90	.....	.....	.....	.....	.....	6.28	.....	6.5	.....	.....	.....
1800	−4.9	.....	.....	.....	−5.8	−6.84	.....	−7.12	.....	.....	.....
10	5.01	.....	.....	−6.5	6.30	7.25	.....	7.62	.....	.....	.....
20	4.99	.....	−6.7	6.58	6.71	7.50	.....	7.96	−9.8	.....	−6.9
30	4.82	−8.9	6.9	6.54	6.97	7.56	−11.0	8.15	10.1	.....	6.5
40	4.51	8.6	6.9	6.37	7.07	7.43	10.7	8.16	10.3	.....	6.03
1850	−4.08	−8.2	−6.7	−6.11	−6.99	−7.12	−10.20	−8.00	−10.31	−8.9	−5.47
55	3.85	8.0	6.5	5.93	6.90	6.90	9.97	7.85	10.25	8.90	5.17
60	3.57	7.7	6.3	5.74	6.75	6.65	9.74	7.66	10.16	8.84	4.85
65	3.28	7.4	6.1	5.53	6.57	6.36	9.50	7.44	10.03	8.74	4.53
70	2.99	7.1	5.78	5.30	6.36	6.05	9.27	7.18	9.86	8.59	4.21
1875	−2.69	−6.7	−5.46	−5.06	−6.12	−5.71	−9.03	−6.90	−9.66	−8.40	−3.88
80	2.39	6.4	5.13	4.81	5.84	5.34	8.80	6.59	9.43	8.16	3.57
85	2.09	6.0	4.78	4.55	5.54	4.97	8.57	6.26	9.17	7.88	3.26
90	1.80	5.6	4.40	4.28	5.23	4.59	8.34	5.91	8.89	7.56	2.96
95	1.53	5.3	4.0	4.02	4.9	4.20	8.1	5.6	8.6	−7.2	2.7
1900	−1.3	−4.9	−3.6	−3.8	−4.6	−3.8	−7.9	−5.2	−8.3	.....	−2.4

TABLE D.—*Secular Variation of Magnetic Declination—Western Group of Stations.*

Year (January 1).	El Paso, Tex.	San Diego, Cal.	Santa Barbara, Cal.	Monterey, Cal.	San Francisco, Cal.	Cape Mendocino, Cal.	Salt Lake City, Utah.	Vancouver, Wash.	Walla Walla, Wash.	Cape Disappointment, Wash.
	°	°	°	°	°	°	°	°	°	°
1700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	—7.3	—8.2	.....	.....	.....	.....	.....	.....	.....
20	.....	7.3	8.2	.....	.....	.....	.....	.....	.....	.....
30	.....	7.45	8.3	.....	.....	.....	.....	.....	.....	.....
40	.....	7.7	8.5	.....	.....	.....	.....	.....	.....	.....
1750	.....	—8.1	—8.9	.....	.....	.....	.....	.....	.....	.....
60	.....	8.5	9.3	.....	.....	.....	.....	.....	.....	.....
70	.....	9.0	9.8	.....	.....	.....	.....	.....	.....	.....
80	.....	9.5	10.4	—11.4	—12.6	—14.2	.....	—15.6	.....	—17.1
90	.....	10.1	11.0	11.8	13.1	14.7	.....	16.1	.....	17.3
1800	.....	—10.7	—11.6	—12.33	—13.6	—15.1	.....	—16.8	.....	—17.7
10	.....	11.3	12.3	12.86	14.1	15.6	.....	17.5	.....	18.2
20	.....	11.8	12.9	13.40	14.54	16.0	.....	18.2	.....	18.7
30	.....	12.27	13.43	13.93	15.00	16.5	.....	18.9	.....	19.2
40	.....	12.67	13.90	14.45	15.42	16.9	.....	19.6	.....	19.8
1850	—12.31	—12.99	—14.30	—14.91	—15.79	—17.2	—16.0	—20.17	—20.4	—20.31
55	12.41	13.11	14.46	15.13	15.96	17.3	16.3	20.41	20.6	20.56
60	12.47	13.21	14.60	15.32	16.10	17.4	16.45	20.62	20.8	20.80
65	12.48	13.28	14.70	15.49	16.23	17.5	16.58	20.78	20.9	21.02
70	12.45	13.32	14.78	15.65	16.34	17.6	16.64	20.91	21.0	21.22
1875	—12.38	—13.34	—14.82	—15.78	—16.44	—17.6	—16.64	—21.00	—21.1	—21.40
80	12.26	13.32	14.84	15.89	16.51	17.69	16.58	21.04	21.1	21.56
85	12.11	13.28	14.82	15.98	16.56	17.70	16.45	21.05	21.1	21.69
90	11.91	13.22	14.8	16.04	16.58	17.69	16.3	21.0	21.0	21.79
95	11.7	13.12	14.7	16.1	16.59	17.7	16.0	20.9	20.9	21.9
1900	—11.4	—13.0	—14.6	—16.1	—16.57	—17.6	—15.7	—20.8	—20.8	— 21.9

Year (January 1).	Seattle, Wash.	Port Townsend, Wash.	Nee-ah Bay, Wash.	Illiulik Harbor, Unalaska Island, Alaska.	Sitka, Alaska.	St. Paul, Kadiak Island, Alaska.	Port Mulgrave, Yakutat Bay, Alaska.	Port Etches, Alaska.	Port Clarence, Alaska.	Chamisso Island, Kotzebue Sound, Alaska.
	°	°	°	°	°	°	°	°	°	°
1700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	.....	.....	.....	.....	.....	.....	.....	—28.0	—32.0
30	.....	.....	.....	.....	.....	.....	.....	.....	29.0	32.5
40	.....	.....	.....	.....	.....	.....	.....	.....	30.0	33.0
1750	.....	.....	.....	.....	.....	.....	.....	.....	—30.0	—33.5
60	.....	.....	.....	.....	.....	.....	.....	.....	30.0	34.0
70	.....	.....	.....	.....	—24.5	—22.2	—23.	—22.5	30.5	34.0
80	—16.8	—17.3	—18.4	25.1	23.4	24.5	24.4	30.0	34.0	
90	17.4	17.8	18.9	25.7	24.5	26.	26.2	30.0	34.0	
1800	—18.1	—18.3	—19.27	—26.39	—25.54	—27.5	—27.84	—30.0	—33.5	
10	18.8	18.9	19.59	27.06	26.37	29.	29.28	29.0	33.0	
20	19.6	19.6	19.80	27.68	26.98	30.	30.44	28.4	32.3	
30	20.3	20.3	19.90	28.22	27.32	31.	31.22	27.6	31.5	
40	20.9	21.0	19.89	28.66	27.38	31.5	31.58	26.7	30.6	
1850	—21.3	—21.38	—21.64	—19.76	—28.95	—27.15	—31.7	—31.50	—25.7	—29.7
55	21.6	21.57	21.90	19.65	29.06	26.93	31.7	31.30	25.3	29.2
60	21.8	21.70	22.13	19.52	29.13	26.65	31.6	30.99	24.8	28.8
65	22.0	21.79	22.33	19.37	29.15	26.31	31.4	30.59	24.4	28.4
70	22.13	21.83	22.50	19.19	29.13	25.90	31.0	30.09	24.0	27.9
1875	—22.23	—21.83	—22.62	—18.99	—29.08	—25.45	—30.8	—29.49	—23.6	—27.5
80	22.28	21.78	22.70	18.78	29.	24.96	30.4	28.8	23.2	27.2
85	22.29	21.68	22.74	18.55	29.	24.4	30.	28.1	22.9	26.8
90	22.25	21.54	22.73	18.31	—29.	23.9	29.	27.3	22.6	26.5
95	22.2	21.3	22.7	18.1	.....	—23.	—29.	—26.	—22.	—26.
1900	—22.1	—21.1	—22.6	—17.8	.....	.....	.....	.....	.....	.....

The following table contains the latitude and longitude of each of the secular variation stations, together with the annual change of the declination for the epochs 1890, 1895 and 1900, as far as known at present. Increasing westerly declination, or what is the same, decreasing easterly declination, has a + sign prefixed to its annual change, whereas decreasing westerly or increasing easterly declination is indicated by a — sign.

TABLE E.—*Latitude and Longitude of places of Magnetic Observation, and Annual Variation of Magnetic Declination.*

Name of place.	Latitude.	Longitude west.	Annual change of decl. for—		
			1890.	1895.	1900.
Eastern Group.	° ′	° ′	′	′	′
Eastport, Me	44 54.4	66 59.2	+0.8	+0.2	.....
Bangor, Me	44 48 2	68 46.9	+2.2	+1.7	+1.2
Burlington, Vt	44 28.5	73 12.0	+2.8	+2.4	+2.0
Hanover, N. H	43 42.3	72 17.1	+3.5	+3.0	+2.4
Portland, Me	43 38.8	70 16.6	+2.6	+2.2	.....
Rutland, Vt	43 36.5	72 55.5	+4.2	+3.8	+3.3
Portsmouth, N. H	43 04.3	70 42.5	+2.9	+2.5	+2.0
Chesterfield, N. H	42 53.5	72 24	+2.7	+2.2	+1.6
Newburyport, Mass	42 48.9	70 49.2	+2.6	+2.2	.....
Williamstown, Mass	42 42.8	73 13.4	+3.4	+3.0	.....
Albany, N. Y	42 39.2	73 45.8	+3.7	+3.4	+3.1
Salem, Mass	42 31.9	70 52.5	+3.6	+3.0	.....
Oxford, N. Y	42 26.5	75 40.5	+3.7	+3.4	.....
Cambridge, Mass	42 22.9	71 07.7	+1.5	+1.2	.....
Boston, Mass	42 21.5	71 03.9	+2.2	+1.9	.....
Provincetown, Mass	42 03.1	70 11.3	+1.9	+1.5	+1.0
Providence, R. I	41 50.2	71 23.8	+4.4	+3.6	.....
Hartford, Conn	41 45.9	72 40.4	+3.3	+3.0	+2.7
New Haven, Conn	41 18.5	72 55.7	+3.8	+3.4	.....
Nantucket, Mass	41 17.0	70 06.0	+1.2	+0.8	.....
Cold Spring Harbor, N. Y	40 52	73 28	+2.6	+2.3	.....
New York, N. Y	40 42.7	74 00.4	+3.8	+3.8	.....
South Bethlehem, Pa	40 36.4	75 22.9	+4.3	+4.0	+3.7
Huntingdon, Pa	40 31	78 02	+4.1	+3.9	.....
New Brunswick, N. J	40 29.9	74 26.8	+2.2	+1.8	.....
Jamesburg, N. J	40 21	74 27	+3.6	+3.3	+2.9
Harrisburg, Pa	40 15.9	76 52.9	+2.3	+1.8	.....
Hatboro, Pa	40 12	75 07	+4.4	+3.3	.....
Philadelphia, Pa	39 56.9	75 09.0	+4.4	+4.4	.....
Chambersburg, Pa	39 55	77 40	+4.9	+4.8	.....
West Creek, N. J	39 38	74 19	+3.3	+2.9	+2.4
Baltimore, Md	39 17.8	76 37.0	+3.1	+2.8	.....
Cape May, N. J	38 56.0	74 57.6	+3.4	.....	.....
Washington, D. C	38 53.3	77 00.6	+2.4	+2.0	.....
Cape Henlopen, Del	38 46.7	75 05.0	+4.0	+3.7	.....
Williamsburg, Va	37 16.2	76 42.4	+3.4	+3.2	.....
Cape Henry, Va	36 55.6	76 00.4	+3.0	+2.8	.....
Newbern, N. C	35 06	77 02	+2.7	+2.3	+1.9
Milledgeville, Ga	33 04.2	83 12	+3.7	+3.7	.....
Charleston, S. C	32 46.6	79 55.8	+2.9	+2.5	.....
Savannah, Ga	32 04.9	81 05.5	+3.6	+3.4	.....
Middle group.					
Duluth, Minn., and Superior, Wis	46 45.5	92 04.5	.....	.....	.....
Sault de Ste. Marie, Mich	46 29.9	84 20.1	+4.1	+4.1	.....
Pierrepont Manor, N. Y	43 44.5	76 03.0	+4.6	+4.2	.....
Toronto, Can	43 39.4	79 23.5	+3.8	+4.4	.....
Grand Haven, Mich	43 05.2	86 12.6	.....	.....	.....
Milwaukee, Wis	43 02.5	87 54.2	+5.4	+5.5	.....
Buffalo, N. Y	42 52.8	78 53.5	+4.5	+4.2	.....
Dunkirk, N. Y	42 29.6	79 21.3	+3.4	+3.1	+2.7
Ithaca, N. Y	42 26.8	76 28.9	+5.3	+5.2	+5.1

TABLE E.—*Latitude and Longitude of places of Magnetic Observation, etc.—Concluded.*

Name of place.	Latitude.	Longitude west.	Annual change of decl. for—		
			1890.	1895.	1900.
Middle Group—Continued.					
	° ′	° ′	′	′	′
Detroit, Mich	42 20.0	83 03.0	+2.8	+2.5	+2.2
Kalamazoo, Mich	42 17.4	85 35.2	+6.1	+6.2	.....
Ypsilanti, Mich	42 14	83 38	+3.1	+2.6	.....
Erie, Pa	42 07.8	80 05.4	+3.5	+3.2	.....
Chicago, Ill	41 50.0	87 36.8	+4.3	+4.4	+4.4
Michigan City, Ind	41 43.4	86 54.4	+3.5	+3.4	.....
Cleveland, Ohio	41 30.4	81 41.5	+3.0	+2.8	.....
Omaha, Neb	41 15.7	95 56.5	+4.1	+4.1	+4.0
Beaver, Pa	40 44	80 20	+3.8	+3.7	.....
Pittsburg, Pa	40 27.6	80 00.8	+3.2	+3.0	.....
Denver, Colo	39 45.3	104 59.5	+3.1	+3.4	.....
Marietta, Ohio	39 25	81 28	+4.1	+3.9	.....
Athens, Ohio	39 19	82 02	+3.3	+3.0	.....
Cincinnati, Ohio	39 06.4	84 29.8	+3.4	+3.3	.....
St. Louis, Mo	38 38.0	90 12.2	+4.4	+4.3	.....
Nashville, Tenn	36 08.9	86 48.2	+4.6	+4.7	.....
Florence, Ala	34 47.2	87 41.7	+3.2	+3.2	+3.1
Mobile, Ala	30 41.4	88 02.5	+3.9	+4.0	.....
Pensacola, Fla	30 20.8	87 18.3	+4.6	+4.6	.....
Austin, Tex	30 16.4	97 44.2	+2.8	.....	.....
New Orleans, La	29 57.2	90 03.9	+4.2	+4.3	.....
San Antonio, Tex	29 26.8	98 27.9	+3.5	+3.7	+3.9
Galveston, Tex	29 17.4	94 47	+4.2	+4.5	.....
Key West, Fla	24 33.5	81 48.5	+3.4	+3.2	.....
Western group.					
El Paso, Tex	31 45.5	106 27.0	+2.6	+3.0	.....
San Diego, Cal	32 42.1	117 14.3	+1.0	+1.3	+1.6
Santa Barbara, Cal	34 24.2	119 43	+0.7	+1.1	.....
Monterey, Cal	36 36.1	121 53.6	−0.6	−0.3	0.0
San Francisco, Cal	37 47.5	122 27.3	−0.2	0.0	+0.1
Cape Mendocino, Cal	40 26.3	124 24.3	+0.3	+0.6	.....
Salt Lake City, Utah	40 46.1	111 53.8	+2.5	+3.2	.....
Vancouver, Wash	45 37.5	122 39.7	+0.8	+1.3	.....
Walla Walla, Wash	46 04	118 22	+1.0	+1.5	.....
Cape Disappointment, Wash	46 16.7	124 02.8	−1.1	−0.7	.....
Seattle, Wash	47 35.9	122 20.0	+0.8	+1.3	.....
Port Townsend, Wash	48 07.0	122 44.9	+2.0	.....	.....
Nee-ah Bay, Wash	48 21.8	124 38.0	+0.3	+0.8	.....
Hiiulink Harbor, Unalaska Isl., Alaska	53 52.6	166 31.5	+2.9	+3.0	+3.1
Sitka, Alaska	57 02.9	135 19.7	−2.0(?)	.....	.....
St. Paul, Kadiak Isl., Alaska	57 48.0	152 21.3	+6.9	+7.2	.....
Port Mulgrave, Yakutat Bay, Alaska	59 33.7	139 45.9	+0.0(?)	.....	.....
Port Etches, Alaska	60 20.7	146 37.6	+9.9	.....	.....
Port Clarence, Alaska	65 16	166 50	+3.4	+2.9	.....
Chamisso Isl., Kotzebue Sound, Alaska	66 13	161 49	+3.5	+3.0	.....

It will be observed that the character of the secular change is fairly uniform over large areas, though each locality apparently has or may have minor features not shared by surrounding stations. It is, however, difficult to distinguish with certainty real from apparent deviations, in consequence of the imperfect data at our command. The following summary of the most probable values for the annual change about the epoch 1893 has been made up from the preceding tabular values and from other less reliable information, but for many States or special subdivisions it can only be a rough approximation.

TABLE F.—*Approximate average Annual Change of the Magnetic Declination about the epoch 1893, for the central part of each State, Territory, or geographical subdivision.*

[As before, a + sign indicates increasing west declination or decreasing east declination, a − sign indicates the contrary.]

Locality.	Annual change.	Locality.	Annual change.
	′		′
Alabama	+3.7	Missouri	+4.0
Alaska:		Montana	+2 (?)
Dixon Entrance	−1 (?)	Nebraska:	
Sitka Bay	−2 (?)	Western part	+3 (?)
Coast off Mount St. Elias	+0 (?)	Eastern part	+4 (?)
Bering Strait	+4 (?)	Nevada	+2 (?)
Arizona Territory	+2	New Hampshire	+4.0
Arkansas	+3	New Jersey:	
California:		Northern part	+3.8
Southern coast	+1	Southern part	+3.3
Coast, central part	−0.5	New Mexico	+2.7
Northern coast	+1	New York:	
Colorado	+2.8	Long Island	+3.2
Connecticut	+3.6	Western part	+4.0
Delaware	+3.4	North Carolina	+3.2
District of Columbia	+2.4	North Dakota	+3 (?)
Florida:		Ohio	+3.4
Northwestern part	+3.9	Oklahoma Territory	+3
Peninsula part	+3.5	Oregon:	
Georgia	+3.5	Western part	+1 (?)
Idaho	+1.5(?)	Eastern part	+2 (?)
Illinois	+3.9	Pennsylvania	+3.8
Indiana	+3.5	Rhode Island	+3.3
Indian Territory	+3.0	South Carolina	+3.0
Iowa	+4.5	South Dakota	+4 (?)
Kansas	+3.4	Tennessee	+3.6(?)
Kentucky	+3.6	Texas:	
Louisiana	+3.6(?)	Eastern part	+3 (?)
Maine:		Central part	+3.4
Western part	+2.4	Southern part	+3 (?)
Eastern part	+1	Utah	+2.5
Maryland	+3.2	Vermont	+4
Massachusetts:		Virginia	+3.0
Western part	+3.3	Washington:	
Eastern part	+2.2	Western part	0 (?)
Michigan:		Eastern part	+1 (?)
Southern part	+3.5(?)	West Virginia	+3.2
Northern part	+4 (?)	Wisconsin	+4 (?)
Minnesota	+3 (?)	Wyoming	+3 (?)
Mississippi	+3.5		

It is highly desirable to render the above list more precise and comprehensive, but this can only be done by an increase of reliable data, which, to some extent, should be proportioned to the vast areas now, magnetically, almost a complete blank. The tabular numbers may be used for a few years (say five) without serious error being introduced.

The diurnal variation of the declination.—Next in order of magnitude of systematic changes, and for which special attention is required when running a compass course, is the diurnal motion of the magnetic needle. In general, about the time of sunrise, or soon after it, the north-seeking end of the needle is found approaching to or near its eastermost position, i. e., near or at its eastern elongation of the solar day period. On the yearly average this phase happens, for instance, at Philadelphia, Pa., about 8 a. m.; at Key West, Fla., about 8¼ a. m.; at Los Angeles, Cal., shortly after 8 a. m. However, the time of occurrence is subject to an annual variation, the eastern elongation being reached about half an hour earlier during summer and about half an hour later during winter than its average epoch. The direction of the needle, after remaining nearly stationary about this time, soon begins its principal daily motion towards the *west*, at first slowly, but after about 9½ a. m. quite rapidly, but slackening again in speed when nearing its western extreme position known as the *western* elongation. It occurs about $1\frac{1}{2}^{h}$ p. m. On the yearly average this phase is reached at Philadelphia about $1\frac{1}{3}^{h}$

p. m., at Key West about $1\frac{1}{2}^h$ p. m., at Los Angeles about $1\frac{1}{4}^h$ p. m. Like the morning extreme it is subject to an annual change, occurring less than $\frac{1}{4}$ of an hour earlier in summer and the same amount later in winter. After this second temporary stand, the needle reverses its angular motion and gradually returns to the position from which it had set out in the early morning, not however without experiencing during the night a secondary but small retrograde motion.

The average position of the needle during the daily period is reached about $10\frac{1}{2}^h$ a. m., and within $\frac{1}{4}$ of an hour of this epoch at all places within the United States (Alaska excepted), yet it is subject to a displacement to 10^h a. m. in summer and to $11\frac{1}{2}^h$ a. m. in winter. The needle crosses a second time the average magnetic meridian between 7^h and 8^m p. m., but this time is less distinctly marked. The amount of angular motion between the morning and afternoon is called the diurnal range. It amounts to about 8′ at Philadelphia, 5′ at Key West, and 6′ at Los Angeles, on the average, but during midsummer it rises to 12′, 8′, and 9′ at these places, respectively, and recedes to 5′, 3′, and 4′, respectively, during midwinter. The solar diurnal variation is further subject to a periodic inequality depending on the sun-spot cycle of about 11 years. The diurnal range is least in years of minimum spots, as in 1878 and 1889, and is greatest in years of maximum spots, which years occur generally about four years after the minimum years, as in 1883 and near the current year. In years of least sun-spot activity, the range is about 0.8, and in years of greatest activity, about 1.3, the average range of the diurnal motion as given above. It must not be supposed that the diurnal variation can be observed regularly, day for day. It is at all times subject to more or less irregularity and occasionally to an extent overpowering the daily range altogether; this happens particularly in the winter season, when the regular motion is small, and in the months of March and September, i. e., the equinoctial months, September preponderating; on the other hand, greater regularity or less interruption from occasional disturbances may be expected during the solstitial months, June and December. In every month there are a few days—about half a dozen, more or less—on which the hourly progression of the diurnal motion is quite regular; such days have been called "quiet days" as representing type curves. The character of the diurnal variation is the same for all places within the temperate zone, but changes as we approach the equatorial (magnetic dip small) region, as well as upon approaching the polar (magnetic dip large) region; thus in Alaska we find diurnal ranges of half a degree and over, with the epochs of the daily extremes shifted to earlier hours. For a satisfactory determination of the declination it is recommended to extend the observations over not less than three days in order to secure data for the elimination of the diurnal motion. It is best to observe the needle, say every ten minutes, about the expected times of the elongations, so as to include them, and to adopt the mean declination obtained for these two epochs.

The following table will be found useful for reducing observed declinations taken at any time of the day between 6^h a. m. and 6^h p. m. on any day of the year, to the average value of the day or that value which would have been obtained had hourly or continuous observations been made throughout the twenty-four hours. The tabular value answers approximately to the middle part of a sun-spot cycle. Considering the ordinary irregularities in the diurnal variation, it suffices to take the nearest whole minute of arc from the table. These tabular quantities are nothing more than the deflections at any hour from the mean of twenty-four hours, with reference to the seasons of the year and to

geographical position of the station. Two sets of figures are given, those for northern places, for latitude between 49° and 37° about, and for southern places, for latitude between 37° and 25°. For the upper geographical zone the observations at Philadelphia, Toronto, and Madison were utilized; for the lower zone, those at Key West and Los Angeles.

Reduction of the result of a declination observed at any hour to the average or mean declination of the day.

The letter W affixed to a number indicates that the direction of the needle at that time is to the west of its average position and by the amount given; the letter E indicates that the needle deviates to the east of the average, and the corrections must be made accordingly.

TABLE G.—*For finding mean Declination for the day.*

Season, and position in latitude.	Local mean time; morning hours.						
	6h	7h	8h	9h	10h	11h	12h
	′	′	′	′	′	′	′
December, January, February:							
Northern part	0.7 E	1.1 E	1.9 E	2.2 E	1.5 E	0.1 W	1.8 W
Southern part	0.1 W	0.1 E	1.0 E	2.0 E	2.2 E	1.1 E	0.5 W
March, April, May:							
Northern part	2.6 E	3.8 E	4.4 E	3.5 E	1.2 E	1.6 E	3.8 W
Southern part	1.6 E	2.8 E	3.3 E	2.6 E	1.1 E	0.6 W	1.9 W
June, July, August:							
Northern part	4.0 E	5.6 E	5.7 E	4.5 E	1.7 E	1.6 E	4.1 W
Southern part	2.4 E	4.0 E	4.2 E	2.9 E	0.5 E	1.6 W	2.8 W
September, October, November:							
Northern part	1.8 E	2.6 E	3.1 E	2.5 E	1.0 E	1.5 E	3.3 W
Southern part	0.9 E	2.1 E	2.6 E	2.1 E	0.6 E	0.9 W	2.1 W

Season, and position in latitude.	Local mean time; afternoon hours.						
	0h	1h	2h	3h	4h	5h	6h
	′	′	′	′	′	′	′
December, January, February:							
Northern part	1.8 W	2.9 W	2.8 W	2.1 W	1.3 W	0.7 W	0.2 W
Southern part	0.5 W	1.5 W	1.8 W	1.6 W	1.0 W	0.4 W	0.1 W
March, April, May:							
Northern part	3.8 W	4.8 W	4.6 W	3.8 W	2.5 W	1.4 W	0.7 W
Southern part	1.9 W	2.6 W	2.8 W	2.4 W	1.6 W	0.9 W	0.5 W
June, July, August:							
Northern part	4.1 W	5.6 W	5.6 W	4.6 W	3.0 W	1.4 W	0.6 W
Southern part	2.8 W	3.2 W	3.1 W	2.4 W	1.5 W	0.8 W	0.4 W
September, October, November:							
Northern part	3.3 W	4.0 W	3.4 W	2.3 W	1.2 W	0.6 W	0.1 W
Southern part	2.1 W	2.3 W	1.9 W	1.2 W	0.7 W	0.4 W	0.2 W

The application of the tabular values to observations as to magnitude and sign is obvious.

Magnetic disturbances.—These disturbances when of great amount and large extent are known as magnetic storms and are not infrequently a source of annoyance to the surveyor; they may occur *at any time* and are, when taken individually, beyond our power of prediction, but when averages are taken of many hundreds or thousands, and discussed, they are nevertheless found to be subject to precise laws. Their presence is generally indicated by sudden deflections and by rapid and large fluctuations from the normal direction of the needle at the time, and they often take place simultaneously over large regions of the globe, even involving both hemispheres. They may last from a few hours to three and sometimes more days, and are not infrequently accompanied by auroral displays. These disturbances are supposed to originate in the solar envelope and are felt here by inductive action. The hours most frequently subject to disturbances are from 7 to 10 a. m.; those least disturbed between 2 and 6 p. m. They are more energetic during

the equinoctial months and less so during the solstitial months; the larger storms occur predominantly during years of maximum sun-spot activity. Within the area of the United States, Alaska excepted, deflections from the normal for the time of day of $\frac{1}{4}^\circ$ are common. Deflections of $\frac{1}{2}^\circ$ occur occasionally, but those exceeding 1° or 2° are rare; in the higher magnetic latitudes they may even reach the greater part of a quadrant.

Minor changes in the direction of the magnetic needle.—It suffices to mention here a few of the smaller fluctuations, not only as matter of general interest* but as showing relations and interdependence of terrestrial and cosmical magnetisms. Of this character are the laws found to govern the direction of the needle with respect to the position of the moon. The principal inequality is that known as the lunar-diurnal variation. It exhibits every lunar day two deflections to the east and two to the west of the normal direction; the range is nearly $27''$ at Philadelphia, $43''$ at Toronto, and $16''$ at Los Angeles. There are also relations depending on the moon's phases and parallax. Of solar inequalities we may mention the annual inequality of about $1\frac{1}{2}'$ (or less) of angular range and the very remarkable one depending on the sun's rotation about its axis, for which period the observations of the needle assign about 26 days.

Remarks on instrumental means and methods for observing the declination.—The accuracy with which the declination may be determined depends chiefly upon the instruments at command and upon the ability and care of the observer in using them. It rests with him to select the proper instrument, the proper method and time for observing. The instruments ordinarily in the hands of the surveyor are sufficiently described in books on surveying or in catalogues of instrument makers, but it may not be superfluous to call renewed attention to the importance of the determination of the so-called index correction. For description and illustration of more refined magnetic instruments as well as for their adjustment and method of using them the reader may consult Coast and Geodetic Survey Report for 1881, Appendix No. 8, entitled, "Directions for measurement of terrestrial magnetism". The method to be followed will depend greatly upon circumstances. Thus the sun or the pole star may be observed for azimuth; local time may be had by the method of equal altitudes of the sun, for which the latitude of the place need only to be known roughly. Observations of the pole star for the true azimuth are generally preferred, since no great precision in the local time is required. The following tables and explanatory remarks have been inserted to facilitate the use of this method. It will serve for the period 1890 to 1910.

* The reader may consult here Appendix No. 9, Coast and Geodetic Survey Report for 1890.

TABLE H.—*Approximate local mean (astronomical*) times of the Culminations and Elongations of Polaris in the year 1893.*

[Computed for latitude + 40° north, and longitude 6h west from Greenwich.]

Date.	East elongation.		Upper culmination.		West elongation.		Lower culmination.	
1893.	*h.*	*m.*	*h.*	*m.*	*h.*	*m.*	*h.*	*m.*
Jan. 1	0	37.2	6	32.0	12	26.8	18	30.0
15	23	38.0	5	36.7	11	31.5	17	34.7
Feb. 1	22	30.8	4	29.6	10	24.4	16	27.6
15	21	35.6	3	34.3	9	29.2	15	32.3
Mar. 1	20	40.4	2	39.1	8	33.9	14	37.1
15	19	45.3	1	44.1	7	38.8	13	42.1
Apr. 1	18	38.3	0	37.0	6	31.8	12	35.1
15	17	43.3	23	38.1	5	36.8	11	40.1
May 1	16	40.5	22	35.2	4	34.0	10	37.2
15	15	45.6	21	40.3	3	39.1	9	42.3
June 1	14	38.9	20	33.7	2	32.4	8	35.7
15	13	44.0	19	38.8	1	37.5	7	40.8
July 1	12	41.4	18	36.2	0	34.9	6	38.2
15	11	46.5	17	41.3	23	36.1	5	43.3
Aug. 1	10	40.0	16	34.8	22	29.6	4	36.8
15	9	45.1	15	39.9	21	34.7	3	41.9
Sept. 1	8	38.5	14	33.3	20	28.1	2	35.3
15	7	43.6	13	38.4	19	33.2	1	40.4
Oct. 1	6	40.8	12	35.6	18	30.4	0	37.6
15	5	45.8	11	40.6	17	35.4	23	38.7
Nov. 1	4	39.0	10	33.8	16	28.6	22	31.8
15	3	43.8	9	38.6	15	33.4	21	36.6
Dec. 1	2	40.8	8	35.6	14	30.4	20	33.6
15	1	45.5	7	40.3	13	35.1	19	38.3

To refer to any calendar day other than the first and fifteenth of each month, subtract 3.94m for every day between it and the preceding tabular day, or add 3.94m for every day between it and the succeeding tabular day.

It will be noticed that for the tabular year two eastern elongations occur on January 10, and two western elongations on July 9; there are also two upper culminations on April 10 and two lower culminations on October 10.

The lower culmination either follows or precedes the upper culmination at an interval of 11h 58.0m. Also east elongation either follows west elongation at an interval of 12h 06.5m, or precedes it at an interval of 11h 49.6m.

For dates and positions other than those directly given by the table, the following corrections need to be applied:

To refer the tabular times to any year subsequent to the year 1893, add 0.25 m. (nearly) for every additional year.†

To refer the tabular times, corrected as above, to any year in a quadrennium, observe that for the first year after a leap year the table is correct; for the second year after a leap year add 0.9m to the tabular value; for the third year after a leap year, add 1.7m to the tabular value; for leap year *before* March 1, add 2.6m to the tabular time, and *from* and *after* March 1 subtract 1.2m from the same.

The longitude correction will be 0.16m for each hour from the meridian of 6h, subtractive when west, additive when east of it.

To refer to any other than the tabular latitude between the limits of 25° and 50° north, *add* to the time of west elongation 0.13m for every

*Counted from noon, and from 0 to 24 hours.

†The annual change is diminishing, and after 1900 the annual change, 0.2m, will be closer.

degree south of latitude 40°, and *subtract* from the time of west elongation 0.18ᵐ for every degree north of 40°; reverse these signs for corrections to the times of east elongation. For latitudes as high as 60°, diminish the times of *west* elongation and increase the times of *east* elongation by 0.23ᵐ for every degree north of latitude 40°.

It will not be considered out of place here to direct attention to the circumstance that the year 1900 will not be a leap year, and this should be kept in view when dealing with dates from and after March 1 of that year. The twentieth century will begin after the expiration of December 31, 1900.

The tabular times thus deduced may generally be depended upon to have no greater error than ±0.3ᵐ.

TABLE J.—*Azimuths of Polaris when at elongation for any year between 1890 and 1910, and for any latitude between 25° and 72° north. The tabular numbers apply more particularly to the middle of April and the middle of September for each year.*

Latitude.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
25	1 24.6	1 24.3	1 23.9	1 23.6	1 23.2	1 22.9	1 22.5	1 22.2	1 21.8	1 21.5
26	25.3	25.0	24.6	24.3	23.9	23.6	23.2	22.9	22.5	22.2
27	26.0	25.7	25.4	25.1	24.7	24.3	24.0	23.6	23.3	22.9
28	26.8	26.5	26.2	25.8	25.4	25.1	24.7	24.4	24.0	23.7
29	27.6	27.3	27.0	26.6	26.3	25.9	25.5	25.2	24.8	24.5
30	1 28.5	1 28.2	1 27.8	1 27.5	1 27.1	1 26.8	1 26.4	1 26.0	1 25.7	1 25.3
31	29.4	29.1	28.8	28.4	28.0	27.6	27.3	26.9	26.5	26.2
32	30.4	30.1	29.7	29.3	29.0	28.6	28.2	27.9	27.5	27.1
33	31.4	31.1	30.7	30.3	30.0	29.6	29.2	28.8	28.5	28.1
34	32.5	32.1	31.8	31.4	31.0	30.6	30.2	29.9	29.5	29.1
35	1 33.6	1 33.2	1 32.9	1 32.5	1 32.1	1 31.7	1 31.3	1 30.9	1 30.6	1 30.2
36	34.8	34.4	34.0	33.6	33.2	32.9	32.5	32.1	31.7	31.3
37	36.0	35.6	35.2	34.8	34.5	34.1	33.7	33.3	32.9	32.5
38	37.3	36.9	36.5	36.1	35.7	35.3	35.0	34.6	34.2	33.8
39	38.7	38.3	37.9	37.5	37.1	36.7	36.3	35.9	35.5	35.1
40	1 40.1	1 39.7	1 39.3	1 38.9	1 38.5	1 38.1	1 37.7	1 37.2	1 36.8	1 36.4
41	41.6	41.2	40.8	40.4	40.0	39.6	39.1	38.7	38.3	37.9
42	43.2	42.8	42.4	42.0	41.5	41.1	40.7	40.3	39.8	39.4
43	44.9	44.4	44.0	43.6	43.2	42.7	42.3	41.9	41.4	41.0
44	46.6	46.2	45.8	45.3	44.9	44.4	44.0	43.6	43.1	42.7
45	1 48.5	1 48.1	1 47.6	1 47.1	1 46.7	1 46.2	1 45.8	1 45.4	1 44.9	1 44.5
46	50.4	50.0	49.5	49.0	48.6	48.2	47.7	47.2	46.8	46.3
47	52.5	52.0	51.5	51.0	50.6	50.2	49.7	49.2	48.8	48.3
48	54.6	54.2	53.7	53.2	52.8	52.3	51.8	51.3	50.9	50.4
49	56.9	56.5	56.0	55.5	55.0	54.5	54.1	53.6	53.1	52.6
50	1 59.3	1 58.8	1 58.3	1 57.9	1 57.4	1 56.9	1 56.4	1 55.9	1 55.4	1 54.9
51	2 01.9	2 01.4	2 00.9	2 00.4	59.9	59.4	58.9	58.4	57.9	57.4
52	04.6	04.1	03.6	03.0	2 02.5	2 02.0	2 01.5	2 01.0	2 00.5	2 00.0
53	07.5	07.0	06.4	05.9	05.3	04.8	04.3	03.8	03.2	02.7
54	10.5	10.0	09.4	08.9	08.3	07.8	07.3	06.7	06.2	05.6
55	2 13.7	2 13.2	2 12.6	2 12.1	2 11.5	2 11.0	2 10.5	2 09.9	2 09.4	2 08.8
56	17.2	16.6	16.1	15.5	15.0	14.4	13.8	13.3	12.7	12.2
57	20.9	20.3	19.7	19.2	18.6	18.0	17.4	16.8	16.3	15.7
58	24.8	24.2	23.6	23.0	22.4	21.8	21.2	20.6	20.0	19.4
59	29.0	28.4	27.8	27.1	26.5	25.9	25.3	24.7	24.0	23.4
60	2 33.5	2 32.9	2 32.2	2 31.6	2 30.9	2 30.3	2 29.7	2 29.0	2 28.4	2 27.7
61	38.3	37.6	37.0	36.3	35.7	35.0	34.3	33.7	33.0	32.4
62	43.4	42.7	42.0	41.4	40.7	40.0	39.3	38.7	38.0	37.4
63	49.0	48.3	47.6	47.0	46.3	45.6	44.9	44.2	43.5	42.8
64	55.0	54.3	53.6	52.8	52.1	51.4	50.7	50.0	49.2	48.5
65	3 01.6	3 00.8	3 00.1	2 59.3	2 58.6	2 57.8	2 57.1	2 56.3	2 55.6	2 54.8
66	08.7	07.9	07.1	3 06.4	3 05.6	3 04.8	3 04.0	3 03.2	3 02.5	3 01.7
67	16.4	15.6	14.8	14.0	13.2	12.4	11.6	10.8	09.9	09.1
68	24.9	24.0	23.2	22.3	21.5	20.6	19.8	18.9	18.1	17.2
69	34.1	33.2	32.3	31.5	30.6	29.7	28.8	27.9	27.1	26.2
70	3 44.4	3 43.5	3 42.6	3 41.6	3 40.7	3 39.8	3 38.9	3 38.0	3 37.0	3 36.1
71	55.8	54.8	53.9	52.9	52.0	51.0	50.0	49.0	48.1	47.1
72	4 08.4	4 07.4	4 06.4	4 05.3	4 04.3	4 03.3	4 02.3	4 01.3	4 00.2	59.2

TABLE J.—*Azimuths of Polaris when at elongation for any year between 1890 and 1910, and for any latitude between 25° and 75° north, etc.—Concluded.*

Latitude.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
25	1 21.2	1 20.8	1 20.5	1 20.1	1 19.8	1 19.4	1 19.1	1 18.7	1 18.4	1 18.1	1 17.7
26	21.8	21.5	21.1	20.8	20.5	20.1	19.8	19.4	19.1	18.7	18.4
27	22.5	22.2	21.9	21.5	21.2	20.8	20.5	20.1	19.8	19.4	19.1
28	23.3	23.0	22.6	22.2	21.9	21.6	21.3	20.9	20.5	20.1	19.8
29	24.1	23.8	23.4	23.0	22.7	22.4	22.1	21.7	21.3	20.9	20.5
30	1 24.9	1 24.6	1 24.2	1 23.9	1 23.5	1 23.1	1 22.8	1 22.4	1 22.1	1 21.7	1 21.3
31	25.8	25.5	25.1	24.7	24.4	24.0	23.6	23.2	22.9	22.5	22.2
32	26.7	26.4	26.0	25.6	25.3	24.9	24.5	24.1	23.8	23.4	23.1
33	27.7	27.3	27.0	26.6	26.2	25.9	25.5	25.1	24.7	24.3	24.0
34	28.7	28.4	28.0	27.6	27.2	26.9	26.5	26.1	25.7	25.3	25.0
35	1 29.8	1 29.4	1 29.0	1 28.7	1 28.3	1 27.9	1 27.5	1 27.1	1 26.8	1 26.4	1 26.0
36	30.9	30.5	30.1	29.8	29.4	29.0	28.6	28.2	27.9	27.5	27.1
37	32.1	31.7	31.3	30.9	30.5	30.1	29.7	29.3	29.0	28.6	28.2
38	33.4	33.0	32.6	32.2	31.8	31.4	31.0	30.6	30.2	29.8	29.4
39	34.7	34.3	33.9	33.5	33.1	32.7	32.3	31.8	31.4	31.0	30.6
40	1 36.0	1 35.6	1 35.2	1 34.8	1 34.4	1 34.0	1 33.6	1 33.2	1 32.8	1 32.4	1 32.0
41	37.5	37.1	36.7	36.2	35.8	35.4	35.0	34.6	34.2	33.8	33.4
42	39.0	38.6	38.2	37.7	37.3	36.9	36.5	36.0	35.6	35.2	34.8
43	40.6	40.2	39.8	39.3	38.9	38.5	38.1	37.6	37.2	36.8	36.3
44	42.3	41.8	41.4	41.0	40.5	40.1	39.7	39.2	38.8	38.4	37.9
45	1 44.0	1 43.6	1 43.2	1 42.7	1 42.3	1 41.8	1 41.4	1 40.9	1 40.5	1 40.1	1 39.6
46	45.9	45.5	45.0	44.6	44.2	43.7	43.2	42.7	42.3	41.9	41.4
47	47.9	47.4	46.9	46.5	46.0	45.6	45.1	44.6	44.2	43.7	43.3
48	49.9	49.5	49.0	48.6	48.1	47.7	47.2	46.7	46.3	45.8	45.3
49	52.1	51.7	51.2	50.7	50.2	49.8	49.3	48.8	48.4	47.9	47.4
50	1 54.4	1 54.0	1 53.5	1 53.0	1 52.5	1 52.0	1 51.5	1 51.0	1 50.6	1 50.1	1 49.6
51	56.9	56.4	55.9	55.4	54.9	54.4	54.0	53.5	53.0	52.5	52.0
52	59.5	59.0	58.5	58.0	57.5	57.0	56.4	55.9	55.4	54.9	54.4
53	2 02.2	2 01.7	2 01.2	2 00.7	2 00.2	59.6	59.1	58.6	58.1	57.6	57.1
54	05.1	04.6	04.1	03.5	03.0	2 02.5	2 02.0	2 01.5	2 00.9	2 00.4	59.9
55	2 08.3	2 07.8	2 07.2	2 06.6	2 06.1	2 05.6	2 05.0	2 04.4	2 03.9	2 03.4	2 02.8
56	11.6	11.0	10.5	09.9	09.4	08.8	08.2	07.7	07.1	06.6	06.9
57	15.1	14.5	14.0	13.4	12.8	12.2	11.7	11.1	10.5	10.0	09.4
58	18.8	18.2	17.6	17.1	16.5	15.9	15.3	14.7	14.2	13.6	13.0
59	22.8	22.2	21.6	21.0	20.4	19.8	19.2	18.6	18.0	17.4	16.8
60	2 27.1	2 26.5	2 25.9	2 25.2	2 24.6	2 24.0	2 23.4	2 22.8	2 22.1	2 21.5	2 20.9
61	31.7	31.1	30.4	29.8	29.1	28.5	27.9	27.2	26.6	25.9	25.3
62	36.7	36.0	35.4	34.7	34.1	33.4	32.7	32.1	31.4	30.8	30.1
63	42.1	41.4	40.7	40.0	39.3	38.6	38.0	37.3	36.6	35.9	35.2
64	47.8	47.1	46.4	45.7	45.0	44.3	43.6	42.9	42.2	41.5	40.8
65	2 54.1	2 53.4	2 52.6	2 51.9	2 51.2	2 50.4	2 49.7	2 49.0	2 48.3	2 47.5	2 46.8
66	3 00.9	3 00.1	59.4	58.6	57.9	57.1	56.3	55.6	54.8	54.1	53.3
67	08.3	07.5	3 06.7	3 05.9	3 05.1	3 04.4	3 03.6	3 02.8	3 02.0	3 01.2	3 00.4
68	16.4	15.6	14.8	13.9	13.1	12.3	11.5	10.7	09.8	09.0	08.2
69	25.3	24.4	23.6	22.7	21.9	21.0	20.1	19.3	18.4	17.6	16.7
70	3 35.2	3 34.3	3 33.4	3 32.5	3 31.6	3 30.6	3 29.7	3 28.8	3 27.9	3 27.0	3 26.1
71	46.1	45.1	44.2	43.2	42.3	41.3	40.3	39.4	38.4	37.5	36.5
72	58.2	57.2	56.2	55.2	54.2	53.2	52.1	51.1	50.1	49.1	48.1

The preceding table was computed with the mean place (declination) of Polaris for each year. A closer result will be had by applying to the tabular results the following correction, which depends upon the difference of the mean and the apparent declinations of the star:

TABLE K.—*Correction of Azimuths from Polaris Observations for each Month.*

For middle of—	Latitude.				For middle of—	Latitude.			
	25°.	40°.	55°.	70°.		25°.	40°.	55°.	70°.
	′	′	′	′		′	′	′	′
January	−0.3	−0.4	−0.5	−0.9	July	+0.2	+0.3	+0.4	+0.6
February	−0.3	−0.3	−0.4	−0.7	August	+0.1	+0.1	+0.2	+0.3
March	−0.1	−0.2	−0.2	−0.4	September	0.0	−0.1	−0.1	−0.1
April	0.0	0.0	0.0	0.0	October	−0.2	−0.3	−0.4	−0.6
May	+0.2	+0.2	+0.2	+0.4	November	−0.5	−0.6	−0.7	−1.1
June	+0.2	+0.3	+0.4	+0.6	December	−0.6	−0.8	−0.9	−1.5

The tabular azimuth thus corrected may generally be depended upon with no greater error than ± 0′.2, except for high latitude, where it must be somewhat increased.

The pole star is now distant from the pole of the equator 1° 16′; it will continue to approach it for very nearly two and a quarter centuries yet, when it will be at the minimum distance—somewhat less than half a degree.

Among the simple methods for tracing out on the ground a true north and south line, and one demanding only a very slender instrumental outfit, is that given in Lalande's Astronomy, published more than a century ago; the method was used by Andrew Ellicott in his boundary survey work of Pennsylvania and was again brought to notice in the present century by Dr. Charles Davies. It consists in watching for the time when Polaris and a given bright star come to the same vertical, and then after a short lapse of time, given in a table, Polaris will be found exactly on the meridian, and hence can be referred to the horizon and to any meridian mark placed there.

The verticality may be ascertained by a plumb line or by the vertical thread of a transit instrument; the method demands neither a graduated circle, nor a chronometer, nor any *exact* knowledge of the local time, an ordinary watch being sufficient to measure the short tabular interval.

Early in the present century the star Alioth (ε Ursæ Majoris) was favorably situated for use of the method; however in 1850 the interval between times of verticality and of culmination already amounted to 17 minutes, which interval now (1893) has grown to 28.5^m for lower culmination and to 29.5^m for upper culmination, hence this star is no longer suitable. ζ Ursæ Majoris or δ Cassiopeiæ should now be substituted for it, both these stars being now in very favorable positions. ζ Ursæ Majoris or Mizar is the middle one of the three stars in the tail of the Great Bear and δ Cassiopeiæ is at the bottom of the first stroke of the letter W, as frequently imagined to unite roughly the five brightest stars of this constellation. At present the pole star culminates nearly at the time when it is on the same vertical circle with ζ Ursæ Majoris; the table is given below showing the interval for each star in the years 1890 and 1900.

For ζ Ursæ Majoris in $\left\{\begin{matrix}1890-0.9^m\\1900+2.6^m\end{matrix}\right\}$ annual increase 0.35^m

For δ Cassiopeiæ in $\left\{\begin{matrix}1890+0.1^m\\1900+3.4^m\end{matrix}\right\}$ annual increase 0.33^m

In the higher latitudes the lower culmination is preferable to the upper, but in all cases special attention is to be paid to the correct projection of the star to the horizon. (*June 1, 1893. C. A. S.*)

TO DETERMINE THE TRUE MERIDIAN BY OBSERVATION ON POLARIS AT ELONGATION, WITH THE ENGINEER'S OR SURVEYOR'S TRANSIT.

1. Set a stone, or drive a wooden plug, firmly in the ground, and upon the top thereof make a small distinct mark.

2. About thirty minutes before the time of the eastern or western elongation of Polaris, as given by the tables of elongation, set up the transit firmly, with its vertical axis exactly over the mark, and carefully level the instrument.

3. Illuminate the cross wires by the light from a bull's-eye lantern or other source, the rays being directed into the object end of the

telescope by an assistant; while great care will be taken to see that the line of collimation describes a truly vertical plane.

4. Place the vertical wire upon the star, which, if it has not reached its elongation, will move to the right for eastern, and to the left for western elongation.

5. While the star moves towards its point of elongation, by means of the tangent screw of the vernier plate it will be continually covered by the vertical wire, until a point is reached where it will appear to remain on the wire for some time, then leave it in a direction contrary to its former motion; thus indicating the point of elongation.

6. At the instant the star appears to thread the vertical wire, depress the telescope to a horizontal position; five chains north of the place of observation, set a stone or drive a wooden plug, upon which by a strongly illuminated pencil or other slender object, exactly coincident with the vertical wire, mark a point in the line of sight thus determined; then, *quickly* revolve the vernier plate 180°, repeat the observation, and as before mark a point in the new direction; then, the middle point between the two marks, with the point under the instrument, will define on the ground the trace of the vertical plane through Polaris at its eastern or western elongation, as the case may be.

7. By daylight, lay off to the east or west, as the case may require, the proper azimuth taken from the table on page 104; the instrument will then define the *true meridian*,* which may be permanently marked by monuments for future reference.

TO DETERMINE THE TRUE MERIDIAN BY OBSERVATION ON POLARIS AT ELONGATION, WITH A PLUMB-LINE AND PEEP SIGHT.

1. Attach the plumb line to a support situated as far above the ground as practicable, such as the limb of a tree, a piece of board nailed or otherwise fastened to a telegraph pole, a house, barn, or other building, affording a clear view in a north and south direction.

The plumb bob may consist of some weighty material, such as a brick, a piece of iron or stone, weighing four to five pounds, which will hold the plumb line straight and vertical, fully as well as one of turned and finished metal.

Strongly illuminate the plumb line just below its support by a lamp or candle, care being taken to obscure the source of light from the view of the observer by an opaque screen.

2. For a peep sight, cut a slot about one-sixteenth of an inch wide in a thin piece of board, or nail two strips of tin, with straight edges, to a square block of wood, so arranged that they will stand vertical when the block is placed flat on its base upon a smooth horizontal rest, which will be placed at a convenient height south of the plumb line and firmly secured in an east and west direction, in such a position that, when viewed through the peep sight, Polaris will appear about a foot below the support of the plumb line.

The position may be practically determined by trial, the night preceding that set for the observation.

3. About thirty minutes before the time of elongation, as given in the tables of elongation, bring the peep sight into the same line of sight with the plumb line and Polaris.

*The magnetic declination may be obtained from a true meridian, as follows: Take the magnetic bearing of the true meridian; then the angle expressed by said magnetic bearing will be the observed magnetic declination, named like the departure if the bearing is taken from the south, but the reverse if taken from the north.

To reach elongation, the star will move off the plumb line to the east for eastern elongation, or to the west for western elongation, therefore by moving the peep sight in the proper direction, east or west, as the case may be, keep the star on the plumb line until it appears to remain stationary, thus indicating that it has reached its point of elongation.

The peep sight will now be secured in place by a clamp or weight, and all further operations will be deferred until the next morning.

4. By daylight, place a slender rod at a distance of two or three hundred feet from the peep sight, and exactly in range with it and the plumb line; carefully measure this distance.

Take from the table on page 103, the azimuth of Polaris corresponding to the latitude of the station and year of observation; find the natural tangent of said azimuth and multiply it by the distance from the peep sight to the rod: the product will express the distance to be laid off from the rod *exactly at right angles* to the direction already determined (to the *west* for eastern elongation or to the *east* for western elongation), to a point, which with the peep sight, will define the direction of the *true meridian* with sufficient accuracy for the needs of local surveyors.

TO DETERMINE THE TRUE MERIDIAN BY OBSERVING THE TRANSITS OF POLARIS AND ANOTHER STAR ACROSS THE SAME VERTICAL PLANE.

1. A very close approximation to a true meridian may be had by remembering that Polaris very nearly reaches the true meridian when it is in the same vertical plane with the star Delta (δ) in the constellation Cassiopeia. Using the apparatus just described, place the "peep sight" in line with the plumb line and Polaris, and move it to the *west* as Polaris moves *east*, until Polaris and Delta *appear upon the plumb-line together*, and carefully note the time by a clock or watch; then, by moving the peep sight, preserve its alinement with *Polaris* and the *plumb line* (paying no further attention to the other star); at the expiration of the small interval of time * derived from the table on page 105 the *peep sight* and *plumb line* will define the *true meridian*, which may be permanently marked for future use.

2. This method is practicable only when the star Delta is *below* the pole during the night; when it passes the meridian above the pole, it is too near the zenith to be of service, in which case the star Zeta (ζ), the last star but one in the tail of the Great Bear, may be used instead.

Delta (δ) Cassiopeiæ is on the meridian below Polaris and the pole, at midnight about April 10, and is, therefore, the proper star to use at that date and for some two or three months before and after.

Six months later, the star Zeta (ζ), in the tail of the Great Bear, will supply its place, and will be used in precisely the same manner.

The method given in this article for finding the true meridian can not be used with advantage on account of the haziness of the atmosphere near the horizon, at places below about 38° north latitude.

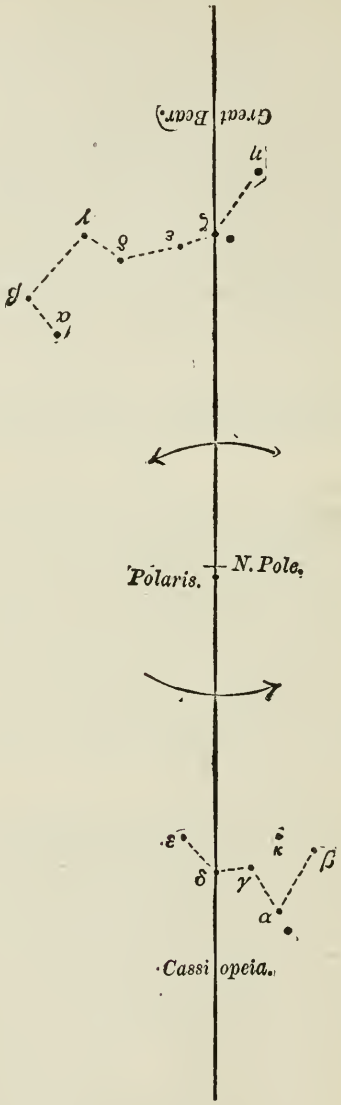
The diagram,† drawn to scale, exhibits the principal stars of the constellations Cassiopeia and Great Bear, with Delta (δ) Cassiopeia, Zeta

* For this year (1894), the "small interval of time" is for Delta (δ) Cassiopeiæ, 1.4^m; for Zeta (ζ) Ursæ Majoris (Great Bear), 0.5^m; during such brief intervals, probably no change in the position of Polaris would be observed by the unaided eye; but, as these intervals are increasing at the rate of about one-third of a minute annually, it was deemed best to provide for the proper application of the time intervals, in the method described.

† See next page.

(ζ) of the Great Bear, and *Polaris* on the meridian, represented by the straight line; Polaris being at *lower* culmination.

This method is given in Lalande's Astronomy and was practiced by A. Ellicott, in 1785, on the Ohio and Pennsylvania boundary.



The diagram held perpendicular to the line of sight directed to the pole, with the right hand side of the page uppermost, will represent the configuration of the constellations with Polaris near *eastern* elongation at midnight about July 10—*inverted*, it will show Zeta (ζ) of the Great Bear and Polaris on the meridian (the former *below* and the latter *above* the pole) at midnight about October 10; and held with left hand side uppermost the diagram will indicate relative situations for midnight about January 10, with Polaris near *western* elongation. The arrows indicate the direction of apparent motion. Zeta (ζ) of the Great Bear (also sometimes called the Great Dipper), was called *Mizar* by the ancient Arabians, and the small star near it *Alcor*. *Mizar* is the second star from the end of the handle of the dipper.

The foregoing methods for the determination of the true meridian are excellent in themselves when available, as they answer the requirements of the surveyor and give results with all desirable precision. They do not require an accurate knowledge of the time, which is their principal advantage. The relative motion of the stars employed, when near the meridian and the unchangeable azimuth of Polaris at elongation) so far as the surveyor is concerned), indicate with sufficient exactness the moment when the observation should be made. Stormy weather, a hazy atmosphere, or the presence of clouds, may interfere with or entirely prevent observation when the star is either at elongation or on the meridian, and both events sometimes occur in broad daylight or at an inconvenient hour of the night. Under such circumstances, a simple method applicable at any time (Polaris being visible), may be acceptable, and can often be used by the surveyor when other methods fail.

DETERMINATION OF THE AZIMUTH OF POLARIS AND TRUE MERIDIAN AT ANY HOUR, THE STAR BEING VISIBLE, AND THE CORRECT LOCAL MEAN TIME BEING KNOWN.

Many years ago a table was published giving azimuths of Polaris at stated times during one year, but as it was arranged for a kind of time with which surveyors are generally unacquainted, and was explained in unfamiliar astronomical terms, and required the use of tables and data not always accessible, it met with little favor and never came into general use.

In this article it is proposed to simplify the work, omit all technicalities requiring a knowledge of astronomy, and present the method, with two new and compact tables adapted to common clock time, with such plain directions for use that any person of ordinary intelligence can understand and apply them.

As the surveyor should have a perfectly clear idea of what is meant by *Astronomical Time* (used to simplify computations), and the *Hour Angle of Polaris*, these terms will now be explained.

The *Civil Day*, according to the customs of society, commences at midnight and comprises twenty-four hours from one midnight to the next following. The hours are counted from 0 to 12 from midnight to noon, after which they are again reckoned from 0 to 12 from noon to midnight. Thus the day is divided into two periods of 12 hours each; the first of which is marked a. m., the last p. m.

The *Astronomical Day* commences at noon on the civil day of the same date. It also comprises twenty-four hours; but they are reckoned from 0 to 24, and from the noon of one day to that of the next following.

The civil day begins twelve hours before the astronomical day; therefore the first period of the civil day answers to the last part of the preceding astronomical day, and the last part of the civil day corresponds to the first part of the astronomical day. Thus, January 9, 2 o'clock p. m., civil time, is also January 9, 2^h, astronomical time; and January 9, 2 o'clock a. m., civil time, is January 8, 14^h, astronomical time.

The rule, then, for the transformation of civil time into astronomical time is this: *If the civil time is marked p. m., take away the designation p. m., and the astronomical time is had without further change; if the civil time is marked a. m., take one from the day and add twelve to the hours, remove the initials a. m., and the result is the astronomical time wanted.*

The substance of the above rule may be otherwise stated, as follows: when the surveyor takes an observation during p. m. hours, civil time, he can say: the *astronomical* time is the hours and minutes passed since the noon of *this* day, and when observing in the a. m. hours he can say the *astronomical* time is the hours and minutes elapsed since the noon of *yesterday*, in either case omitting the designation a. m. or p. m., and

writing for the day of the month, that civil date on which the noon falls, from which the time is reckoned. Finally, *the astronomical time may be called the hours and minutes elapsed since the* NOON LAST PAST, *the astronomical* DATE *being that of the civil day to which the noon belongs.* Thus, April 23, 4.15 p. m., civil time, is April 23, $4^h\ 15^m$, astronomical time, and April 23, 4.15 a. m., civil time, is April 22, $16^h\ 15^m$, astronomical time.

The surveyor should thoroughly master this transformation* of the civil time into astronomical time, as it will be the first duty he will have to perform after observing Polaris out of the meridian.

Hour Angle of Polaris.—In fig. 2, Plate I, the full vertical line represents a portion of the meridian passing through the zenith Z (the point directly overhead), and intersecting the northern horizon at the north point N, from which, for surveying purposes, the azimuths of Polaris are reckoned east or west. The meridian is pointed out by the plumb line when it is in the same plane with the eye of the observer and Polaris on the meridian, and a visual representation is also seen in the vertical wire of the transit, when it bisects the star on the meridian.

When Polaris crosses the meridian it is said to culminate; above the pole (at S), the passage is called the *Upper Culmination*, in contradistinction to the *Lower Culmination* (at S′).

In the diagram,—which the surveyor may better understand by holding it up perpendicular to the line of sight when he looks toward the pole,—Polaris is supposed to be on the meridian, where it will be about *noon* on April 10th of each year. The star appears to revolve around the pole, in the direction of the arrows, once in every $23^h\ 56^m.1$† of *mean solar time;* it consequently comes to and crosses the meridian, or *culminates*, nearly four minutes *earlier* each successive day. The apparent motion of the star being uniform, one quarter of the circle will (omitting fractions) be described in $5^h\ 59^m$, one half in $11^h\ 58^m$, and three quarters in $17^h\ 57^m$. For the positions s_1, s_2, s_3, etc., the angles SPs_1, SPs_2, SPs_3, etc., are called *Hour Angles of Polaris* for the instant the star is at s_1, s_2, or s_3, etc., and they are measured by the arcs Ss_1, Ss_2, Ss_3, etc., expressed (in these instructions) in *mean solar* (common clock) time, and are always counted from the *upper* meridian (at S), to the *west*, around the circle from $0^h\ 0^m$ to $23^h\ 56^m.1$, and may have any value between the limits named. The hour angles, measured by the arcs Ss_1, Ss_2, Ss_3, Ss_4, Ss_5, and Ss_6, are approximately $1^h\ 8^m$, $5^h\ 55^m$, $9^h\ 4^m$, $14^h\ 52^m$, $18^h\ 01^m$,‡ and $22^h\ 48^m$ respectively; their extent is also indicated, graphically, by broken fractional circles about the pole.

Suppose the star observed (e. g.) at the point S_3; the time it was at S, (the time of upper culmination), taken from the whole circle, $23^h\ 56^m.1$, will leave the arc Ss_1, s_2, s_3, or the *hour angle* at the instant of observation; similar relations will obtain when the star is observed in any other position; therefore, in general:

Subtract the time of Upper Culmination from the correct local mean time of observation; the remainder will be the Hour Angle of Polaris.

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*The change can always be made mentally, no written work being required. Table I might be easily altered to give the times by the civil count marked a. m. and p. m., but such an arrangement would greatly extend and complicate the following rules and examples, and correspondingly increase the chances for making mistakes.

†A closer value is 23 hours, 56 minutes, 4.09 seconds.

‡The hour angles, $5^h\ 55^m$ and $18^h\ 01^m$ are those at west and east elongation, respectively, in latitude 40° N.

The *observation* will be made as directed on page 105, modified as follows: there will be no waiting for the star to reach elongation; the observation may be made at any instant when Polaris is visible, the exact time being carefully noted.

Table I.

This table gives, in "Part I," the local mean time of the upper culmination of Polaris, on the 1st and 15th of each month, for the years 1890 to 1900,* inclusive. The times decrease, in each year, to April 10, when they become zero; then, commencing at $23^h\ 56^m.1$, the times again decrease until the following April, and so on, continuously. The quantity in the column marked "Diff. for 1 day" is the decrease *per day* during the interval of time against which it stands, and answers for *all the years* marked in the table. For any intermediate date, the "Diff. for 1 day" will be multiplied by the days elapsed since the preceding tabular *date*, and the product *subtracted* from the corresponding *time*, to obtain the required time of upper culmination for the date under consideration. The table answers directly for 90° west longitude. For places east or west of the assumed meridian, a small correction,† dependent on the longitude, may be applied to the deduced time of culmination. This correction may be taken from Part III, and, with sufficient accuracy, for the longitude *nearest* that of the station. Use the correction according to the direction placed over it. A few examples will illustrate the use of the table.

1. Required the time of upper culmination of Polaris for a station in longitude 116° west, for March 3, 1892.

	h.	m.
Astron. time, U. C. of Polaris, 1892, March 1	2	37.8
Red. for 2 days is $3^m.94\times2=7^m.9$ (Part II) } Subtract Corr. for 116° long. is $0^m.3$ (Part III) } Subtract		8.2
Local mean time U. C. of Polaris, 1892, March 3	2	29.6

The required time may also be obtained by using the table in the opposite direction; by taking the time for March 15, and *adding* the reduction, as follows:

	h.	m.
Astron. time, U. C. of Polaris, 1892, March 15	1	42.6
Red. for 12 days is $3^m.94\times12=47^m.3$, add		47.3
Sum	2	29.9
Correction for longitude 116° (Part III), subtract		0.3
Local mean time U. C. of Polaris, 1892, March 3	2	29.6

In this case the two results are identical. If the computation is made both ways, the results will check each other.

Part II has been inserted to save the surveyor the little trouble of making multiplications; thus, for the above example, look in Part II, under the proper tabular difference, $3^m.94$, and opposite the day of the month in left hand column is the correction $7^m\ .9$; also in Part III is

*The surveyor can extend the table to the year 1910 by following directions in article on "Magnetic Declination." The values for the years following 1896 were thus computed.

†The correction for longitude should *not* be used for dates subsequent to December 31, 1896.

found the correction for 116° longitude, $0^m.3$, the sum being $8^m.2$. The work may be put down as follows:

	h.	m.
Astron. time, U. C. of Polaris, 1892, March 1 (Part I)	2	37.8
Red. (Part II), and correction for long. (Part III), subtract		8.2
Local mean time, U. C. of Polaris, 1892, March 3	2	29.6

The longitude correction being small, may generally be omitted; it will not be considered in the following examples.

Computing from a *preceding* date, for days between April 11 and 15 of any year, the reduction in Part II will be *greater* than the tabulated time of culmination, in which case $23^h\ 56^m.1$ will be *added*, to make the subtraction possible.

2. Required, for a station in long. 90° west, the time of U. C. of Polaris for April 14, 1891:

	h.	m.
Astron. time, U. C. of Polaris, 1891, April 1 (Part I)	0	38.4
Add	23	56.1
Sum	24	34.5
Reduction to April 14, (Part II), subtract		51.1
Local mean time, U. C. of Polaris, April 14	23	43.4

Working from a *following* date, for days between 9th and 15th of April, the *sum* will exceed $23^h\ 56^m.1$, and when this occurs *subtract* $23^h\ 56^m.1$ from the sum, and the *remainder* will be the required time.

3. Required, for a station in long. 90° west, the time of U. C. of Polaris for April 10, 1892:

	h.	m.
Astron. time, U. C. of Polaris, 1892, April 15 (Part I)	23	36.8
Reduction for 5 days (Part II), add		19.6
Sum	23	56.4
Subtract	23	56.1
Local mean time, U. C. of Polaris, 1892, April 10	0	0.3

This example, worked like the last one, from the *preceding* date (April 1), will give precisely the result above written. (See example above.) If to the above time of culmination we add $23^h\ 56^m.1$, and then subtract $3^m.9$, we obtain $23^h\ 52^m.5$, the time of the *second* upper culmination on April 10, since both occur within 24 hours of noon and consequently on the *same day*. The upper culmination, to be used at any time, will always be the *last* one that occurs before the observation. In this instance it is, of course, the first one that takes place on the 10th.*

The surveyor should be careful to employ Part II, Table I, correctly. When the table is used in regular order, the "Reduction" may be taken from Part II with the argument,† "Day of the month" in *left* hand column, or "Number of days elapsed" in *right* hand column, as may be preferred. In example 2, Part II, may be entered in with the argument 13 days elapsed (from 1st to 14th) in *right* hand column; then the reduction, $51^m.1$, results, as above written; but, when working from a *following* date (example 3), the day of the month in left hand column *can not be used.*

Mistakes are often made by using the wrong column in Part I; as a

* The *second* culmination occurs $7^m.5$ *before* noon of April 11, and consequently in broad daylight.

† "Argument", the quantity on which another quantity in a table depends.

matter of course, the time should *always* be taken out for the *current year.*

The foregoing examples embrace all cases which can occur in the use of Table I, and will be a sufficient guide for its application.

TABLE I.—*Local mean (astronomical) time of the upper culmination of Polaris, computed for longitude 6 hours (90°) west of Greenwich.*

[The time on line with any date in Part I is the hours and minutes elapsed (measured by a common clock or watch) since the preceding noon.]

Part I.

Date.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	Diff. for 1 day.
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	m.
Jan. 1	6 32.2	6 33.4	6 34.6	6 32.0	6 33.3	6 34.7	6 36.1	6 33.0	3.95
15	5 36.9	5 38.1	5 39.3	5 36.7	5 38.0	5 39.4	5 40.8	5 37.7	3.95
Feb. 1	4 29.8	4 31.0	4 32.2	4 29.6	4 30.9	4 32.3	4 33.7	4 30.6	3.95
15	3 34.5	3 35.7	3 37.0	3 34.3	3 35.7	3 37.1	3 38.5	3 35.3	3.95
Mar. 1	2 39.3	2 40.5	2 37.8	2 39.1	2 40.4	2 41.8	2 39.3	2 40.1	3.94
15	1 44.2	1 45.4	1 42.6	1 43.9	1 45.3	1 46.7	1 44.1	1 44.9	3.94
Apr. 1	0 37.2	0 38.4	0 35.7	0 37.0	0 38.4	0 39.7	0 37.2	0 38.0	3.94
15	23 38.3	23 39.5	23 36.8	23 38.1	23 39.4	23 40.8	23 38.3	23 39.1	3.93
May 1	22 35.4	22 36.6	22 34.0	22 35.2	22 36.6	22 38.0	22 35.5	22 36.2	3.93
15	21 40.5	21 41.7	21 39.0	21 40.3	21 41.7	21 43.0	21 40.6	21 41.3	3.92
June 1	20 33.9	20 35.1	20 32.4	20 33.7	20 35.0	20 36.4	20 33.9	20 34.7	3.92
15	19 39.0	19 40.2	19 37.5	19 38.9	19 40.2	19 41.6	19 39.1	19 39.9	3.92
July 1	18 36.4	18 37.6	18 34.9	18 36.2	18 37.6	18 38.9	18 36.5	18 37.2	3.92
15	17 41.5	17 42.8	17 40.1	17 41.4	17 42.7	17 44.1	17 41.7	17 42.4	3.92
Aug. 1	16 35.0	16 36.2	16 33.5	16 34.8	16 36.2	16 37.6	16 35.1	16 35.8	3.91
15	15 40.1	15 41.3	15 38.7	15 40.0	15 41.3	15 42.7	15 40.3	15 41.0	3.92
Sept. 1	14 33.5	14 34.7	14 32.0	14 33.3	14 34.7	14 36.1	14 33.7	14 34.3	3.92
15	13 38.6	13 39.8	13 37.1	13 38.4	13 39.8	13 41.2	13 38.8	13 39.4	3.92
Oct. 1	12 35.7	12 37.0	12 34.3	12 35.6	12 37.0	12 38.4	12 36.0	12 36.6	3.93
15	11 40.7	11 42.0	11 39.3	11 40.6	11 42.0	11 43.4	11 41.0	11 41.6	3.93
Nov. 1	10 33.9	10 35.1	10 32.4	10 33.8	10 35.1	10 36.6	10 34.1	10 34.8	3.93
15	9 38.8	9 40.0	9 37.3	9 38.6	9 40.0	9 41.5	9 39.0	9 39.6	3.94
Dec. 1	8 35.7	8 36.9	8 34.3	8 35.6	8 37.0	8 38.4	8 35.9	8 36.6	3.94
15	7 40.5	7 41.7	7 39.1	7 40.4	7 41.8	7 43.2	7 40.7	7 41.4	3.94
									3.95

Part I—Continued.

Date.	1898.	1899.	1900.	Diff. for 1 day.
	h. m.	h. m.	h. m.	m.
Jan. 1	6 34.1	6 35.2	6 36.3	3.95
15	5 38.8	5 39.9	5 41.0	3.95
Feb. 1	4 31.7	4 32.8	4 33.9	3.95
15	3 36.4	3 37.5	3 38.6	3.95
Mar. 1	2 41.2	2 42.3	2 43.4	3.94
15	1 46.0	1 47.1	1 48.2	3.94
Apr. 1	0 39.1	0 40.2	0 41.3	3.94
15	23 40.2	23 41.3	23 42.4	3.93
May 1	22 37.3	22 38.4	22 39.5	3.93
15	21 42.4	21 43.5	21 44.6	3.92
June 1	20 35.8	20 36.9	20 38.0	3.92
15	19 41.0	19 42.1	19 43.2	3.92
July 1	18 38.3	18 39.4	18 40.5	3.92
15	17 43.5	17 44.6	17 45.7	3.92
Aug. 1	16 36.9	16 38.0	16 39.1	3.91
15	15 42.1	15 43.1	15 44.3	3.92
Sept. 1	14 35.4	14 46.5	14 37.6	3.92
15	13 40.5	13 41.6	13 42.7	3.92
Oct. 1	12 37.7	12 38.8	12 39.9	3.93
15	11 42.7	11 43.8	11 44.9	3.93
Nov. 1	10 35.9	10 37.0	10 38.1	3.93
15	9 40.7	9 41.8	9 42.9	3.94
Dec. 1	8 37.7	8 38.8	8 39.9	3.94
15	7 42.5	7 43.6	7 44.7	3.94
				3.95

Part II.

Reduction of tabular times to *intermediate dates.*

Subtract the reduction when computing from a *preceding,* or add it when working from a *following* date.

Day of the month.	Reduction. Arg.—"Diff. for 1 day."					No. of days elapsed.
	m. 3.91.	m. 3.92.	m. 3.93.	m. 3.94.	m. 3.95.	
	m.	m.	m.	m.	m.	
2 or 16	3.9	3.9	3.9	3.9	3.9	1
3 or 17	7.8	7.8	7.9	7.9	7.9	2
4 or 18	11.7	11.8	11.8	11.8	11.8	3
5 or 19	15.6	15.7	15.7	15.8	15.8	4
6 or 20	19.5	19.6	19.6	19.7	19.7	5
7 or 21	23.5	23.5	23.6	23.6	23.7	6
8 or 22	27.4	27.4	27.5	27.6	27.6	7
9 or 23	31.3	31.4	31.4	31.5	31.6	8
10 or 24	35.2	35.3	35.4	35.5	35.5	9
11 or 25	39.1	39.2	39.3	39.4	39.5	10
12 or 26	43.0	43.1	43.2	43.3	43.4	11
13 or 27	47.0	47.0	47.2	47.3	47.4	12
14 or 28	50.8	51.0	51.1	51.2	51.3	13
29	54.7	54.9	55.0	55.2	55.3	14
30	58.6	58.8	58.9	59.1	59.2	15
31	62.6	62.7	62.9	63.0	63.2	16

Applications of Tables I and II.

4. Required the *Hour Angle* and *Azimuth of Polaris*, for a station in latitude 46° N., longitude 90° W., at 8h 24m p. m., November 7, 1891.

	h.	m.	h.	m.
Astronomical time of observation, 1891, Nov. 7			8	24.0
Astron. time, U. C. Polaris, Nov. 1 (Table I, Part I)	10	35.1		
Reduction to Nov. 6* (Part II), subtract		†19.7		
Astron. time, U. C. Polaris, Nov. 6	10	15.4, subtract	‡10	15.4
Hour Angle of Polaris, at observation			22	8.6
Subtract from			§23	56.1
Time Argument for Table II			1	47.5

Azimuth of Polaris, at observation ..... 1° 51′ E.

PART III.—*Correction of the tabular time for longitude.*

Longitude.	63°	72°	81°	90°	99°	108°	117°	127°
Correction	Add *m.* 0.3	Add *m.* 0.2	Add *m.* 0.1	Add *m.* 0.0	Subtract *m.* 0.1	Subtract *m.* 0.2	Subtract *m.* 0.3	Subtract *m.* 0.4

5. Required the *Hour Angle* and *Azimuth of Polaris*, for a station in latitude 41° 12′ N., longitude 94° W., at 6h 16m a. m., Nov. 19, 1898.

	h.	m.	h.	m.
Astronomical time of observation, 1898, Nov. 18			18	16.0
Astron. time, U. C. Polaris, Nov. 15 (Table I, Part I)	9	40.7		
Reduction to Nov. 19 (Part II), subtract		15.8		
Astron. time, U. C. Polaris, Nov. 19	9	24.9, subtract	9	24.9
Hour Angle of Polaris, at observation, and *Time Argument* for Table II			‖8	51.1

Azimuth of Polaris, at observation (Table II) ..... ¶ 1° 11′ W.

TABLE II.

This table gives, for various hour angles, expressed in *mean solar time*, and for even degrees of latitude from 30 to 50 degrees, the *Azimuths of Polaris* during the remainder of this century, computed for average values of the north polar distance of the star—the arguments (reference numbers), being the *hour angle* (or 23h 56m.1, *minus* the hour angle, when the latter exceeds 11h 58m), which is termed the *Time*

* By reference to the above table, the surveyor will observe that the times, between Nov. 1 and 15, are greater than 8h 24m; consequently, the culmination for one day earlier, Nov. 6, will be used; see directions on page 111; also, last clause of example 3, page 112.

† From Part II, Table I, opposite 6th day of month, and under "3.94m."

‡ To subtract, take 1 day from Nov. 7, and add its equivalent, 24h, to 8h 24m, making, Nov. 6, 32h 24m (which is the time expressed by Nov. 7, 8h 24m); then subtract in the usual manner.

§ See last clause of footnote, page 115.

‖ In case the *Hour Angle* comes out *greater* than 11h 58m, *subtract* it from 23h 56.1m; see example 4, above.

¶ The *Hour Angle* being *less* than 11h 58m, the Azimuth is *west*; see precepts, top of Table II.

Argument;* and the *latitude* of the place of observation. The table is so extended that azimuths may be taken out by mere inspection and all interpolation avoided, except such as can be performed mentally.

The *hours* of the "time arguments" are placed in the columns headed "Hours," on left of each page. The *minutes* of the time arguments will be found in the columns marked "m.," under the years for which they are computed, and they are included between the same heavy zigzag lines which inclose the hours to which they belong.

The time arguments are given to the nearest half minute; the occurrence of a period after the *minutes* of any one of them, indicates that its value is 0.5^m greater than printed, the table being so arranged to economize space.

The table will be used as follows: *Find the* HOURS *of the time argument in the left-hand column of either page; then, between the heavy lines which inclose the hours, find the* MINUTES *in the column marked at the top with the current year. On the same horizontal line with the* MINUTES, *the azimuth will be found under the given latitude, which is marked at the top of the right-hand half of each page.* Thus, for 1892, *time argument*, 0^h 40^m, latitude 42°; find 0^h on left-hand page and under 1892, find 40^m, on tenth line from the top, and on same line with the *minutes*, under latitude 42°, is the azimuth 0° 18′. For 1896, time argument 7^h 58^m, lat. 36°, the azimuth is 1° 19′, found on the 9th line from bottom of right-hand page.

If the *exact* time argument is not found in the table, the azimuth should be proportioned to the difference between the given and tabular values of said argument. Thus, if the time argument in the first of the above examples (for 1892) was 0^h 42^m, instead of 0^h 40^m, the azimuth would be the mean between 0° 18′ and 0° 20′, or 0° 19′. In a similar manner, if the *latitude* is nearer an *odd* than an *even* degree, the mean of the azimuths for the next greater and next less latitude will be used; thus, in the above example for 1896, if the given latitude was 37°, the mean between 1° 19′ and 1° 21′, or 1° 20′, would be the corresponding azimuth. The table has been arranged to give the azimuths as exemplified above, by simple inspection. No written arithmetical work is required, all being performed mentally. It will always be sufficient to take the nearest *whole* degree of latitude and use it as above directed, except for a few values near the bottom of either page, where the difference of azimuths, for 2° difference of latitude, amounts to 4 or 5 minutes of arc; for example, 1890, time argument, 7^h 29^m, lat. 46° 40′. In this case the latitude may be taken to the nearest *half* degree (46½°); the corresponding azimuth is 1° 42′. See another example in Specimen Field Notes, page 158.

3. The attention of the surveyor is directed to the fact that he should always use *one day* of *twenty-four hours* as the unit when he subtracts

* The vertical diameter SS′, Plate I, fig. 2, divides the apparent path of Polaris into two equal parts, and for the star at any point s_6 on the *east* side, there is a corresponding point s_1, on the *west* side of the meridian, for which the azimuth Nw, is equal to the azimuth Ne. The arc $Ss_1S's_6$, taken from the entire circle (or 23^h $56^m.1$), leaves the arc Ss_6, and its equal, Ss_1, expressed in time, may be used to find, from Table II, the azimuth Nw, which is equal to Ne.

The hour angles entered in Table II include only those of the *west half* of the circle ending at S′, and when an hour angle *greater* than 11^h 58^m results from observation, it will be *subtracted* from 23^h $56^m.1$, and the *remainder* will be used as the "time argument" for the table. The surveyor should not confound these two quantities. The *hour angle itself* always decides the *direction* of the azimuth and defines the place of the star with reference to the pole and meridian, as noted at top of Table II. See examples below Table I, page 114.

the time of *culmination* from the time of *observation*. See example 4, page 114. In any case when the time of upper culmination, taken from Table I, for the given date, would be numerically *greater* than the *astronomical* time of observation, the former time will be taken out for a date *one day earlier* than the date of observation. The surveyor will decide when such condition exists by comparing the time given in the table with his *astronomical* time of observation. See example 4 and explanations in footnotes below Table I, page 114.

When an hour angle comes out within *one minute* of either $0^h\ 0^m$, or $23^h\ 56^m.1$, the observation may be regarded as having been taken with the star on the meridian, *above* the pole; if within one minute of $11^h\ 58^m$, Polaris may be considered on the meridian *below* the pole at the time of observation.

At *elongation* Polaris is nearly $5^h\ 55^m$ west (or east) of its position at upper culmination; consequently if the hour angle for *any* observation comes out within *five minutes* of $5^h\ 55^m$ or $18^h\ 1^m$, the star may be assumed to be *at elongation*, *west* for the first and *east* for the second hour angle, and its azimuth may be taken from a preceding table, which gives its value at elongation, from 1890 to 1910,* inclusive.

Should the surveyor wish the time of *Lower Culmination*, for use with the plumb-line method, described on page 107, or for any other purpose, he will first determine the time of *upper* culmination for the date (Table I), and then *subtract* $11^h\ 58^m$ for the *preceding* lower culmination, or *add* $11^h\ 58^m$ for the lower culmination *following* the derived time for upper culmination, attending to the addition or subtraction of $23^h\ 56^m.1$, as directed on page 112.

The time to be used when making observations on Polaris off the meridian, should be as accurate as can be obtained. Looking at Table II, near the top of either page, the surveyor will observe, that for a difference of *four* minutes in the time argument, there is a change of about *two* minutes in azimuth; consequently, to obtain the azimuth to the *nearest whole minute of arc*, the *local mean time*, upon which all depends, should be known *within two minutes*. When the surveyor uses a solar instrument, he can readily determine the time for himself during the afternoon *before* observing Polaris, or in the morning *after* observation, and, without moving the hands of his watch, apply the necessary correction to his *observed* watch time, as exemplified in Specimen Field Notes, page 172. When the surveyor uses *standard railroad time*, he will correct the same for the difference of longitude between his station and the standard meridian for which the time is given, at the rate of *four minutes* of time *for each degree* of the difference in arc. Thus, if the difference of longitude is $6^\circ\ 45'$, the equivalent in time will be 27 minutes. The difference of longitude may be taken from a good map. The number of seconds taken from the 5th column of Table X, (opposite the proper latitude), multiplied by the number of *ranges*, will give the correction for longitude in *seconds* of time. The correction will be *subtracted* from the standard railroad time of observation, when the surveyor's station is *west*, or *added* when *east* of the standard meridian, as the case may require, to obtain *local* time. It is immaterial *where* the surveyor obtains the standard time, provided he gets it right; a result which will be determined in the most satisfactory manner, by a direct comparison at telegraph office, personally conducted.

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* See table prepared in office of U. S. Coast and Geodetic Survey; article on Magnetic Declination, page 103.

Generally, the surveyor will have only two or three simple additions or subtractions to make, and ten minutes will be ample time in which to make the observation and perform the little computation required.

NOTE.—The *azimuths* entered in the following table were calculated with the mean North Polar Distance of Polaris (1° 16′ 32″), the assumed latitudes of the table, and the stated *hour angles* for the year 1890. The resulting values having been tabulated, the process was reversed, and with the mean N. P. D. of the star, for the 1st of July of each of the remaining ten years of the series, the *latitudes* named, and *azimuths* already determined, the corresponding *hour angles* were found. By this artifice, the table (which, if computed for the *same* hour angles for each year, would cover twenty-two pages of this book), is here confined to two pages, and this without any sacrifice of precision, and with the additional advantage of presenting all the *azimuths for eleven years*, at one opening of the book, an arrangement which will be appreciated by those surveyors who may have occasion to use this method in the discharge of their professional duties.

VERIFYING RESULTS OF SOLAR WORK.

Surveyors general and their deputies have sometimes failed to appreciate the requirements of the Manual on testing the adjustment of the solar compass and verifying the accuracy of its work. In some cases a wholly erroneous idea thereon has been entertained, making it necessary to instruct deputies that the adjustments of a solar compass are *not* proved correct by its own meridian, obtained at a single setting; but that its meridian must be verified by a proper Polaris observation, to render the field notes reliable.

If a solar instrument standing unmoved, both forenoon and afternoon, gives an unvarying result, it is presumed to be accurately set, and all its parts in adjustment; but the requirement of a careful test of the solar by stellar observation, will be rigidly adhered to.

The practice of permitting field examinations to be made by examiners using needle compasses only will be henceforth discontinued. Surveyors general should appoint for inspectors of field work only such as are competent to make critical examination of the courses of surveyed lines.

TABLE II.—*Azimuths of Polaris*

[The hour angles are expressed in *mean solar* time. The occurrence of a period

STAR AND AZIMUTH.

W. of N. when hour angle is *less* than $11^h\ 58^m$.
E. of N. when hour angle is *greater* that $11^h\ 58^m$.

Time argument, the star's hour angle (or $23^h\ 56^m.1$ *minus* the star's hour angle), for the year—

POLARIS *above* THE POLE

To determine the true meridian, the azimuth will be laid off to the *east* when the hour angle is *less* than $11^h\ 58^m$, and to the *west* when *greater* than $11^h\ 58^m$.

Hours.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.
h.	4	4	4	4	4	4	4	4	4	4	4
0	4	4	4	4	4	4	4	4	4	4	4
	8	8	8	8	8	8	8	8	8.	8.	8.
	12	12	12	12	12	12	12.	12	12.	12.	12.
	16	16	16	16	16.	16.	16.	16.	16.	16.	16.
	20	20	20	20.	20.	20.	20.	20.	20.	21	21
	24	24	24	24.	24.	24.	24.	24.	24.	25	25
	28	28	28	28.	28.	28.	28.	28.	29	29	29
	32	32	32	32.	32.	32.	32.	33	33	33.	33.
	36	36	36	36.	36.	36.	37	37	37	37.	37.
	40	40	40	40.	40.	41	41	41	41.	41.	41.
	44	44	44.	44.	44.	45	45	45.	45.	45.	46
	48	48	48.	48.	49	49	49	49.	49.	50	50
	52	52	52.	52.	53	53	53.	53.	53.	54	54
0	56	56	56.	56.	57	57	57.	57.	58	58	58.
1	0	0	0.	0.	1	1.	1.	2	2	2.	2.
	5	5	5.	6	6	6.	6.	7	7	7.	7.
	10	10.	10.	11	11	11.	11.	12	12.	13	13
	15	15.	15.	16	16	16.	17	17.	17.	18	18
	20	20.	20.	21	21.	21.	22	22.	22.	23	23.
	25	25.	25.	26	26.	27	27	28	28.	28.	28.
	30	30.	31	31.	31.	32	32.	33	33.	34	34
	34.	35	35.	36.	36.	37	37.	38	38	38.	39
	39.	40	40.	41	41.	42	42.	43	43.	44	44.
	44.	45	45.	46	46.	47	47.	48	48.	49	49.
	49.	50	50.	51	52	52.	53	53.	54	54.	55
	54.	55	55.	56.	57	57	58	58.	59	59.	0
1	59.	0.	1	1.	2	2.	3	3.	4.	5	5.
2	4.	5.	6	6.	7.	8	8.	9	9.	10	10.
	9.	10	11	11.	12	12.	13.	14	14.	15	16
	14.	15	16	16.	17.	18	18.	19	20	20.	21.
	19.	20.	21	21.	22.	23	24	24.	25	26	26.
	24.	25.	26	26.	27.	28	29	30	30.	31	32
	29.	30.	31	31.	32.	33.	34.	35	35.	36.	37
	34	35.	36	37	38	38.	39.	40	41	41.	42.
	39.	40.	41	42	43	43.	44.	45.	46.	47	48
	44.	45.	46	47	48	49	49.	50.	51.	53	53
	49.	50.	51	52	53.	54	55	56	57	57	58.
	54.	55.	56.	57	58.	59	0	1	2	3	4
2	59.	1.	1.	2.	3.	4.	5.	6.	7.	8.	9.
3	5.	6.	7.	8.	10	10.	12	13	14	15	16
	11.	12.	13.	14.	16	17	18	19.	20.	21.	23
	17.	18.	19.	21	23	23	24.	25.	27	28	29.
	23.	24.	26	27	29	29.	31	32.	33.	35	36
	29.	30.	32	33	35	36	37.	39	40	41.	43
	36.	38	39	40.	42	43.	45	46.	48	49.	51
	43.	45	46.	47.	49.	51	52.	54	55.	57.	59
	50.	52	53.	55	57	58.	0	2	3.	5	7
3	59.	1	2.	4	6.	8	10	12	13.	15.	17.
4	9.	11	13	15	17.	19	21.	23.	25.	28	30
	19.	21.	23.	25.	28.	30.	33	35.	38	40.	43
	29.	32	34	36.	40	42	45	48	50.	54	57.
	44	47.	50	53	57.	0.	4.	8.	12.	17.	23
4	59	3	7	11	17	20.	29	37	50.	....	....
5	19	25.	32	41.	....	....	....	....	....	....	....
5	55	....	....	....	....	....	....	....	....	....	....

Azimuths for latitude—

30	32	34	36	38	40	42	44	46	48	50
°	°	°	°	°	°	°	°	°	°	°
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
0 2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0
3	3	3	3	3	4	4	4	4	4	4
5	5	5	5	5	5	6	6	6	6	6
6	6	6	7	7	7	7	8	8	8	8
8	8	8	8	9	9	9	9	10	10	11
9	10	10	10	10	11	11	11	12	12	13
11	11	11	12	12	12	13	13	14	14	15
12	13	13	13	14	14	15	15	16	16	17
14	14	15	15	15	16	16	17	18	18	19
15	16	16	17	17	18	18	19	20	20	21
17	17	18	18	19	19	20	21	21	23	23
19	19	19	20	21	22	22	23	23	24	25
20	21	21	22	22	23	24	24	25	26	27
22	22	23	23	24	25	25	26	27	28	29
23	24	24	25	26	26	27	28	29	30	32
25	26	26	27	28	28	29	30	31	33	34
27	28	29	30	31	32	33	33	34	35	37
29	29	30	31	32	33	34	35	36	38	39
31	31	32	33	34	35	36	37	38	40	42
32	33	34	35	36	37	38	39	41	42	44
34	35	36	37	38	39	40	42	43	45	47
36	37	38	39	40	41	42	44	45	47	49
38	39	40	41	42	43	44	46	47	49	51
39	40	41	42	44	45	46	48	50	52	54
41	42	43	44	46	47	48	50	52	54	56
43	44	45	46	47	49	50	52	54	56 0	59
45	46	47	48	49	51	52	54	56 0	58 1	1
46	47	49	50	51	53	54	56 0	58 1	1	3
48	49	50	51	53	54	56 0	58 1	0	3	5
50	51	52	53	55	56 0	58 1	0	2	5	8
51	52	54	55	57 0	58 1	0	2	4	7	10
53	54	55	57 0	58 1	0	2	4	6	9	12
54	55	57 0	58 1	0	2	4	6	8	11	14
56	57 0	58 1	0	2	3	6	8	10	13	16
57 0	59 1	0	2	3	5	7	9	12	15	18
59 1	0	2	3	5	7	9	11	14	17	20
1 0	2	3	5	7	8	11	13	16	19	22
2	3	5	6	8	10	12	15	17	20	24
3	4	6	8	10	12	14	16	19	22	26
5	6	8	10	12	13	16	18	21	24	28
6	8	9	11	13	15	18	20	23	27	30
8	9	11	13	15	17	19	22	25	28	32
9	11	13	14	16	19	21	24	27	30	34
11	13	14	16	18	20	23	25	29	32	36
12	14	16	17	20	22	25	27	31	34	38
14	15	17	19	21	24	26	29	32	36	40
15	17	19	21	23	25	28	31	34	38	42
17	19	21	23	25	27	30	33	36	40	44
19	21	23	24	27	29	32	35	39	43	47
20	22	24	26	29	31	34	37	41	45	49
22	24	26	28	30	33	36	39	42	47	51
24	26	28	30	33	35	38	41	45	49	54
26	27	30	32	34	37	40	43	47	51	56
27	29	31	33	36	39	42	45	49	53	58
1 29 1	30 1	32 1	35 1	37 1	40 1	43 1	47 1	50 1	55 1	59

for the use of land surveyors.

after minutes of an hour angle indicates that its value is 0ᵐ.5 greater than printed.]

STAR AND AZIMUTH.

W. of N. when hour angle is *less* than 11ʰ 58ᵐ.
E. of N. when hour angle is *greater* than 11ʰ 58ᵐ.

Time argument, the star's hour angle (or 23ʰ 56ᵐ 1. *minus* the star's hour angle), for the year—

Hours.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
h.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.
11	54	54	54	54	54	54	54	54	54	54	54
	50	50	50	50	50	50	50	50	50	50	50
	46	46	46	46	46	46	46.	45.	45.	46.	45.
	42	42	42	42	42	42	41.	41.	41.	41.	41.
	38	38	38	37.	37.	37.	37.	37.	37.	37.	37.
	34	34	34	33.	33.	33.	33.	33.	33.	33	33
	30	30	30	29.	29.	29.	29.	29.	29	29	29
	26	26	26	25.	25.	25.	25.	25	25	25	25
	22	22	22	21.	21.	21	21	21	21	21	21
	18	18	18	17.	17.	17.	17	17	17	16.	16.
	14	14	14	13.	13.	13.	13	13	12.	12.	12.
	10	10	10	9.	9.	9.	9	8.	8.	8.	8
	6	6	6	5.	5.	5.	5	4.	4.	4.	4
11	2	2	2	1.	1.	1	1	1	0.	0.	0
10	58	57.	57.	57	57	56.	56.	56.	56.	55.	55.
	53	52.	52.	52.	52	51.	51.	51	51	50.	50.
	48	47.	47.	47.	47	46.	46.	46	46	45.	45
	43	42.	42.	42.	42.	41.	41.	41	40.	40.	40
	38.	38	37.	37.	37	36.	36	35.	35.	35	35
	33.	33	32.	32.	32	31.	31	30.	30.	30	29.
	28.	28	27.	27	26.	26	26	25.	25	24.	24.
	23.	23	22.	22	21.	21	21	20.	20	19.	19
	18.	18	17.	17	16.	16	15.	15.	15	14.	14
	13.	13	12.	12	11.	11	10.	10	9.	9	8.
	8.	8	7.	7	6.	6	5.	5	4.	4	3.
10	3.	3	2.	2	1.	1	0	59.	59	58.	58
9	58.	58	57.	57	56	55.	55.	54.	54	53	53
	53.	53	52.	52	51	50.	50.	49	49	48	47.
	48.	48	47.	46.	46	45.	44.	44	43.	43	42
	43.	43	42	41.	40.	40.	39.	39	38.	37.	37
	38.	38	37	36.	35.	35	34.	33.	33	32	31.
	33.	32.	32	31.	30.	30	29	28.	28	27	26.
	28.	28	27	26.	25.	25	24	23	22.	21.	21
	23.	23	22	21.	20.	19.	19	18	17.	16.	15.
	18.	17.	17	16	15	14.	13.	12.	12	11	10
	13.	12.	12	11	10	9.	8.	7.	6.	5.	5
	8.	7.	7	6	5	4	3	2	1.	0.	59.
9	3.	2.	2	1	59.	58	58	57	56	55	54
8	58.	57.	56.	55.	54.	54	52.	52	51	49.	49
	52.	51.	50.	49.	48.	47.	46.	45.	44.	43	42.
	46.	45.	44.	43.	42.	41.	40	39.	38	36.	35.
	40.	39.	38.	37.	36	35	33.	32.	31.	30	29
	34.	33.	32.	31	29.	28.	27	27	25	23.	23.
	28.	27.	26	25	23	21.	21	19.	17.	17	15.
	21.	20.	19	18	16	15	13.	12	10.	9	7.
	14.	13	12	10.	8.	7.	5.	4	2.	1	59.
8	7.	6	5	3.	1	0	58	56.	55	53	51.
7	58.	57	55	54	51.	50	48	46.	44.	42.	40.
	48.	47	45	43.	40.	39	37	35	33	30.	28.
	38.	36.	34.	32.	29.	28	25	23	20.	18	15.
	29	26.	24	22	18.	16.	13.	10.	7.	4.	1.
7	14	11	8	5	1	58	54	50	45.	41	35.
6	59	55	51.	47.	41	37.	30	22.	11	....	....
6	39	52.	26	16.	....	....	....	....	....	....	....
5	55	....	....	....	....	....	....	....	....	....	....

POLARIS *below* THE POLE.

To determine the true meridian, the azimuth will be laid off to the *east* when the hour angle is *less* than 11ʰ 58ᵐ, and to the *west* when *greater* than 11ʰ 58ᵐ.

Azimuths for latitude—

° 30	° 32	° 34	° 36	° 38	° 40	° 42	° 44	° 46	° 48	° 50
° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
0 1 0	1 0	1 0	2 0	2 0	2 0	2 0	2 0	2 0	2 0	2
3	3	3	3	3	3	3	4	4	4	4
5	5	5	5	5	5	5	5	6	6	6
6	6	6	6	7	7	7	7	8	8	8
8	8	8	8	8	8	9	9	9	10	10
9	9	9	10	10	10	11	11	11	12	12
11	11	11	11	12	12	12	13	13	14	14
12	12	13	13	13	14	14	14	15	15	16
14	14	14	15	15	15	16	16	17	17	18
15	15	16	16	17	17	18	18	19	19	20
17	17	17	18	18	19	19	20	21	21	22
18	18	19	19	20	20	21	22	22	23	25
20	20	20	21	22	22	23	23	24	25	26
21	21	22	23	23	24	24	25	26	27	28
23	23	24	24	25	25	26	27	28	29	30
24	25	25	26	27	27	28	29	30	31	32
26	27	27	28	29	29	30	31	32	34	35
28	29	29	30	31	31	32	33	35	36	37
30	30	31	32	33	34	35	36	37	38	40
32	32	33	34	35	36	37	38	39	41	42
33	34	35	36	37	38	39	40	41	43	44
35	36	37	37	39	40	41	42	43	45	47
37	38	39	39	40	41	43	44	46	47	49
39	39	40	41	42	43	45	46	48	49	51
40	41	42	43	44	45	47	48	50	52	54
42	43	44	45	46	47	49	50	52	54	56
44	45	46	47	48	49	51	52	54	56 0	58
45	46	47	48	50	51	53	54	56 0	58 1	0
47	48	49	50	51	53	54	56 0	58 1	0	2
49	50	51	52	53	55	56 0	58 1	0	2	5
50	51	52	53	55	56 0	58 1	0	2	4	7
51	53	54	55	57 0	58 1	0	2	4	6	9
53	54	56	57 0	58 1	0	2	4	6	8	11
55	56	57 0	58 1	0	2	4	5	8	10	13
56	57 0	59 1	0	2	3	5	7	10	12	15
58 0	59 1	0	2	3	5	7	9	11	14	17
59 1	0	2	3	5	7	9	11	13	16	19
1 0	2	3	5	6	8	10	12	15	18	21
2	3	5	6	8	10	12	14	17	20	23
3	5	6	8	10	12	14	16	19	22	25
5	6	8	9	11	13	16	18	21	24	27
7	8	10	11	13	15	17	20	22	26	29
8	9	11	13	15	17	19	22	24	28	31
10	11	13	14	16	18	21	23	26	29	33
11	13	14	16	18	20	23	25	28	31	35
13	14	16	18	20	22	25	27	30	33	37
14	16	18	19	21	24	26	29	32	35	39
16	18	19	21	24	26	28	31	34	38	42
18	19	21	23	26	28	31	33	37	40	44
20	21	23	25	27	30	33	35	39	43	47
21	23	25	27	29	32	35	37	41	45	49
23	25	27	29	32	34	37	40	43	47	52
25	27	29	31	34	36	39	42	46	50	54
27	29	31	33	36	38	41	44	48	52	57
1 29 1	30 1	32 1	35 1	37 1	40 1	43 1	47 1	50 1	55 1	59

SURVEYING BASE LINES AND STANDARD PARALLELS BY OFFSETS FROM STRAIGHT LINES.

[See Plate II, fig. 5.]

The corners on a Base Line or Standard Parallel could be established from chords of the latitude curve, joining successive township corners; from a tangent to the true latitude curve at a point midway between the township corners; or from an intermediate straight line parallel to the lines above mentioned. In the *first* case, all the offsets would be measured *south;* in the *second* case, all offsets would be measured *north;* and, in both cases, the *maximum* offset, or greatest distance of the latitude curve from the reference lines, would be one-fourth of the greatest offset from a tangent six miles long, (i. e.) the offset found in table V, opposite the proper latitude, and in the column headed "3 miles"; while the *initial bearings* of the three lines, (i. e.) the angles K, M, and L, would be *equal to each other*; similar relations between the bearings at corresponding points, would obtain through a range.

The method of establishing corners on a true latitude curve by offsets from a line situated between and parallel to the chord and tangent, which was devised to meet a demand for *short offsets*, will now be described.

SECANT METHOD.

[See Plate II, figs. 1, 2, and 5.]

This method consists of running out a connected series of straight lines, each six miles long, on such courses that any one of the lines will intersect the curve of the parallel of latitude in two points, separated by an interval of four miles; and, from the lines thus established, measuring north or south, as the case may be, to attain other required points on the latitude curve. For the sake of brevity, said straight lines will be called *secants*.

TABLE III.—*Azimuths of the Secant, and Offsets, in Feet, to the Parallel.*

Arguments: latitude in left hand column and distance from starting point at top or bottom of the table.*

Latitude.	Azimuths and offsets at—							Deflection Angle and nat. tan. to Rad. 66 ft.
	0 miles.	½ mile.	1 mile.	1½ miles.	2 miles.	2½ miles.	3 miles.	
°								
30	89° 58′.5 1.93 N.	89° 58′.7 0.87 N.	89° 59′.0 0.00	89° 59′.2 0.67 S.	89° 59′.5 1.15 S.	89° 59′.7 1.44 S.	90° (E. or W.) 1.54 S.	3′ 00″.2 0.69 ins.
31	89° 58′.4 2.01 N.	89° 58′.6 0.91 N.	89° 58′.9 0.00	89° 59′.2 0.70 S.	89° 59′.5 1.20 S.	89° 59′.7 1.50 S.	90° (E. or W.) 1.60 S.	3′ 07″.4 0.72 ins.
32	89° 58′.4 2.09 N.	89° 58′.6 0.94 N.	89° 58′.9 0.00	89° 59′.2 0.73 S.	89° 59′.5 1.25 S.	89° 59′.7 1.56 S.	90° (E. or W.) 1.67 S.	3′ 15″.0 0.75 ins.
33	89° 58′.3 2.17 N.	89° 58′.5 0.97 N.	89° 58′.8 0.00	89° 59′.1 0.76 S.	89° 59′.4 1.30 S.	89° 59′.7 1.62 S.	90° (E. or W.) 1.73 S.	3′ 22″.6 0.78 ins.
34	89° 58′.2 2.25 N.	89° 58′.5 1.01 N.	89° 58′.8 0.00	89° 59′.1 0.79 S.	89° 59′.4 1.35 S.	89° 59′.7 1.69 S.	90° (E. or W.) 1.80 S.	3′ 30″.4 0.81 ins.
35	89° 58′.2 2.33 N.	89° 58′.5 1.05 N.	89° 58′.8 0.00	89° 59′.1 0.82 S.	89° 59′.4 1.40 S.	89° 59′.7 1.75 S.	90° (E. or W.) 1.87 S.	3′ 38″.4 0.84 ins.
36	89° 58′.1 2.42 N.	89° 58′.4 1.09 N.	89° 58′.7 0.00	89° 59′.0 0.85 S.	89° 59′.4 1.46 S.	89° 59′.7 1.82 S.	90° (E. or W.) 1.94 S.	3′ 46″.4 0.87 ins.
37	89° 58′.0 2.51 N.	89° 58′.3 1.13 N.	89° 58′.6 0.00	89° 58′.9 0.88 S.	89° 59′.3 1.51 S.	89° 59′.7 1.89 S.	90° (E. or W.) 2.01 S.	3′ 55″.0 0.90 ins.
38	89° 58′.0 2.61 N.	89° 58′.3 1.17 N.	89° 58′.6 0.00	89° 58′.9 0.91 S.	89° 59′.3 1.56 S.	89° 59′.7 1.95 S.	90° (E. or W.) 2.08 S.	4′ 03″.6 0.93 ins.
39	89° 57′.9 2.70 N.	89° 58′.2 1.21 N.	89° 58′.6 0.00	89° 58′.9 0.94 S.	89° 59′.3 1.62 S.	89° 59′.7 2.02 S.	90° (E. or W.) 2.16 S.	4′ 12″.6 0.97 ins.
40	89° 57′.8 2.79 N.	89° 58′.1 1.25 N.	89° 58′.5 0.00	89° 58′.9 0.98 S.	89° 59′.3 1.68 S.	89° 59′.7 2.10 S.	90° (E. or W.) 2.24 S.	4′ 21″.6 1.00 ins.
41	89° 57′.7 2.89 N.	89° 58′.0 1.30 N.	89° 58′.4 0.00	89° 58′.8 1.02 S.	89° 59′.2 1.74 S.	89° 59′.6 2.17 S.	90° (E. or W.) 2.32 S.	4′ 31″.2 1.04 ins.
42	89° 57′.7 3.00 N.	89° 58′.0 1.35 N.	89° 58′.4 0.00	89° 58′.8 1.05 S.	89° 59′.2 1.80 S.	89° 59′.6 2.25 S.	90° (E. or W.) 2.40 S.	4′ 40″.8 1.08 ins.
43	89° 57′.6 3.11 N.	89° 58′.0 1.40 N.	89° 58′.4 0.00	89° 58′.8 1.08 S.	89° 59′.2 1.86 S.	89° 59′.6 2.33 S.	90° (E. or W.) 2.48 S.	4′ 50″.8 1.12 ins.
44	89° 57′.5 3.22 N.	89° 57′.9 1.45 N.	89° 58′.3 0.00	89° 58′.7 1.12 S.	89° 59′.2 1.93 S.	89° 59′.6 2.41 S.	90° (E. or W.) 2.57 S.	5′ 01″.0 1.16 ins.
45	89° 57′.4 3.33 N.	89° 57′.8 1.50 N.	89° 58′.3 0.00	89° 58′.7 1.16 S.	89° 59′.1 2.00 S.	89° 59′.5 2.49 S.	90° (E. or W.) 2.66 S.	5′ 11″.8 1.20 ins.
46	89° 57′.3 3.44 N.	89° 57′.7 1.55 N.	89° 58′.2 0.00	89° 58′.6 1.21 S.	89° 59′.1 2.07 S.	89° 59′.5 2.59 S.	90° (E. or W.) 2.76 S.	5′ 22″.8 1.24 Ins.
47	89° 57′.2 3.57 N.	89° 57′.6 1.61 N.	89° 58′.1 0.00	89° 58′.6 1.25 S.	89° 59′.1 2.14 S.	89° 59′.5 2.67 S.	90° (E. or W.) 2.86 S.	5′ 34″.2 1.28 Ins.
48	89° 57′.1 3.70 N.	89° 57′.5 1.66 N.	89° 58′.0 0.00	89° 58′.5 1.30 S.	89° 59′.0 2.22 S.	89° 59′.5 2.78 S.	90° (E. or W.) 2.96 S.	5′ 46″.2 1.33 ins.
49	89° 57′.0 3.82 N.	89° 57′.5 1.72 N.	89° 58′.0 0.00	89° 58′.5 1.34 S.	89° 59′.0 2.30 S.	89° 59′.5 2.87 S.	90° (E. or W.) 3.06 S.	5′ 58″.6 1.38 ins.
50	89° 56′.9 3.96 N.	89° 57′.4 1.78 N.	89° 57′.9 0.00	89° 58′.4 1.39 S.	89° 59′.0 2.38 S.	89° 59′.5 2.97 S.	90° (E. or W.) 3.17 S.	6′ 11″.4 1.43 Ins.
Latitude.	6 miles.	5½ miles.	5 miles.	4½ miles.	4 miles.	3½ miles.	3 miles.	Deflection Angle and nat. tan. to Rad. 66 ft.
	Azimuths and offsets at—							

**Applications of Table III.*—The *true bearing* of the secant at each mile and half-mile point will be expressed by the tabular azimuth preceded by the initial meridional letter N, when the distance argument is found at the *top* of the table; but when said argument is found at the *bottom* of the table,

The direction of the first secant will be determined at its initial point by observations on *Polaris at elongation*, and similar observations will be made *at intervals not exceeding 18 miles;* while observations by the method given on page 107, *et seq.*, or on Polaris at elongation (as the deputy may prefer), will be taken *every night* when practicable, to guard against mistakes, detect errors, and check the direction of the line.

The principal advantage of this method, over that by offsets from a tangent, results directly from the proximity of the secant and the parallel of latitude, and the consequent reduced length of the *maximum* offsets; thereby limiting the cutting, which will contain both *secant and parallel*, to a single opening less than four feet in width; avoiding the necessity for clearing out roads for, and *instrumentally* laying off the long offsets inseparable from the tangent method; and permitting the noting of topographical features on the lines actually run, a convenience unattainable by the tangent method.

In any given case, the secant lines will bear such relations to the latitude curve, that points on said secants, at one and five miles from either end of any secant, will be coincident with two points on the latitude curve four miles apart; between which points the latitude curve will lie *south* of the secants; while the curve will lie *north* of the secant lines on the first and sixth miles; therefore, each secant will run *south of secs. 31 and 36*, in every range, and *through* all other sections on the north side of the base line or standard parallel, as the case may be. (See figs. 1 and 2.)

Each secant, the azimuth and offsets thereof, and the corresponding part of the parallel, will be symmetrically divided by the middle meridian of each range, (i. e.) the bearings and offsets at equal distances on opposite sides of the central meridian will be equal; the bearings, which continually change, will always be north of east (or west), on the first three miles, and south of east (or west), on the last three miles of each secant. The changes of bearing should not be understood to imply a change of direction of any secant with respect to its initial direction; the change is due to the varying inclination of the meridians to the *straight* secant, (i. e.) the effect of "convergency of meridians." (See third column of Table X, and Plate II, figs. 1, 2, and 5.)

Employing the data provided by Table III, the practical application of the method herein outlined will be conducted in the field as follows:

1. Set up the carefully adjusted transit *south* of the township corner at which the survey will begin, and at a distance therefrom to be interpolated for the given latitude, from the column headed "0 miles." By observations on Polaris at elongation, determine and mark a true meridian, in accordance with directions on page 105.

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the meridional letter S. will be placed before the azimuth; while the departure letter, E. or W., will be made to agree with the direction of the survey, *east* or *west*, as the case may require. The bearings will be taken from the table, to the *nearest whole minute only*, and entered at the beginning of each mile recorded in the field notes. The direction of the offsets or distances from the secant north or south to the base line or standard parallel, as the case may be, are indicated by the initial letters, N. or S. following the offsets.

Example 1.—Standard parallel run west, lat. 48° N.; dist. from initial point of secant, 2 miles; the bearing is N. 89° 59′ W., the offset, 2.22 ft. S.; at 5½ miles the bearing is S. 89° 57′ W., the offset 1.66 ft. N. In all latitudes the bearing of the secant at 3 miles will be east or west, agreeing with the direction of the survey. (See the 8th column of the table.)

The offsets may be interpolated for minutes of latitude, by simple proportion, as follows: *Multiply the difference between the offsets corresponding to the whole degrees of latitude, immediately preceding and following the given latitude, by the minutes, expressed in decimals of a degree, and add the product to the offset corresponding to the lesser latitude; the sum will be the offset required.*

Example 2.— (*See* Plate II, figs. 1 and 2.) Lat. 45° 34′.5; dist., 0 miles or 6 miles; the diff. between offsets in latitudes 45° and 46°, is 0.11 ft.; 34′.5 = 0°.575; 0.11 × 0.575 = 0.06 ft.; and, 3.33 + 0.06 = 3.39 ft., the offset required. All offsets written in figs. 1 and 2 were thus computed. A similar method of interpolation may be applied to the data in the right-hand column.

Example 3.—Latitude 45° 34′.5; diff. of angles, is 0′ 11″; 11 × 0.575 = 6″.3; and 5′11″.8 + 6″.3 = 5′ 18″, nearly; also, 0.04 × 0.575 = 0.02 ins.; and, 1.20 + 0.02 = 1.22 ins. (*See* at D.)

2. Lay off the azimuth, found in the table under "0 miles," toward the *east* (or west), as the case may be, and remeasure the angle a sufficient number of times to secure an accurate result.

3. Produce the direction of the secant thus determined, a distance of six miles in a *straight* line, taking double back and fore sights at each setting of the instrument. At each half mile and mile point, establish on the standard parallel the proper quarter section and section corners by offsets of correct length, north or south, as indicated in the table, by the initial letters "N." or "S."

The offsets being very short, their *direction* (perpendicular to the secant, without sensible error), may be determined by the eye; the *length* of offsets should be carefully *measured.*

4. At 6 miles on the secant, turn off to the north the proper deflection angle, given in the right-hand column of the table, thereby defining the direction of a new secant, from which points will be established on the parallel, as directed in clause 3.

The deputy should clearly understand from the foregoing rules and directions that the correct establishment of a standard parallel on a true latitude curve, by offsets from secant lines, will depend in the order of sequence upon careful attention to the following points:

1. *Accurate observations on Polaris at elongation, to determine a true meridian.*
2. *Close measurement of the azimuth angle, to define the initial direction of the secant.*
3. *Careful prolongation of the secant in a straight line.*
4. *Correct measurement of the deflection angle.*

With ordinary field instruments, usually reading to single minutes only, fractional parts of the "least count" are generally estimated by the eye. Greater accuracy may be attained by making use of a linear measure to lay off deflection angles. Table III supplies the requisite data; "the natural tangent of the angle of deflection to a radius of one chain," inserted in the right-hand column, may be employed as follows:

Having taken a back sight at the 6-mile point on the secant, at exactly one chain in advance of the center of the instrument, place upon the ground in a horizontal position, and precisely at right angles to the line, a rule or scale divided into decimal parts of an inch; move the scale north or south until one of its principal lines appears coincident with the vertical wire; then, with the tangent screw of the vernier plate, carry the wire over the scale toward the north, the required distance (i. e.), the length of tangent* in the right-hand column. The readings of the vernier will check the measurement and guard against mistakes.

To mark the direction of the new secant thus determined, set a flag on line, and as far in advance of the instrument as practicable. The direction will be verified by another similar observation, to be made after revolving the azimuth circle 180°.

Theoretically, it is immaterial whether the scale be placed above or below the level of the telescope, provided the *horizontal* distance from the center of the instrument is accurately one chain (66 ft.); practically, the most satisfactory result will be had on level ground, suitable for correct measurement of the distance.

* This tangent will have a constant value in any given latitude. A piece of white paper with two fine parallel lines drawn across it, exactly the proper distance apart, pasted on a thin slip of wood (such as a piece of cigar box, 3 inches long by 1 inch wide), will make an accurate and very convenient and portable substitute for a rule or scale. Several copies may be prepared in advance to replace the original in case of loss.

The secant method, adapted to transit instruments exclusively, is recommended for its simplicity and accuracy, and the facility with which the line may be extended over rough mountainous land or through dense undergrowth; in deep valleys or canyons where the sun can not be observed in favorable positions; or anywhere during the continuance of adverse weather conditions and under circumstances when the use of solar apparatus would be, if not impossible, at least inconvenient and unreliable.

The true bearing of a line joining any two points on a standard parallel will be obtained from Table IV, by taking it from the column headed with one-half of the distance between said points. Example, (Plate II, fig. 2). Required the bearing from corner of secs. 32 and 33, R. 22 E., to corner of secs. 32 and 33 E., R. 21 E. The latitude is 45° 34′.5, the distance 6 miles. Consequently, the azimuth from the column marked "3 miles" for the given latitude, is N. 89° 57′ 20″.9 W., the required true bearing.

The Specimen Field Notes No. 1, page 142, exhibit the form for record of the survey of a standard parallel through two ranges, executed in accordance with these instructions, and the practical method of correcting the line when a small deviation from the true latitude curve has been detected by observations on Polaris at elongation.

Plate II, fig. 1, illustrates a theoretically correct survey of a standard parallel; exhibits the bearings along the secant and lengths of offsets; and the deflection angle (at D), and place for the scale or rule required for measurement of the angle; while fig. 2 illustrates the method described in the field notes for correcting the line when error has been discovered. The topography is laid down on Plate III.

TANGENT METHOD.

[See Plate II, Fig. 3.]

This method consists in laying off from a true meridian, established by observations on Polaris at elongation, an angle of 90°, producing the direction thus determined, a distance of 6 miles, in a straight line, and measuring north therefrom, at half mile intervals, distances of correct length, taken from Table V (interpolated if necessary), for the given latitude, to attain other points on the latitude curve passing through the tangential or initial point.

TABLE IV.—*Azimuths of the Tangent to the Parallel.*

[The azimuth is the *smallest* angle the tangent makes with the true meridian and always measured from the *north* and towards the tangential points.]

Latitude.	1 mile.	2 miles.	3 miles.	4 miles.	5 miles.	6 miles.
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″
30	89 59 30.0	89 58 59.9	89 58 29.9	89 57 59.9	89 57 29.9	89 56 59.8
31	89 59 28.8	89 58 57.5	89 58 26.3	89 57 55.0	89 57 23.8	89 56 52.5
32	89 59 27.5	89 58 55.0	89 58 22.5	89 57 50.0	89 57 17.5	89 56 45.0
33	89 59 26.2	89 58 52.5	89 58 18.7	89 57 44.9	89 57 11.2	89 56 37.4
34	89 59 24.9	89 58 49.9	89 58 14.8	89 57 39.7	89 57 04.6	89 56 29.6
35	89 59 23.6	89 58 47.2	89 58 10.8	89 57 34.4	89 56 58.0	89 56 21.6
36	89 59 22.2	89 58 44.4	89 58 06.8	89 57 28.9	89 56 51.1	89 56 13.4
37	89 59 20.8	89 58 41.6	89 58 02.5	89 57 23.3	89 56 44.1	89 56 05.0
38	89 59 19.4	89 58 38.8	89 57 58.2	89 57 17.5	89 56 36.9	89 55 56.3
39	89 59 17.9	89 58 35.8	89 57 53.7	89 57 11.6	89 56 29.6	89 55 47.5
40	89 59 16.4	89 58 32.8	89 57 49.2	89 57 05.5	89 56 21.9	89 55 38.3
41	89 59 14.8	89 58 29.6	89 57 44.4	89 56 59.3	89 56 14.1	89 55 28.9
42	89 59 13.2	89 58 26.4	89 57 39.6	89 56 52.8	89 56 06.0	89 55 19.2
43	89 59 11.5	89 58 23.1	89 57 34.6	89 56 46.2	89 55 57.7	89 55 09.2
44	89 59 09.8	89 58 19.6	89 57 29.5	89 56 39.3	89 55 49.1	89 54 58.9
45	89 59 08.0	89 58 16.1	89 57 24.1	89 56 32.1	89 55 40.2	89 54 48.2
46	89 59 06.2	89 58 12.4	89 57 18.6	89 56 24.8	89 55 31.0	89 54 37.2
47	89 59 04.3	89 58 08.6	89 57 12.9	89 56 17.1	89 55 21.4	89 54 25.7
48	89 59 02.3	89 58 04.6	89 57 06.9	89 56 09.2	89 55 11.5	89 54 13.8
49	89 59 00.2	89 58 00.5	89 57 00.7	89 56 00.9	89 55 01.2	89 54 01.4
50	89 58 58.1	89 57 56.2	89 56 54.3	89 55 52.6	89 54 50.5	89 53 48.5

Latitude.	7 miles.	8 miles.	9 miles.	10 miles.	11 miles.	12 miles.
°	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″
30	89 56 29.8	89 55 59.8	89 55 29.8	89 54 59.7	89 54 29.7	89 53 59.7
31	89 56 21.3	89 55 50.0	89 55 18.8	89 54 47.6	89 54 16.3	89 53 45.1
32	89 56 12.5	89 55 40.0	89 55 07.6	89 54 35.1	89 54 02.6	89 53 30.1
33	89 56 03.6	89 55 29.9	89 54 56.1	89 54 22.3	89 53 48.5	89 53 14.8
34	89 55 54.5	89 55 19.4	89 54 44.4	89 54 09.3	89 53 34.2	89 52 59.1
35	89 55 45.2	89 55 08.8	89 54 32.3	89 53 55.9	89 53 19.5	89 52 43.1
36	89 55 35.6	89 54 57.8	89 54 20.0	89 53 42.3	89 53 04.5	89 52 26.7
37	89 55 25.8	89 54 46.6	89 54 07.4	89 53 28.2	89 52 49.1	89 52 09.9
38	89 55 15.7	89 54 35.1	89 53 54.5	89 53 13.9	89 52 33.2	89 51 52.6
39	89 55 05.4	89 54 23.3	89 53 41.2	89 52 59.1	89 52 17.0	89 51 34.9
40	89 54 54.7	89 54 11.1	89 53 27.5	89 52 43.8	89 52 00.2	89 51 16.6
41	89 54 43.7	89 53 58.5	89 53 13.4	89 52 28.2	89 51 43.0	89 50 57.8
42	89 54 32.4	89 53 45.6	89 52 58.8	89 52 12.0	89 51 25.2	89 50 38.4
43	89 54 20.8	89 53 32.3	89 52 43.8	89 51 55.4	89 51 06.9	89 50 18.5
44	89 54 08.7	89 53 18.5	89 52 28.4	89 51 38.2	89 50 48.0	89 49 57.8
45	89 53 56.3	89 53 04.3	89 52 12.3	89 51 20.4	89 50 28.4	89 49 36.4
46	89 53 43.4	89 52 49.5	89 51 55.7	89 51 01.9	89 50 08.1	89 49 14.3
47	89 53 30.0	89 52 34.3	89 51 38.6	89 50 42.9	89 49 47.2	89 48 51.4
48	89 53 16.1	89 52 18.4	89 51 20.7	89 50 23.0	89 49 25.3	89 48 27.6
49	89 53 01.7	89 52 01.9	89 51 02.1	89 50 02.4	89 49 02.6	89 48 02.8
50	89 52 46.6	89 51 44.7	89 50 42.8	89 49 40.9	89 48 39.0	89 47 37.1

The azimuth or bearing of the tangent at successive mile points will be taken from Table IV to the nearest whole minute only, and will be inserted in the field notes, no interpolation being required, *except* when *test sights* are taken. The true bearing between two points on a standard parallel will be derived from Table IV by taking it in the column head with one half of the distance between said points. (See example in the secant method, page 122.) The offsets at intervals of one mile are inserted in Table V; to obtain the length of offsets at

the half-mile points, take one-fourth of the offset corresponding to twice the distance of the half-mile point from the tangential point.

Example.—Required the offset at $5\frac{1}{2}$ miles, in latitude 45° 34′.5. The offset at 11 miles (interpolated for the given latitude) is 82.16 ft., which divided by 4 gives 20.54 ft., the offset required. Tables IV, V, and VI, are extended to 12 miles, in order to provide necessary data; but the tangent will be limited to six miles, as indicated by the full lines of fig. 3.

This method is suitable for running standard parallels and latitudinal township lines in a level open country, where no intersections with topographical features will be required; but, in all cases the secant method will be found most convenient.

The specimen field notes No. 1, page 150, exhibit the form of record of the survey of a Standard Parallel through one range, executed by the tangent method, which notes, considered in connection with Plate II, fig. 3, will fully explain the process here outlined.

TABLE V.—*Offsets, in feet, from Tangent to Parallel.*

Latitude.	1 mile.	2 miles.	3 miles.	4 miles.	5 miles.	6 miles.
°	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
30	0.39	1.54	3.47	6.17	9.64	13.88
31	0.40	1.60	3.61	6.42	10.03	14.44
32	0.42	1.67	3.76	6.67	10.42	15.02
33	0.43	1.73	3.90	6.93	10.82	15.60
34	0.45	1.80	4.05	7.20	11.25	16.20
35	0.47	1.87	4.20	7.47	11.68	16.81
36	0.48	1.94	4.36	7.75	12.11	17.44
37	0.50	2.01	4.52	8.04	12.57	18.09
38	0.52	2.08	4.69	8.33	13.02	18.75
39	0.54	2.16	4.86	8.63	13.49	19.43
40	0.56	2.24	5.03	8.95	13.98	20.11
41	0.58	2.32	5.21	9.27	14.48	20.85
42	0.60	2.40	5.40	9.59	14.99	21.59
43	0.62	2.48	5.59	9.93	15.52	22.35
44	0.64	2.57	5.79	10.29	16.07	23.14
45	0.67	2.66	5.99	10.65	16.64	23.96
46	0.69	2.76	6.20	11.02	17.21	24.80
47	0.71	2.85	6.42	11.41	17.83	25.68
48	0.74	2.95	6.65	11.82	18.47	26.59
49	0.76	3.06	6.88	12.24	19.12	27.54
50	0.79	3.17	7.13	12.68	19.80	28.52

Latitude.	7 miles.	8 miles.	9 miles.	10 miles.	11 miles.	12 miles.
°	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
30	18.89	24.67	31.23	38.55	46.65	55.52
31	19.66	25.68	32.49	40.12	48.54	57.77
32	20.44	26.69	33.78	41.71	50.47	60.06
33	21.23	27.74	35.10	43.34	52.44	62.41
34	22.05	28.80	36.45	45.00	54.45	64.80
35	22.89	29.89	37.83	46.71	56.62	67.26
36	23.74	31.01	39.25	48.45	58.63	69.77
37	24.62	32.16	40.70	50.24	60.79	72.35
38	25.52	33.33	42.19	52.08	63.02	75.00
39	26.44	34.54	43.71	53.97	65.30	77.71
40	27.40	35.78	45.29	55.91	67.65	80.51
41	28.37	37.06	46.90	57.91	70.07	83.39
42	29.38	38.38	48.57	59.97	72.56	86.35
43	30.42	39.74	50.29	62.09	75.13	89.41
44	31.50	41.14	52.07	64.28	77.78	92.57
45	32.61	42.59	53.91	66.55	80.53	95.84
46	33.76	44.10	55.81	68.90	83.37	99.22
47	34.95	45.65	57.78	71.34	86.32	102.72
48	36.19	47.27	59.83	73.86	89.37	106.36
49	37.48	48.95	61.96	76.49	92.55	110.15
50	38.82	50.70	64.17	79.22	95.86	114.08

TABLE VI.—*Offsets, in Chains, from Tangent to Parallel.*

Latitude.	1 mile.	2 miles.	3 miles.	4 miles.	5 miles.	6 miles.
°	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*
30	0.006	0.023	0.053	0.09	0.14	0.21
31	0.006	0.024	0.055	0.10	0.15	0.22
32	0.006	0.025	0.057	0.10	0.16	0.23
33	0.007	0.026	0.059	0.10	0.16	0.24
34	0.007	0.027	0.061	0.11	0.17	0.25
35	0.007	0.028	0.064	0.11	0.18	0.25
36	0.007	0.029	0.066	0.12	0.18	0.26
37	0.008	0.031	0.068	0.12	0.19	0.27
38	0.008	0.032	0.071	0.13	0.20	0.28
39	0.008	0.033	0.074	0.13	0.20	0.29
40	0.008	0.034	0.076	0.13	0.21	0.30
41	0.009	0.035	0.079	0.14	0.22	0.32
42	0.009	0.036	0.082	0.14	0.23	0.33
43	0.009	0.038	0.085	0.15	0.24	0.34
44	0.010	0.039	0.088	0.16	0.24	0.35
45	0.010	0.040	0.091	0.16	0.25	0.36
46	0.010	0.042	0.094	0.17	0.26	0.37
47	0.011	0.044	0.097	0.17	0.27	0.39
48	0.011	0.045	0.101	0.18	0.28	0.40
49	0.012	0.046	0.104	0.19	0.29	0.42
50	0.012	0.048	0.108	0.19	0.30	0.43

Latitude.	7 miles.	8 miles.	9 miles.	10 miles.	11 miles.	12 miles.
°	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*
30	0.29	0.37	0.47	0.58	0.71	0.84
31	0.30	0.39	0.49	0.60	0.74	0.88
32	0.31	0.40	0.51	0.63	0.76	0.91
33	0.32	0.42	0.53	0.65	0.79	0.95
34	0.33	0.43	0.55	0.68	0.82	0.98
35	0.35	0.45	0.57	0.70	0.86	1.02
36	0.36	0.47	0.59	0.73	0.89	1.06
37	0.37	0.48	0.61	0.75	0.91	1.10
38	0.38	0.50	0.64	0.78	0.95	1.14
39	0.40	0.52	0.66	0.81	0.99	1.18
40	0.41	0.54	0.68	0.84	1.02	1.22
41	0.43	0.56	0.70	0.87	1.06	1.26
42	0.44	0.58	0.73	0.90	1.09	1.31
43	0.46	0.60	0.75	0.93	1.14	1.35
44	0.48	0.62	0.79	0.97	1.18	1.40
45	0.49	0.64	0.81	1.00	1.22	1.45
46	0.51	0.66	0.84	1.04	1.26	1.50
47	0.53	0.68	0.87	1.07	1.31	1.56
48	0.55	0.71	0.91	1.12	1.35	1.61
49	0.57	0.74	0.93	1.16	1.40	1.67
50	0.59	0.77	0.97	1.20	1.45	1.73

SURVEY OF TOWNSHIP EXTERIORS BY THE SECANT OR TANGENT METHODS.

When township lines are surveyed by either of these methods, three lines should be taken into account, as follows:

First: The *directing* or *reference line*, which will be the secant or tangent, as the case may be.

Second: The *line of temporary corners* set by proper offsets; which will be the *random* line.

Third: The *true line* or random line corrected for the falling in the usual manner, upon which the corners will be established.

By setting the temporary corners, including, as a matter of course, that of the objective *township* corner, all complications incidental to the combined falling and offset from the secant or tangent, will be eliminated.

TABLE VII.—*Correction of Randoms—Links and Minutes of Arc.*

VII A.—*Correction, to nearest whole minute, for reducing random to true bearings. Distance, 80 chains.*

Falling.	Correction.	Falling.	Correction.
Links.	*Minutes.*	*Links.*	*Minutes.*
1	0-	31	13
2	1	32	14
3	1	33	14
4	2	34	15
5	2	35	15
6	3	36	15
7	3	37	16
8	3	38	16
9	4	39	17
10	4	40	17
11	5	41	18
12	5	42	18
13	6	43	18
14	6	44	19
15	6	45	19
16	7	46	20
17	7	47	20
18	8	48	21
19	8	49	21
20	9	50	21
21	9	51	22
22	9	52	22
23	10	53	23
24	10	54	23
25	11	55	24
26	11	56	24
27	12	57	24
28	12	58	25
29	12	59	25
30	13	60	26

VII B.—*Showing departure in running 80.00 chs. at any course from 1 to 60 minutes (or difference in latitude for 90° minus angle.)*

Angle.	Departure.	Angle.	Departure.
Minutes.	*Links.*	*Minutes.*	*Links.*
1	2⅛	31	72⅛
2	4⅛	32	74⅛
3	7	33	77
4	9⅛	34	79⅛
5	11⅞	35	81⅞
6	14	36	84
7	16⅛	37	86⅛
8	18⅞	38	88⅞
9	21	39	91
10	23⅛	40	93⅛
11	25⅞	41	95⅞
12	28	42	98
13	30⅛	43	100⅛
14	32⅞	44	102⅞
15	35	45	105
16	37⅛	46	107⅛
17	39⅞	47	109⅞
18	42	48	112
19	44⅛	49	114⅛
20	46⅞	50	116⅞
21	49	51	119
22	51⅛	52	121⅛
23	53⅞	53	123⅞
24	56	54	126
25	58⅛	55	128⅛
26	60⅞	56	130⅞
27	63	57	133
28	65⅛	58	135⅛
29	67⅞	59	137⅞
30	70	60	140

Table VII A. will be used to determine the *return* from the *random* course, by the following rules, the meridians being regarded as *parallel.*

1.—If the random line is run *east or west*, subtract the falling [in minutes of arc] from 90°, reverse the departure letter of the random, and name the meridional letter N. or S., like the falling.

2.—When the random course is nearly east and west, take the **sum** of the random course and falling [in minutes of arc], if they are of the **same** name—that is, both north or both south—but their **difference**

when of **different** names; in either case changing the meridional and departure letters of the random line. [This is easily remembered by bearing in mind the initial letters of Sum and Same, and Difference and Different].

3.—In any case when the sum exceeds 90°, the return course is found by subtracting said sum from 180°, and retaining the meridional letter of the random course unchanged. If the sum is exactly 90°, the return course is evidently west [or east] to the starting point.

4.—*Through the north tier of sections.* If the random line intersects at the objective corner, the return course will be the random course reversed. When the random falls east or west of the objective corner, reverse its bearing; then take the **sum** of the *reversed* random bearing and the falling [in minutes of arc], if they are of the **same** name—that is, both east or both west—but their **difference** when of **different** names; in either case making the departure letter, E. or W., agree with that of the greater value. Should the difference come out zero, the return course will be *south*. [This rule may be memorized as suggested in 2.]

Table VII B, which is merely a fragment of a traverse table, may be consulted to determine the difference of latitude and the departures of the township lines tabulated on page 128, and in other similar cases when bearings and distances are within prescribed limits. (See page 59.)

The *departure* for *one mile* (80.00 chs.) will be multiplied by the length of the course expressed in miles, to obtain the *departure* of a meridional township line; while, practically, the *difference of latitude* will be equal to the *length of the line.*

To determine the *difference of latitude* between the ends of latitudinal township boundaries, subtract the bearing from 90°, and with the remainder as an argument for the table, take out the *difference of latitude* from the column headed "*Departure*"; the *departure* will be equal to the *length of the line.* (See Boundaries, etc., page 177.)

Tables VIII and IX.

These tables, which require no special description, are useful for converting linear into angular, and angular into linear measures, as well as for determining the convergencies and divergencies of the meridians, on the spheroidal surface of the earth. As the tabular values are given in *chains*, the tables will be found convenient for the surveyor's use. The following rules and examples will illustrate their application:

1. *Given the latitudes of any two places on the same meridian, to find the distance between them.*

Rule.—Find from Table VIII the length of a degree of the meridian at each latitude, and take half their sum for the mean length of a degree. Then say, as 60 minutes is to the difference of latitude, so is the mean length of a degree to the distance required.

The latitude of the north boundary of Wyoming is 45° N., and that of the 1st Standard Parallel South, Montana, 45° 26′ 4″.08; what is the meridional distance between them?

chains. chains.
As 60′ : 26′ 4″.08 :: 5524.02 : 2400, the distance required.

2. *Given the distance between any two places on the same meridian, and the latitude of one of them, to find the difference of latitude.*

Rule.—Find from Table VIII the length of a degree of the meridian in the given latitude, and also in that differing from it, by the merid-

ional distance, converted into arc at the rate of 52 seconds per mile, and take half their sum for the mean length of a degree. Then say, as the mean length of a degree is to the meridional distance, so is 60 minutes to the difference of latitude required.

The latitude of the north boundary of Wyoming is 45° N.; what is the latitude of the 1st Standard Parallel South, Montana, the meridional distance being 30 miles?

chains. chains.
As 5524.02 : 2400 :: 60′ : 26′ 4″.08, the difference of latitude required.

3. *Given the longitudes of any two places, on the same parallel, in a given latitude, to find the distance between them.*

RULE.—Find from Table IX the length of a degree of longitude in the given latitude; and say, as 60 minutes is to the difference of longitude, so is the length of a degree of longitude to the distance required.

The longitude of the Willamette Meridian is 122° 44′, and that of east boundary of range 6 east, 121° 59′ 31″; what is the distance between them, on the Base Line, in latitude 45° 30′?

chains. chains.
As 60′ : 44′29″ : : 3884.81 : 2880, the distance required.

4. *Given the distance between any two places on the same parallel, in a given latitude, to find their difference of longitude.*

RULE.—Find from Table IX the length of a degree of longitude in the given latitude; and say, as the length of the degree of longitude is to the given distance, so is 60 minutes to the difference of longitude.

The longitude of the Willamette Meridian is 122° 44′; what is the difference of longitude to east boundary of range 6 east, the distance on the Base Line, in latitude 45° 30′, being 36 miles?

chains. chains.
As 3884.81 : 2880 :: 60′ : 44′ 29″, the difference of longitude required.

5. *Given the distance between two meridians, on any parallel, in a given latitude, to find the convergency of the meridians for any distance north of that parallel.*

RULE.—Find the length of a degree of longitude, at each latitude, by the foregoing rules; and say, as the *greater* of the two lengths is to their difference, so is the given distance to the *convergency* required.

The distance between the Principal Meridian and first range line west, in latitude 42° 39′ 07″, is 6 miles; what is the convergency of the two range lines at the Base Line, the meridional distance being 24 miles?

chains. chains. chains. chains.
As 4075.76 : 22.80 :: 480 : 2.69, the convergency required.

6. *Given the distance between two meridians, on any parallel in a given latitude, to find the divergency of the meridians for any distance south of that parallel.*

RULE.—Find the length of a degree of longitude, at each latitude, by the foregoing rules; and say, as the *less* of the two lengths is to their difference, so is the given distance to the *divergency* required.

The distance between the Principal Meridian and first range line on the Base Line in latitude 43°, is 5 miles 77.31 chains; what is the divergency of the two range lines at the parallel 42° 39′ 07″, the meridional distance being 24 miles?

Chains. Chains. Chains. Chains.
As 4052.96 : 22.80 :: 477.31 : 2.69, the divergency required.

TABLE VIII.—*Length of a Degree of Latitude.*

Lat.	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°	Lat.
′	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	′
0	5509.15	5509.97	5510.82	5511.67	5512.55	5513.44	5514.34	5515.25	5516.18	5517.11	0
1	09.16	09.99	10.83	11.69	12.56	13.45	14.35	15.27	16.19	17.13	1
2	09.17	10.00	10.84	11.70	12.58	13.47	14.37	15.28	16.21	17.14	2
3	09.19	10.01	10.86	11.72	12.59	13.48	14.38	15.30	16.22	17.16	3
4	09.20	10.03	10.87	11.73	12.61	13.50	14.40	15.31	16.24	17.17	4
5	09.21	10.04	10.89	11.75	12.62	13.51	14.42	15.33	16.25	17.19	5
6	09.23	10.06	10.90	11.76	12.64	13.53	14.43	15.34	16.27	17.20	6
7	09.24	10.07	10.91	11.78	12.65	13.54	14.45	15.36	16.28	17.22	7
8	09.25	10.08	10.93	11.79	12.67	13.56	14.46	15.38	16.30	17.23	8
9	09.27	10.10	10.94	11.81	12.68	13.57	14.48	15.39	16.32	17.25	9
10	09.28	10.11	10.96	11.82	12.70	13.59	14.49	15.41	16.33	17.27	10
11	09.30	10.13	10.97	11.83	12.71	13.60	14.51	15.42	16.35	17.28	11
12	09.31	10.14	10.99	11.85	12.73	13.62	14.52	15.44	16.36	17.30	12
13	09.32	10.15	11.00	11.86	12.74	13.63	14.54	15.45	16.38	17.31	13
14	09.34	10.17	11.01	11.88	12.76	13.65	14.55	15.47	16.39	17.33	14
15	09.35	10.18	11.03	11.89	12.77	13.66	14.57	15.48	16.41	17.34	15
16	09.36	10.19	11.04	11.91	12.79	13.68	14.58	15.50	16.42	17.36	16
17	09.38	10.21	11.06	11.92	12.80	13.69	14.60	15.51	16.44	17.38	17
18	09.39	10.22	11.07	11.94	12.81	13.71	14.61	15.53	16.46	17.39	18
19	09.41	10.24	11.09	11.95	12.83	13.72	14.63	15.54	16.47	17.41	19
20	09.42	10.25	11.10	11.96	12.84	13.74	14.64	15.56	16.49	17.42	20
21	09.43	10.26	11.11	11.98	12.86	13.75	14.66	15.57	16.50	17.44	21
22	09.45	10.28	11.13	11.99	12.87	13.77	14.67	15.59	16.52	17.45	22
23	09.46	10.29	11.14	12.01	12.89	13.78	14.69	15.61	16.53	17.47	23
24	09.47	10.31	11.16	12.02	12.90	13.80	14.70	15.62	16.55	17.49	24
25	09.49	10.32	11.17	12.04	12.92	13.81	14.72	15.64	16.56	17.50	25
26	09.50	10.33	11.19	12.05	12.93	13.83	14.73	15.65	16.58	17.52	26
27	09.51	10.35	11.20	12.07	12.95	13.84	14.75	15.67	16.60	17.53	27
28	09.53	10.36	11.21	12.08	12.96	13.86	14.76	15.68	16.61	17.55	28
29	09.54	10.38	11.23	12.10	12.98	13.87	14.78	15.70	16.63	17.56	29
30	09.56	10.39	11.24	12.11	12.99	13.89	14.79	15.71	16.64	17.58	30
31	09.57	10.41	11.26	12.12	13.01	13.90	14.81	15.73	16.66	17.60	31
32	09.58	10.42	11.27	12.14	13.02	13.92	14.82	15.74	16.67	17.61	32
33	09.60	10.44	11.29	12.15	13.04	13.93	14.84	15.76	16.69	17.63	33
34	09.61	10.45	11.30	12.17	13.05	13.95	14.86	15.77	16.70	17.64	34
35	09.63	10.46	11.31	12.18	13.07	13.96	14.87	15.79	16.72	17.66	35
36	09.64	10.48	11.33	12.20	13.08	13.98	14.89	15.81	16.74	17.67	36
37	09.65	10.49	11.34	12.21	13.10	13.99	14.90	15.82	16.75	17.69	37
38	09.67	10.50	11.36	12.22	13.11	14.01	14.92	15.84	16.77	17.71	38
39	09.68	10.52	11.37	12.24	13.13	14.02	14.93	15.85	16.78	17.72	39
40	09.69	10.53	11.39	12.26	13.14	14.04	14.95	15.87	16.80	17.74	40
41	09.71	10.55	11.40	12.27	13.16	14.05	14.96	15.88	16.81	17.75	41
42	09.72	10.56	11.42	12.29	13.17	14.07	14.98	15.90	16.83	17.77	42
43	09.74	10.57	11.43	12.30	13.18	14.08	14.99	15.91	16.84	17.78	43
44	09.75	10.59	11.44	12.31	13.20	14.10	15.01	15.93	16.86	17.80	44
45	09.76	10.60	11.46	12.33	13.21	14.11	15.02	15.94	16.88	17.82	45
46	09.78	10.62	11.47	12.34	13.23	14.13	15.04	15.96	16.89	17.83	46
47	09.79	10.63	11.49	12.36	13.24	14.14	15.05	15.98	16.91	17.85	47
48	09.80	10.65	11.50	12.37	13.26	14.16	15.07	15.99	16.92	17.86	48
49	09.82	10.66	11.52	12.39	13.27	14.17	15.08	16.01	16.94	17.88	49
50	09.83	10.67	11.53	12.40	13.29	14.19	15.10	16.02	16.95	17.89	50
51	09.85	10.69	11.54	12.42	13.30	14.20	15.11	16.04	16.97	17.91	51
52	09.86	10.70	11.56	12.43	13.32	14.22	15.13	16.05	16.98	17.93	52
53	09.87	10.72	11.57	12.45	13.33	14.23	15.15	16.07	17.00	17.94	53
54	09.89	10.73	11.59	12.46	13.35	14.25	15.16	16.08	17.02	17.96	54
55	09.90	10.74	11.60	12.48	13.36	14.26	15.18	16.10	17.03	17.97	55
56	09.92	10.76	11.62	12.49	13.38	14.28	15.19	16.11	17.05	17.99	56
57	09.93	10.77	11.63	12.51	13.39	14.29	15.21	16.13	17.06	18.00	57
58	09.94	10.79	11.65	12.52	13.41	14.31	15.22	16.15	17.08	18.02	58
59	09.96	10.80	11.66	12.53	13.42	14.32	15.24	16.16	17.09	18.04	59
60	5509.97	5510.82	5511.67	5512.55	5513.44	5514.34	5515.25	5516.18	5517.11	5518.05	60

TABLE VIII.—*Length of a Degree of Latitude—Concluded.*

Lat.	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	Lat.
′	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	′
0	5518.05	5519.00	5519.96	5520.92	5521.88	5522.85	5523.81	5524.78	5525.75	5526.72	0
1	18.07	19.02	19.97	20.93	21.90	22.86	23.83	24.80	25.77	26.73	1
2	18.08	19.03	19.99	20.95	21.91	22.88	23.85	24.82	25.78	26.75	2
3	18.10	19.05	20.00	20.96	21.93	22.89	23.86	24.83	25.80	26.76	3
4	18.11	19.06	20.02	20.98	21.94	22.91	23.88	24.85	25.82	26.78	4
5	18.13	19.08	20.04	21.00	21.96	22.93	23.90	24.86	25.83	26.80	5
6	18.15	19.10	20.05	21.01	21.98	22.94	23.91	24.88	25.85	26.81	6
7	18.16	19.11	20.07	21.03	21.99	22.96	23.93	24.90	25.86	26.83	7
8	18.18	19.13	20.08	21.04	22.01	22.98	23.94	24.91	25.88	26.84	8
9	18.19	19.14	20.10	21.06	22.02	22.99	23.96	24.93	25.90	26.86	9
10	18.21	19.16	20.12	21.08	22.04	23.01	23.98	24.94	25.91	26.88	10
11	18.22	19.18	20.13	21.09	22.06	23.02	23.99	24.96	25.93	26.89	11
12	18.24	19.19	20.15	21.11	22.07	23.04	24.01	24.98	25.94	26.91	12
13	18.26	19.21	20.16	21.12	22.09	23.06	24.02	24.99	25.96	26.92	13
14	18.27	19.22	20.18	21.14	22.11	23.07	24.04	25.01	25.98	26.94	14
15	18.29	19.24	20.20	21.16	22.12	23.09	24.06	25.03	25.99	26.96	15
16	18.30	19.25	20.21	21.17	22.14	23.10	24.07	25.04	26.01	26.97	16
17	18.32	19.27	20.23	21.19	22.15	23.12	24.09	25.06	26.02	26.99	17
18	18.34	19.29	20.24	21.20	22.17	23.14	24.11	25.07	26.04	27.00	18
19	18.35	19.30	20.26	21.22	22.19	23.15	24.12	25.09	26.06	27.02	19
20	18.37	19.32	20.28	21.24	22.20	23.17	24.14	25.11	26.07	27.04	20
21	18.38	19.33	20.29	21.25	22.22	23.19	24.15	25.12	26.09	27.05	21
22	18.40	19.35	20.31	21.27	22.23	23.20	24.17	25.14	26.10	27.07	22
23	18.41	19.37	20.32	21.29	22.25	23.22	22.19	25.15	26.12	27.09	23
24	18.43	19.38	20.34	21.30	22.27	23.23	24.20	25.17	26.14	27.10	24
25	18.45	19.40	20.36	21.32	22.28	23.25	24.22	25.19	26.15	27.12	25
26	18.46	19.41	20.37	21.33	22.30	23.27	24.23	25.20	26.17	27.13	26
27	18.48	19.43	20.39	21.35	22.31	23.28	24.25	25.22	26.19	27.15	27
28	18.49	19.45	20.40	21.36	22.33	23.30	24.27	25.23	26.20	27.17	28
29	18.51	19.46	20.42	21.38	22.35	23.31	24.28	25.25	26.22	27.18	29
30	18.53	19.48	20.44	21.40	22.36	23.33	24.30	25.27	26.23	27.20	30
31	18.54	19.49	20.45	21.41	22.38	23.35	24.32	25.28	26.25	27.21	31
32	18.56	19.51	20.47	21.43	22.40	23.36	24.33	25.30	26.27	27.23	32
33	18.57	19.53	20.48	21.45	22.41	23.38	24.35	25.32	26.28	27.25	33
34	18.59	19.54	20.50	21.46	22.43	23.40	24.36	25.33	26.30	27.26	34
35	18.60	19.56	20.52	21.48	22.44	23.41	24.38	25.35	26.31	27.28	35
36	18.62	19.57	20.53	21.49	22.46	23.43	24.40	25.36	26.33	27.29	36
37	18.64	19.59	20.55	21.51	22.48	23.44	24.41	25.38	26.35	27.31	37
38	18.65	19.60	20.56	21.53	22.49	23.46	24.43	25.40	26.36	27.33	38
39	18.67	19.62	20.58	21.54	22.51	23.48	24.44	25.41	26.38	27.34	39
40	18.68	19.64	20.60	21.56	22.52	23.49	24.46	25.43	26.39	27.36	40
41	18.70	19.65	20.61	21.57	22.54	23.51	24.48	25.44	26.41	27.37	41
42	18.72	19.67	20.63	21.59	22.56	23.52	24.49	25.46	26.43	27.39	42
43	18.73	19.68	20.64	21.61	22.57	23.54	24.51	25.48	26.44	27.41	43
44	18.75	19.70	20.66	21.62	22.59	23.56	24.52	25.49	26.46	27.42	44
45	18.76	19.72	20.68	21.64	22.60	23.57	24.54	25.51	26.47	27.44	45
46	18.78	19.73	20.69	21.65	22.62	23.59	24.56	25.52	26.49	27.45	46
47	18.79	19.75	20.71	21.67	22.64	23.60	24.57	25.54	26.51	27.47	47
48	18.81	19.76	20.72	21.69	22.65	23.62	24.59	25.56	26.52	27.49	48
49	18.83	19.78	20.74	21.70	22.67	23.64	24.61	25.57	26.54	27.50	49
50	18.84	19.80	20.76	21.72	22.69	23.65	24.62	25.59	26.56	27.52	50
51	18.86	19.81	20.77	21.74	22.70	23.67	24.64	25.61	26.57	27.53	51
52	18.87	19.83	20.79	21.75	22.72	23.69	24.65	25.62	26.59	27.55	52
53	18.89	19.84	20.80	21.77	22.73	23.70	24.67	25.64	26.60	27.57	53
54	18.91	19.86	20.82	21.78	22.75	23.72	24.69	25.65	26.62	27.58	54
55	18.92	19.88	20.84	21.80	22.77	23.73	24.70	25.67	26.64	27.60	55
56	18.94	19.89	20.85	21.82	22.78	23.75	24.72	25.69	26.65	27.61	56
57	18.95	19.91	20.87	21.83	22.80	23.77	24.73	25.70	26.67	27.63	57
58	18.97	19.92	20.88	21.85	22.81	23.78	24.75	25.72	26.68	27.65	58
59	18.98	19.94	20.90	21.86	22.83	23.80	24.77	25.73	26.70	27.66	59
60	5519.00	5519.96	5520.92	5521.88	5522.85	5523.81	5524.78	5525.75	5526.72	5527.68	60

TABLE IX.—*Length of a Degree of Longitude.*

Lat.	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°	Lat.
′	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	′
0	4843.17	4795.82	4747.01	4696.75	4645.06	4591.96	4537.45	4481.56	4424.29	4365.68	0
1	42.40	95.02	46.19	95.90	44.19	91.06	36.53	80.61	23.33	64.69	1
2	41.62	94.22	45.36	95.05	43.32	90.16	35.61	79.67	22.36	63.70	2
3	40.84	93.42	44.53	94.20	42.44	89.26	34.69	78.73	21.40	62.72	3
4	40.06	92.61	43.71	93.35	41.57	88.37	33.77	77.78	20.43	61.73	4
5	39.28	91.81	42.88	92.50	40.69	87.47	32.84	76.84	19.46	60.74	5
6	38.50	91.01	42.05	91.65	39.82	86.57	31.92	75.89	18.49	59.75	6
7	37.72	90.20	41.22	90.80	38.94	85.67	31.00	74.95	17.53	58.76	7
8	36.94	89.40	40.39	89.94	38.06	84.77	30.08	74.00	16.56	57.77	8
9	36.16	88.59	39.56	89.09	37.19	83.87	29.15	73.05	15.59	56.77	9
10	35.38	87.79	38.73	88.24	36.31	82.97	28.23	72.11	14.62	55.78	10
11	34.60	86.98	37.90	87.38	35.43	82.07	27.30	71.16	13.65	54.79	11
12	33.82	86.18	37.07	86.53	34.55	81.17	26.38	70.21	12.68	53.80	12
13	33.04	85.37	36.24	85.67	33.68	80.26	25.46	69.26	11.71	52.81	13
14	32.26	84.56	35.41	84.82	32.80	79.36	24.53	68.32	10.74	51.81	14
15	31.47	83.76	34.58	83.96	31.92	78.46	23.60	67.37	09.77	50.82	15
16	30.69	82.95	33.75	83.11	31.04	77.56	22.68	66.42	08.80	49.83	16
17	29.91	82.14	32.92	82.25	30.16	76.65	21.75	65.47	07.82	48.83	17
18	29.12	81.33	32.08	81.40	29.28	75.75	20.83	64.52	06.85	47.84	18
19	28.34	80.52	31.25	80.54	28.40	74.85	19.90	63.57	05.88	46.84	19
20	27.55	79.71	30.42	79.68	27.52	73.94	18.97	62.62	04.91	45.85	20
21	26.77	78.90	29.58	78.82	26.64	73.04	18.04	61.67	03.93	44.85	21
22	25.98	78.09	28.75	77.97	25.75	72.13	17.11	60.72	02.96	43.85	22
23	25.20	77.28	27.92	77.11	24.87	71.23	16.19	59.77	01.98	42.86	23
24	24.41	76.47	27.08	76.25	23.99	70.32	15.26	58.81	01.01	41.86	24
25	23.62	75.66	26.25	75.39	23.11	69.41	14.33	57.86	4400.04	40.86	25
26	22.83	74.85	25.41	74.53	22.22	68.51	13.40	56.91	4399.06	39.87	26
27	22.05	74.04	24.57	73.67	21.34	67.60	12.47	55.96	98.08	38.87	27
28	21.26	73.22	23.74	72.81	20.45	66.69	11.54	55.00	97.11	37.87	28
29	20.47	72.41	22.90	71.95	19.57	65.78	10.61	54.05	96.13	36.87	29
30	19.68	71.60	22.06	71.09	18.69	64.88	09.67	53.09	95.16	35.87	30
31	18.89	70.78	21.22	70.22	17.80	63.97	08.74	52.14	94.18	34.87	31
32	18.10	69.97	20.39	69.36	16.91	63.06	07.81	51.19	93.20	33.87	32
33	17.31	69.16	19.55	68.50	16.03	62.15	06.88	50.23	92.22	32.87	33
34	16.52	68.34	18.71	67.64	15.14	61.24	05.94	49.27	91.25	31.87	34
35	15.73	67.53	17.87	66.77	14.26	60.33	05.01	48.32	90.27	30.87	35
36	14.94	66.71	17.03	65.91	13.37	59.42	04.08	47.36	89.29	29.87	36
37	14.15	65.89	16.19	65.05	12.48	58.51	03.14	46.41	88.31	28.87	37
38	13.35	65.08	15.35	64.18	11.59	57.60	02.21	45.45	87.33	27.87	38
39	12.56	64.26	14.51	63.32	10.70	56.68	01.28	44.49	86.35	26.87	39
40	11.77	63.44	13.67	62.45	09.81	55.77	4500.34	43.53	85.37	25.86	40
41	10.98	62.52	12.82	61.59	08.93	54.86	4499.40	42.57	84.39	24.86	41
42	10.18	61.81	11.98	60.72	08.04	53.95	98.47	41.62	83.41	23.86	42
43	09.39	60.99	11.14	59.85	07.15	53.03	97.53	40.66	82.42	22.85	43
44	08.59	60.17	10.30	58.99	06.26	52.12	96.59	39.70	81.44	21.85	44
45	07.80	59.35	09.45	58.12	05.36	51.21	95.66	38.74	80.46	20.85	45
46	07.00	58.53	08.61	57.25	04.47	50.29	94.72	37.78	79.48	19.84	46
47	06.21	57.71	07.76	56.38	03.58	49.38	93.78	36.82	78.49	18.84	47
48	05.41	56.89	06.92	55.51	02.69	48.46	92.84	35.86	77.51	17.83	48
49	04.61	56.07	06.07	54.65	01.80	47.55	91.91	34.89	76.53	16.82	49
50	03.82	55.25	05.23	53.78	00.90	46.63	90.97	33.93	75.54	15.82	50
51	03.02	54.43	04.38	52.91	4600.01	45.71	90.03	32.97	74.56	14.81	51
52	02.22	53.60	03.54	52.04	4599.12	44.80	89.09	32.01	73.57	13.80	52
53	01.42	52.78	02.69	51.17	98.22	43.88	88.15	31.04	72.59	12·80	53
54	4800.62	51.96	01.84	50.30	97.33	42.96	87.21	30.08	71.60	11.79	54
55	4799.82	51.13	01.00	49.42	96.44	42.04	86.27	29.12	70.62	10.78	55
56	99.02	50.31	4700.15	48.55	95.54	41.13	85.32	28.15	69.63	09.77	56
57	98.22	49.49	4699.30	47.68	94.64	40.21	84.38	27.19	68.64	08.76	57
58	97.42	48.66	98.45	46.81	93.75	39.29	83.44	26.22	67.66	07.75	58
59	96.62	47.84	97.60	45.94	92.85	38.37	82.50	25.26	66.67	06.74	59
60	4795.82	4747.01	4696.75	4645.06	4591.96	4537.45	4481.56	4424.29	4365.68	4305.73	60

TABLE IX.—*Length of a Degree of Longitude—Concluded.*

Lat.	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	Lat.
′	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	*Chains.*	′
0	4305.73	4244.47	4181.91	4118.06	4052.96	3986.62	3919.05	3850.28	3780.33	3709.22	0
1	04.72	43.44	80.85	16.99	51.87	85.50	17.91	49.12	79.15	08.03	1
2	03.71	42.41	79.80	15.91	50.77	84.38	16.78	47.97	77.98	06.83	2
3	02.70	41.37	78.75	14.84	49.67	83.27	15.64	46.81	76.80	05.63	3
4	01.69	40.34	77.69	13.76	48.58	82.15	14.50	45.65	75.63	04.44	4
5	4300.68	39.31	76.64	12.69	47.48	81.03	13.36	44.50	74.45	03.24	5
6	4299.67	38.27	75.58	11.61	46.38	79.91	12.23	43.34	73.27	02.05	6
7	98.65	37.24	74.52	10.53	45.28	78.79	11.09	42.18	72.00	3700.85	7
8	97.64	36.20	73.47	09.46	44.19	77.68	09.95	41.02	70.92	3699.65	8
9	96.63	35.17	72.41	08.38	43.09	76.56	08.81	39.86	69.74	98.46	9
10	95.61	34.13	71.36	07.30	41.99	75.44	07.67	38.70	68.56	97.26	10
11	94.60	33.10	70.30	06.22	40.89	74.32	06.53	37.54	67.38	96.06	11
12	93.59	32.06	69.24	05.14	39.79	73.20	05.39	36.38	66.20	94.86	12
13	92.57	31.02	68.18	04.07	38.69	72.08	04.25	35.22	65.02	93.66	13
14	91.56	29.99	67.12	02.99	37.59	70.96	03.11	34.06	63.84	92.46	14
15	90.54	28.95	66.07	01.91	36.49	69.84	01.97	32.90	62.66	91.26	15
16	89.52	27.91	65.01	4100.83	35.39	68.72	3900.83	31.74	61.48	90.06	16
17	88.51	16.87	63.95	4099.75	34.29	67.59	3899.69	30.58	60.30	88.86	17
18	87.49	25.84	62.89	98.67	33.19	66.47	98.54	29.42	59.12	87.66	18
19	86.48	24.80	61.83	97.58	32.09	65.35	97.40	28.26	57.94	86.46	19
20	85.46	23.76	60.77	96.50	30.98	64.23	96.26	27.09	56.76	85.26	20
21	84.44	22.72	59.71	95.42	29.88	63.11	95.12	25.93	55.57	84.06	21
22	83.42	21.68	58.65	94.34	28.78	61.98	93.97	24.77	54.39	82.86	22
23	82.40	20.64	57.58	93.26	27.67	60.86	92.83	23.60	53.21	81.66	23
24	81.39	19.60	56.52	92.17	26.57	59.73	91.68	22.44	52.02	80.46	24
25	80.37	18.56	55.46	91.09	25.47	58.61	90.54	21.28	50.84	79.25	25
26	79.35	17.52	54.40	90.01	24.36	57.49	89.40	20.11	49.66	78.05	26
27	78.33	16.48	53.44	88.92	23.26	56.36	88.25	18.95	48.47	76.85	27
28	77.31	15.43	52.27	87.84	22.15	55.24	87.11	17.78	47.29	75.64	28
29	76.29	14.39	51.21	86.75	21.05	54.11	85.96	16.62	46.10	74.44	29
30	75.27	13.35	50.14	85.67	19.94	52.98	84.81	15.45	44.92	73.24	30
31	74.24	12.31	49.08	84.58	18.84	51.86	83.67	14.29	43.73	72.03	31
32	73.22	11.26	48.02	83.50	17.73	50.73	82.52	13.12	42.55	70.83	32
33	72.20	10.22	46.95	82.41	16.62	49.60	81.37	11.95	41.30	69.62	33
34	71.18	09.18	45.89	81.33	15.52	48.48	80.23	16.79	40.18	68.42	34
35	70.16	08.13	44.82	80.24	14.41	47.35	79.08	09.62	38.99	67.21	35
36	69.13	07.09	43.75	79.15	13.30	46.22	77.93	08.45	37.80	66.01	36
37	68.11	06.04	42.69	78.07	12.19	45.09	76.78	07.28	36.62	64.80	37
38	67.09	05.00	41.62	76.98	11.09	43.96	75.63	06.11	35.43	63.59	38
39	66.06	03.95	40.55	75.89	09.98	42.83	74.48	04.95	34.24	62.39	39
40	65.04	02.90	39.49	74.80	08.87	41.71	73.34	03.78	33.05	61.18	40
41	64.01	01.86	38.42	73.71	07.76	40.58	72.19	02.61	31.86	59.97	41
42	62.99	4200.81	37.35	72.62	06.65	39.45	71.04	01.44	30.67	58.76	42
43	61.96	4199.76	36.28	71.53	05.54	38.32	69.89	3800.27	29.48	57.56	43
44	60.93	98.72	35.21	70.44	04.43	37.18	68.74	3799.10	28.30	56.35	44
45	59.91	97.67	34.14	69.35	03.32	36.05	67.58	97.93	27.11	55.14	45
46	58.88	96.62	33.08	68.26	02.21	34.92	66.43	96.76	25.92	53.93	46
47	57.85	95.57	32.01	67.17	4001.10	33.79	65.28	95.59	24.73	52.72	47
48	56.83	94.52	30.93	66.08	3999.98	32.66	64.13	94.41	23.53	51.51	48
49	55.80	93.47	29.86	64.99	98.87	31.53	62.98	93.24	22.34	50.30	49
50	54.77	92.42	28.79	63.90	97.76	30.39	61.82	92.07	21.15	49.09	50
51	53.74	91.37	27.72	62.81	96.65	29.26	60.67	90.90	19.96	47.88	51
52	52.71	90.32	26.65	61.71	95.53	28.13	59.52	89.72	18.77	46.67	52
53	51.68	89.27	25.58	60.62	94.42	26.99	58.36	88.55	17.58	45.46	53
54	50.66	88.22	24.51	59.53	93.31	25.86	57.21	87.38	16.38	44.25	54
55	49.63	87.17	23.43	58.43	92.19	24.73	56.06	86.20	15.19	43.03	55
56	48.59	86.12	22.36	57.34	91.08	23.59	54.90	85.03	14.00	41.82	56
57	47.56	85.07	21.29	56.25	89.96	22.46	53.75	83.86	12.80	40.61	57
58	46.53	84.02	20.21	55.15	88.85	21.32	52.59	82.68	11.61	39.40	58
59	45.50	82.96	19.14	54.06	87.73	20.19	51.44	81.51	10.41	38.18	59
60	4244.47	4181.91	4118.06	4052.96	3986.62	3919.05	3850.28	3780.33	3709.22	3636.97	60

TABLE X.—*Convergency of Meridians six miles long and six miles apart, and other relevant data.*

Latitude.	Convergency.		Difference of longitude per range.		Longitude.	Difference of latitude for—	
	On the parallel.	Angle.	In arc.	In time.	Arc of 1″.	1 mile in arc.	1 Tp. in arc.
°	*Links.*	′ ″	′ ″	*Seconds.*	*Chains.*		
30	41.9	3 0	6 0.36	24.02	1.332		
31	43.6	3 7	6 4.02	24.27	1.319		
32	45.4	3 15	6 7.93	24.53	1.305	0′.871	5′.225
33	47.2	3 23	6 12.00	24.80	1.290		
34	49.1	3 30	6 16.31	25.09	1.275		
35	50.9	3 38	6 20.95	25.40	1.260		
36	52.7	3 46	6 25.60	25.71	1.245		
37	54.7	3 55	6 30.59	26.04	1.229	0′.870	5′.221
38	56.8	4 4	6 35.81	26.39	1.213		
39	58.8	4 13	6 41.34	26.76	1.196		
40	60.9	4 22	6 47.13	27.14	1.179		
41	63.1	4 31	6 53.22	27.55	1.162		
42	65.4	4 41	6 59.62	27.97	1.144	0′.869	5′.217
43	67.7	4 51	7 6.27	28.42	1.126		
44	70.1	5 1	7 13.44	28.90	1.107		
45	72.6	5 12	7 20.93	29.39	1.089		
46	75.2	5 23	7 28.81	29.92	1.070		
47	77.8	5 34	7 37.10	30.47	1.050	0′.869	5′.212
48	80.6	5 46	7 45.79	31.05	1.030		
49	83.5	5 59	7 55.12	31.67	1.010		
50	86.5	6 12	8 4.90	32.33	0.990	0′.868	5′.209

Convergency of meridians.—The *second* column of Table X contains the convergency of two meridians *six miles long and six miles apart*, measured on a parallel of latitude.

When the parallel of latitude passing through the south ends of such meridians, and forming the *south boundary* of the township of which the meridians form the *meridional boundaries*, is coincident with a tabular latitude given in the *first* column, the required convergency will be obtained directly from the *second* column (Plate VI, fig. 5); while for other than the tabular latitudes, it will be obtained by simple proportion (fig. 6).

The *third* column contains the *angle* of convergency. (abc, figs. 5 and 6.)

For the purpose of computing convergency *within* the boundaries of a regular township, said boundaries may be regarded as *straight* lines and the township a plain figure, generally a trapezoid; the convergency of any rectangular part thereof, bounded by meridional and latitudinal section lines, will be determined, as follows:

Multiply the convergency for the township, determined as above directed, by the length of the tract divided by 6*, and the product by the width* of the tract divided by 6; the resulting product will be the convergency required. (See Plate VI, fig. 5.)

To obtain the convergency of the meridional boundaries of any tract bounded by section lines, or other lines of legal subdivision, within a township, proceed as follows: Divide the tract into the least possible number of rectangular parts and compute the convergency for each tract; then, take the sum of the convergencies thus determined. (See example, Plate VI, fig. 7.)

The convergency of two meridians of equal length, in the same latitude, is proportional to their distance apart; (e. g.) the convergency

* All dimensions in miles and decimals of a mile.

of two meridians 6 miles long, separated by 5 ranges, latitude 38°, is 56.8 lks × 5 = 2.84 chains.

Convergencies of meridians in the same latitude, and not exceeding 24 miles in length, may be computed by an approximate proportion, which combines the advantages of convenience with an accuracy sufficient for the ordinary wants of the land surveyor; the proportion is this:

The cosines of the latitudes are to each other as the lengths of the intercepted parallels.

Resume example 5, page 130; we have:

cos 42° 39′ 07″ : cos 43° :: 480.00 chs. : 477.31 chs., which proportion may be worked with natural cosines, or more expeditiously by logarithms, as follows:

a. c.	log cos	42° 39′ 07″	0.133427
	log cos	43°	9.861127
	log	480.00	2.681241
	log	477.30	2.678795

The difference ..... 2.70 chs. is the convergency required.

The convergency division of Table X having been sufficiently explained, application of the remaining columns may be inferred from their titles.

OFFSETS AND TRIANGULATIONS.

Offsets from and to standard parallels, guide meridians, township or section lines, will always be run north, south, east, or west, as the case may be, while the *offset line* will be run *parallel* to the *random or true line*, as prevailing conditions may require. Examples may be found in Specimen Field Notes No. 5, pages 188, 192 and 198 and on Plate IV.

Triangulations may be executed with either right-angled or oblique angled triangles, as may be found most convenient; but all triangles will be *well conditioned* (i. e., right-angled) triangles, and should have the angle opposite the required side less than 45°; in other words, the base should be longer than the side to be determined.

The angles of oblique-angled triangles shall in no case be greater than 120° or less than 30°. All the angles of a triangle will be measured when the angular points are accessible. It will avoid several sources of possible error to take the readings of the courses to the two ends of the base from the opposite angle, both at a single setting of the instrument. This may readily be done by leaving the base properly flagged for observation; or by having the base laid off on the objective side of the obstacle, and angles taken both before and after crossing.

Computation of particular cases in the field notes, inserted here, as examples. See pages 188 and 192.

	log tan 40° 55′	9.9379
	log 20.00	0.3010
	log 17.34	0.2389
a. c.	log sin 48° 15′	0.1272
	log sin 64° 47′	9.9565
	log 15.00	1.1761
	log 18.19	1.2598

Page 211. By traverse table. From the south end of the base, let fall a perpendicular to the required distance, dividing it into two parts, thus forming two right-angled triangles; call the perpendicular a meridian; and, from the base as a course (N. 30° 30′ E., 36.00 chs.), determine the corresponding diff. lat. and departure, the latter being the length of the east part of the required distance; then, with the latitude just determined and bearing to flag, find the corresponding departure or west part of the required distance. The work may be arranged as follows:

Designation.	Bearings.	Distance.	Difference of latitude.	Departures.
Base	N. 30° 30′ E.	36.00	31.02	18.27 (E. part).
Perpendicular	North	31.02		
From S. end of base to flag	N. 37° 30′ W.	(?)*	30.94 0.08	23.74 0.06 (W. part).
		(?)*	31.02	23.80 (W. part).

*These distances are not required. The departures will be found with the arguments "bearing" and "diff. lat."

Then, 18.27+23.80=42.07 chs., the required distance.
Same example by logarithms:

a. c. log sin 52° 30′	0.1005
log sin 68°	9.9672
log 36.00	1.5563
log 42.07	1.6240

Four-place logarithms are quite sufficient if the tables are correct.

SPECIMEN FIELD NOTES.

No. 1.

TITLE PAGE.

[See Plate II.]

FIELD NOTES

OF THE SURVEY OF THE

THIRD STANDARD PARALLEL NORTH

THROUGH

Ranges Nos. 21, 22, 23, and 24 East

OF THE

PRINCIPAL BASE AND MERIDIAN

IN THE

STATE OF MONTANA,

AS SURVEYED BY

RICHARD ROODS,
U. S. DEPUTY SURVEYOR,

UNDER HIS CONTRACT No. 97,
DATED JULY 10, 1890.

Survey commenced August 22, 1890.
Survey completed August 29, 1890.

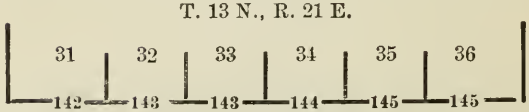
[Second page.]

NAMES AND DUTIES OF ASSISTANTS.

PETER LONG.....Chainman.
JOHN SHORT.....Chainman.
ELI MARKER.....Chainman.
WILLIAM TALLY .....Chainman.
LEWIS LINK.....Chainman.
HENRY CLAY .....Moundman.
WILLIAM STONE .....Moundman.
GEORGE SHARP .....Axman.
ADAM DULL .....Axman.
JAMES BANNER .....Flagman.

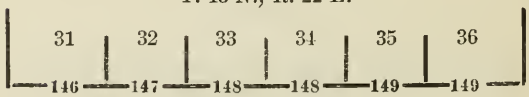
INDEX.

T. 13 N., R. 21 E.



3rd Standard Parallel N.

T. 13 N., R. 22 E.



3rd Standard Parallel N.

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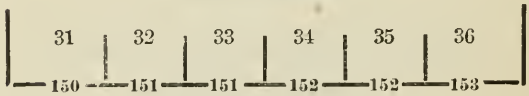

3rd Standard Parallel N.

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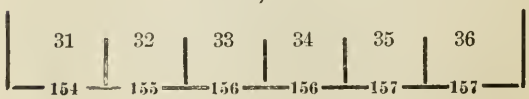

3rd Standard Parallel N.

[Third Page.]

PRELIMINARY OATHS OF ASSISTANTS.

We, Peter Long, John Short, Eli Marker, and William Tally, do solemnly swear that we will well and faithfully execute the duties of chainmen; that we will level the chain upon even and uneven ground, and plumb the tally pins, either by sticking or dropping the same; that we will report the true distances to all notable objects, and the true lengths of all lines that we assist in measuring, to the best of our skill and ability, and in accordance with instructions given us, in the survey of the Third Standard Parallel North, through Ranges Nos. 21, 22, 23, and 24 East, of the Principal Base and Meridian, in the State of Montana.

PETER LONG, *Chainman.*
JOHN SHORT, *Chainman.*
ELI MARKER, *Chainman.*
WILLIAM TALLY, *Chainman.*

Subscribed and sworn to before me this second day of August, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

We, Henry Clay and William Stone, do solemnly swear that we will well and truly perform the duties of moundmen, in the establishment of corners, according to the instructions given us, to the best of our skill and ability, in the survey of the Third Standard Parallel North, through Ranges Nos. 21, 22, 23, and 24 East, of the Principal Base and Meridian, in the State of Montana.

HENRY CLAY, *Moundman.*
WILLIAM STONE, *Moundman.*

Subscribed and sworn to before me this second day of August, 1890.
[SEAL.] WILLIAM MARTIN.
Notary Public.

We, George Sharp and Adam Dull, do solemnly swear that we will well and truly perform the duties of axmen, in the establishment of corners and other duties, according to instructions given us, and to the best of our skill and ability, in the survey of the Third Standard Parallel North, through Ranges Nos. 21, 22, 23, and 24 East, of the Principal Base and Meridian, in the State of Montana.

GEORGE SHARP, *Axman.*
ADAM DULL, *Axman.*

Subscribed and sworn to before me this second day of August, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

I, James Banner, do solemnly swear that I will well and truly perform the duties of flagman, according to instructions given me, to the best of my skill and ability, in the survey of the Third Standard Parallel North, through Ranges Nos. 21, 22, 23, and 24 East, of the Principal Base and Meridian, in the State of Montana.

JAMES BANNER, *Flagman.*

Subscribed and sworn to before me this second day of August, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

I, Lewis Link, do solemnly swear that I will well and faithfully execute the duties of chainman; that I will level the chain upon even and uneven ground, and plumb the tally pins, either by sticking or dropping the same; that I will report the true distances to all notable objects, and the true length of all lines that I assist in measuring, to the best of my skill and ability, and in accordance with instructions given me, in the survey of the Third Standard Parallel North, through Ranges Nos. 23 and 24 East, of the Principal Base and Meridian, in the State of Montana.

LEWIS LINK, *Chainman.*

Subscribed and sworn to before me this twenty-seventh day of August, 1890.
[SEAL.] RICHARD ROODS,
U. S. Deputy Surveyor.

Third Standard Parallel North, through Range 21 East.

Chains.	
	Survey commenced August 22, 1890, and executed with a W. & L. E. Gurley light mountain transit, No. —; the horizontal limb having two double verniers placed opposite to each other and reading to 30″ of arc.
	The instrument was examined, tested on the true meridian at Helena, found correct, and was approved by the surveyor general for Montana, August 1, 1890.
	I begin at the standard corner of townships 13 north, ranges 20 and 21 east, which is a sandstone, 8×7×5 ins. above ground, firmly set, and marked and witnessed as described by the surveyor general.
	At a point 3.39 ft.* south of said standard corner, in latitude 45° 34′.5 N., longitude 107° 54′ W.,† at 9h. 19.7m. p. m., by my watch, which is 2 minutes fast of local mean time, I observe Polaris at *eastern elongation*, in accordance with instructions‡ in the Manual, and mark the line thus determined, by a tack driven in a wooden plug set in the ground, five chains north of my station.
	August 22, 1890.
	August 23, 1890: At 6 a. m., I lay off the azimuth of Polaris, 1° 49′.6, to the *west*, and mark the TRUE MERIDIAN thus determined, by cutting a mark on a stone firmly set in the ground, west of the point established last night; the *magnetic* bearing of said true meridian is N. 18° 13′ W., which reduced by the table on page 100 of the Manual, gives the *mean magnetic declination, 18° 09′ east.*
	At this station (i. e., the point 3.39 ft. S. of the standard cor.), I turn off from the *true meridian*, an angle§ of 89° 57′ 20″.9 toward the east, and run
	N. 89° 57′ E. on the secant, S. of sec. 31.
	Over gently rolling prairie.
28.10	Indian trail, bears N. 28° E. and S. 28° W.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 4 lks.; position of middle point
	By 1st set, 40.02 chs.
	By 2nd set, 39.98 chs.; the mean of which is
40.00	N. 1.53 ft. from the secant,
	Set a limestone, 20 × 8 × 5 ins., 15 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; dig pits 18 × 18 × 12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
	Samuel Somer's house bears N. 65° E.
54.10	Leave prairie, enter Somer's field, bears N. and S.
71.55	Leave field, enter prairie, bears N. and S.; field extends N. to Somer's house, and S. about 15 chs.
	Difference between measurements‖ of 80.00 chs. by two sets of chainmen, is 6 lks.; position of middle point
	By 1st set, 79.97 chs.
	By 2nd set, 80.03 chs.; the mean of which is
80.00	Set a limestone, 24×9×6 ins., 18 ins. in the ground, for standard cor. of secs. 31 and 32,¶ marked S. C. on N., with 5 grooves on E. and 1 groove on W. faces; dig pits 24×18×12 ins., crosswise on each line, E. and W., 3 ft., and N. of stone, 7 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, N. of cor.
	Samuel Somer's house bears N. 38° W.
	Land, gently rolling prairie.
	Soil, sandy loam; 1st rate.
	No timber.

*Interpolated by simple proportion, for the given latitude, from the second column of Table III, page 121.

†The latitude and longitude will be given by the surveyor general, in his special written instructions.

‡See directions for making the observation, page 105.

§This angle is interpolated by simple proportion, for the given latitude, from the column headed "3 miles" in Table IV. But hereafter the exact angle required will be changed to the nearest angle that can be set off or read on the instrument used.

‖The measurements are counted from the beginning of the mile; 40.00 chs. are measured from the last ¼ sec. cor.; see "Base Line," par. 6, page 51.

¶At this point, the secant intersects the standard parallel. See Plate II, figs. 1 and 2.

Chains.	
	N. 89° 58′ E. on the secant, through sec. 32.
	Over gently rolling prairie.
3.20	Road from Lake City to Ashland, bears N. 30° W. and S. 30° E.
12.40	Leave prairie, bears N. 25° W. and S. 25° E.; begin descent.
17.50	Pine Creek, 50 lks. wide, 40 ft. below prairie, course S. 20° E.; clear water 5 ft. deep; rapid current, gravelly bottom; bank 10 ft. high.
19.40	Top of bluff bank 25 ft. high, bears N. 20° W. and S. 20° E.; enter heavy pine timber and begin steep ascent, over stony ground, sloping N. W.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 24 lks.; position of middle point
	By 1st set, 39.88 chs.
	By 2nd set, 40.12 chs.; the mean of which is
40.00	S. 1.19 ft. from the secant,
	Set a granite stone, 14×8×6 ins., 9 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; from which
	A pine 16 ins. diam., bears N. 37½° E., 48 lks. dist., marked S. C. ¼ S. B. T.
	A pine, 14 ins. diam., bears N. 42° W., 51 lks. dist., marked S. C. ¼ S. B. T.
54.00	Leave heavy timber, bears N. and S.
74.00	Top of high granite ridge, 320 ft. above Pine Creek, bears N. E. and S. W.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 22 lks.; position of middle point
	By 1st set, 80.11 chs.
	By 2nd set, 79.89 chs.; the mean of which is
80.00	S. 2.04 ft. from the secant,
	Set a granite stone, 20×8×4 ins., 15 ins. in the ground, for Standard Cor. of secs. 32 and 33, marked S. C., on N., with 4 grooves on E. and 2 grooves on W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	NOTE.—I erect a signal at this corner for a test sight from one of the high points visible to the east.
	Land, mountainous.
	Soil, stony; 4th rate.
	Timber, pine and fir.
	Mountainous or heavily timbered land, 60.60 chs.
	August 22, 1890.
	NOTE.—The sky was overcast during the entire night. Polaris not visible.
	August 23, 1890.
	N. 89° 59′ E. on the secant, through sec. 33.
	Over stony ground on top of ridge.
8.10	Begin descent over rocky ground, sloping S. E.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 18 lks.; position of middle point
	By 1st set, 39.91 chs.
	By 2nd set, 40.09 chs.; the mean of which is
40.00	S. 2.55 ft. from secant,
	Set a granite stone, 19×8×7 ins., 14 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	This cor. is 40 ft. below top of ridge.
76.30	Enter scattering, stunted cedars, bearing N. and S.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 16 lks.; position of middle point
	By 1st set, 80.08 chs.
	By 2nd set, 79.92 chs.; the mean of which is
80.00	S. 2.72 ft. from the secant,
	Set a granite stone, 19×8×6 ins., 15 ins. in the ground, for standard cor. of secs. 33 and 34, marked S. C. on N., with 3 grooves on E. and W. faces; from which
	A cedar, 6 ins. diam., bears N. 22½° E., 32 lks. dist., marked T. 13 N., R. 21 E., S. 34, B. T.
	A cedar, 8 ins. diam., bears N. 41¼° W., 45 lks. dist., marked T. 13 N., R. 21 E., S. 33, B. T.

Chains.	
	This cor. is 100 ft. below top of ridge. Land, mountainous. Soil, rocky; 4th rate. Timber, scattering cedars. Mountainous land, 80.00 chs.
	East, on the secant, through sec. 34. Descend eastern slope through scattering cedars.
16.10	Begin very steep descent to Black River Canon, bears N. E. and S. W.
20.00	Foot of descent, 300 ft. below last cor., bears N. E. and S. W.
20.68	To right bank of Black River, course S. 28° W. S. 2.64 ft.* from the secant, Set a granite stone, 19×8×5 ins., 15 ins. in the ground, for meander cor. on S. bdy. sec. 34, marked S. C. on N., and M. C. on E. faces; dig a pit, 3 ft. sq., 8 ft. W., of stone; and raise a mound of earth, 4 ft. base, 2 feet high, W. of cor. To find the distance across the river, I set a flag on the *secant* line, on east bank; then measure a base, N. 6.20 chs., to a point from which the flag bears S. 43° 10′ E.; which gives for the distance, tan. 43° 10′ × base, or 0 938×6.20 chs.=5.82 chs.
26.50	To left bank of Black River, course S. W. Banks, 12 ft. high; rapid current over stony bottom; clear water, about 5 ft. deep: S. 2.64 ft.* from the secant. Set a granite stone, 17×9×7 ins., 12 ins. in the ground, for meander cor. on S. bdy. sec. 34, marked S. C. on N., and M. C. on W. faces; dig a pit, 3 ft. sq., 8 ft. E. of stone; and raise a mound of earth, 4 ft. base, 2 ft. high, E. of cor. Thence, up steep ascent through scattering cedars. Difference between the measurements of 40.00 chs., by the two sets of chainmen, is 20 lks.; position of middle point By 1st set, 39.90 chs. By 2nd set, 40.10 chs.; the mean of which is
40.00	S. 2.55 ft. from the secant: A cedar, 7 ins. diam., for standard ¼ sec. cor., I mark S. C., ¼ S. on N. side; from which A cedar, 4 ins. diam., bears N. 31° E., 20 lks. dist., marked S. C., ¼ S., B. T. A cedar, 6 ins. diam., bears N. 64¼° W., 18 lks. dist., marked S. C., ¼ S., B. T. Thence up side of ridge, sloping S. W.
40.40	Leave scattering cedars, bearing N. E. and S. W. Difference between measurements of 80.00 chs., by two sets of chainmen, is 18 lks.; position of middle point By 1st set, 80.09 chs. By 2nd set, 79.90 chs.; the mean of which is
80.00	S. 2.04 ft. from the secant, Set a granite stone, 21×8×5 ins., 16 ins. in the ground, for standard cor. of secs. 34 and 35, marked S. C. on N., with 2 grooves on E. and 4 grooves on W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable. This cor. is on top of a ridge, about 300 ft. above Black River. Land, mountainous. Soil, rocky; 4th rate. Timber, scattering cedars. Mountainous land, 80.00 chs. August 23, 1890.
	NOTE.—Continuous rain since afternoon of August 23; observations on Polaris not possible. August 25, 1890, 7 a. m. S. 89° 59′ E. on the secant, through sec. 35.

* These distances may be found by taking the mean of the offsets at the preceding sec., and following ¼ sec. cor.

Third Standard Parallel North, through Range 21 East—Continued.

Chains.	
	Descend over rough, stony ground sloping S.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 14 lks.; position of middle point
	By 1st set, 40.07 chs.
	By 2nd set, 39.93 chs.; the mean of which is
40.00	S. 1.19 ft. from the secant,
	Set a granite stone, 15×8×5 ins., 10 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
	This cor. is about 280 ft. below top of ridge.
	Descend abruptly, 90 ft.
50.10	Bottom of ravine, 10 lks. wide, course S. 20° W.; water in holes; thence, steep ascent over ground sloping W.
56.40	Enter pine timber, bears N. E. and S. W.
56.58	A pine, 16 ins. diam., on line, I mark with 2 notches on E. and W. sides.
68.40	Leave pine timber, bears N. E. and S. W.
68.50	Alexander Selkirk's house, bears S., 8.40 chs. dist.
73.50	Road, bears N. and S.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 16 lks.; position of middle point
	By 1st set, 79.92 chs.
	By 2nd set, 80.08 chs.; the mean of which is
80.00	* Set a limestone, 20×8×6 ins., 15 ins. in the ground, for standard cor. of secs. 35 and 36, marked S. C. on N., with 1 groove on E. and 5 grooves on W. faces; dig pits, 24×18×12 ins., crosswise on each line, E. and W., 3 ft., and N. of stone, 7 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, N. of cor. This cor. is about 60 ft. above ravine.
	Land, mountainous.
	Soil, stony; 4th rate.
	Timber, pine.
	Mountainous land, 80.00 chs.
	S. 89° 58′ E. on the secant, S. of sec. 36.
	Ascend over ground sloping W.
12.70	Enter heavy oak timber, bears N. and S.
28.30	Top of ridge, 80 ft. above last cor., bears N. and S.
38.50	Leave heavy oak timber, bears N. and S.
	Difference between measurements of 40.00 chs., by two sets of chainmen is 14 lks.; position of middle point
	By 1st set, 40.07 chs.
	By 2nd set, 39.93 chs.; the mean of which is
40.00	N. 1.53 ft. from the secant,
	Set a limestone, 16×7×5 ins., 11 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
52.20	Road, bears N. 70° E. and S. 60° W.
68.10	Creek, 20 lks. wide, course S. 50° W.; ascend over ground sloping W., about 90 ft.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 18 lks.; position of middle point
	By 1st set, 79.91 chs.
	By second set, 80.09 chs.; the mean of which is
80.00	N. 3.39 ft. from the secant,
	Set a granite stone, 20×7×6 ins., 15 ins. in the ground, for standard cor. of Tps. 13 N., Rs. 21 and 22 E., marked †
	S. C., 13 N. on N.,
	22 E. on E., and
	21 E. on W. faces; with 6 grooves on N. E., and W. faces; dig pits, 30×24×12 ins., crosswise on each line, E. and W., 4 ft.; and N. of stone, 8 ft. dist.; and raise a mound of earth, 5 ft. base, 2½ ft. high, N. of cor.
	Land, mountainous.

* The secant intersects the standard parallel 1 mile from end of secant, and at the point for the corner of secs. 35 and 36. See Plate II, figs. 1 and 2.

† See "STANDARD TOWNSHIP CORNERS," page 23.

Third Standard Parallel North, through Range 21 East—Concluded.

Chains. Soil, stony; 3rd and 4th rate.
Timber, oak.
Mountainous or heavily timbered land, 80.00 chs.

August 25, 1890.

Third Standard Parallel North, through Range 22 East.

Chains. At the last point determined on the *secant*, which is 6 miles from the starting point and 3.39 ft. *south* of the corner of Tps. 13 N., Rs. 21 and 22 E., I deflect an angle * of 5′ to the *north* and run
N. 89° 57′ E., on the secant, S. of sec. 31.
Up steep ascent, over stony ground sloping west.
36.10 To edge of mesa, 60 ft. above Tp. cor., bears N. and S.
Difference between measurements of 40.00 chs., by two sets of chainmen, is 14 lks.; position of middle point
By 1st set, 40.07 chs.
By 2nd set, 39.93 chs.; the mean of which is
40.00 N. 1.53 ft. from the secant; the point for standard ¼ sec. cor. falls on rock *in place*, 6 × 3 × 2 ft. above ground, on which
Cut a cross (×) at the exact corner point, for standard ¼ sec. cor., marked S. C. ¼, on N. side of cross; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
August 26, 1890: At this standard ¼ sec. cor., I observe Polaris at 5h 9m a. m., by my watch, which is 2m 47s fast of local mean time, and mark the direction thus determined, by a tack driven in a picket firmly set, 5 chains north of the cor.

	h.	m.	h.	m.
Astron. time by watch, Aug. 25			17	9.0
Watch fast				2.8
Astron. l. m. t. of obs. Aug. 25			17	6.2
U. C. Polaris, August 25	15	10.1		
Red. to Aug. 25		39.2		
U. C. Polaris, Aug. 25	15	0.9	15	0.9
Hour angle of Polaris and time argument			2	5.3

Azimuth of Polaris, at obs ..... 10° 57′.5 W.

(Note.—The true meridian could be defined by laying off the azimuth to the *east*, but this is unnecessary; the bearing of the signal will be found as follows:)
I measure the angle between the direction thus determined, and the signal established at the standard cor. of secs. 32 and 33, as follows:

	°	″
1.	88	59 45
2.	89	00 30
3.	89	00 30
Mean,	89	00 15
Add the azimuth	0	57 30 W.

The *observed* bearing is N. 89 57 45.0 W.
The *true* bearing † is....N. 89 58 00.7 W.

The difference,..... 0 00 15.7, is the deviation of the standard, *south* of the true latitude curve. As the difference is probably less than the errors of observation, I continue the secant as marked on the ground.
Over level mesa.

* Interpolated by simple proportion from right hand column of Table III, page 121. See directions following the table.
† Interpolated by simple proportion from Table IV, for the given latitude, and for 2¾ miles (i. e.) for *one-half* of the distance to signal.

Third Standard Parallel North, through Range 22 East—Continued.

Chains.	
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 6 lks.; position of middle point
	By 1st set, 79.97 chs.
	By 2nd set, 80.03 chs; the mean of which is
80.00	* Set a sandstone, 15×7×6 ins., 10 ins. in the ground, for standard cor. of secs. 31 and 32, marked S. C., on N.; with five grooves on E. and 1 groove on W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	Land, mountainous and mesa.
	Soil, stony; 4th rate. No timber.
	Mountainous land, 36.10 chs.
	N. 89° 58′ E. on the secant, through sec. 32.
	Over level mesa.
18.00	Road, bears N. and S.
32.20	Edge of mesa, bears N. W. and S.; descend abruptly 50 ft. Difference between measurements of 40.00 chs., by two sets of chainmen, is 14 lks.; position of middle point
	By 1st set, 40.07 chs.
	By 2nd set, 39.93 chs.; the mean of which is
40.00	S. 1.19 ft. from the secant, falls on a boulder, 8×6×3 ft. above ground, on which
	I cut a cross (×) at the exact corner point, for standard ¼ sec. cor., marked S. C. ¼ on N. side of cross; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
40.40	Enter scattering cottonwood timber, bears N. W. and S. E.; descend 80 ft. to
52.50	Left bank of Cow Creek, 20 lks. wide, course N. W.; banks, 10 ft. high; water, pure and cold, 2 ft. deep; swift current over rock bottom.
64.50	Leave scattering cottonwood timber, bears N. W. and S. E.; begin steep ascent over stony ground, sloping S. W.
75.00	Top of granite ridge 230 ft. above Cow Creek, bears N. W. and S. E.
	Difference between measurements of 80.00 chs., by two sets of chainmen is 16 lks.; position of middle point
	By 1st set, 79.92 chs.
	By 2nd set, 80.08 chs.; the mean of which is
80.00	S. 2.04 ft. from the secant,
	Set a granite stone, 15×8×6 ins., 10 ins. in the ground, for standard cor. of secs. 32 and 33, marked S. C., on N.; with 4 grooves on E. and 2 grooves on W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	Land, mountainous and level.
	Soil, stony; 4th rate.
	Timber, scattering cottonwood.
	Mountainous land, 47.80 chains. August 26, 1890.

At the corner last described (i. e.) the standard cor. of secs. 32 and 33, I observe Polaris at *eastern elongation*, August 26, at $9^h\ 5^m$ p. m. by my watch, which is 3 minutes fast of local mean time; and mark the direction thus determined by a tack driven in a wooden plug set firmly in the ground, five chains north of my station.

August 27, 1890: At 6 a. m., I lay off the azimuth of Polaris, 1° 50′ to the *west;* and mark the TRUE MERIDIAN thus determined by a cross on a stone firmly set in the ground, west of the point marked last night. I measure the angle between the true meridian and the signal erected at the standard cor. of secs. 32 and 33, Tp. 13 N., R. 21 E., as follows:

	°	′	″
1.	89	57	00
2.	89	56	30
3.	89	57	00
Mean,	89	56	50

therefore

The *observed* bearing is N. 89 56 50 W.

The *true* bearing is N. 89 57 20.9 W.; and the difference, 0′ 31″ (closely),

* At this point, *the secant intersects the standard;* see Plate II, figs. 1 and 2.

Chains.	
	is the deviation of the standard parallel south of the true latitude curve; therefore, this corner is 4.80 ft. south of its true place on the parallel of latitude passing through the signal.
	I will correct the line east of this corner and return to the true latitude curve, at the corner of Tps. 13 N., Rs. 22 and 23 E. The nat. tan. of the angle subtended by 4.80 feet at a distance of 4 miles, will be 4.80 ft. divided by 4 miles (expressed in feet) and the angle itself will be 0′ 47″; which added to the deviation of the secant, 0′ 31″, determined by observation, gives 1′ 18″ for the total deflection of the secant to make the curve of the parallel attain the Tp. cor.*
	The new reference line thus determined, will be called the *correction secant*. The *bearings* of said "correction secant" at successive mile points, will be those of Table III, corrected by the total deflection (1′ 18″); while the *offsets* will remain unchanged. The corrected bearings will be as follows:
	At corner of secs. 32 & 33.; secs. 33 & 34.; secs. 34 & 35.; secs. 35 & 36.
	Corrected bearings: N. 89° 58′ E.; N. 89° 59′ E.; East; S. 89° 59′ E.
	N. 89° 58′ E. on the secant, through sec. 33.
	Over rough barren ground.
8.40	Begin steep descent, over stony ground, sloping N. E.
26.00	Foot of descent, about 250 ft. below top of ridge, bears N. W. and S. E. Spring of pure water, 2 ft. deep, bears S., 4 chs. dist.: thence, over rolling land.
36.10	Spring branch, 2 lks. wide, course N. E.; sinks in the ground within 20 chs.
	Difference between measurements of 40.00 chs., by two sets of chainmen is 12 lks; position of middle point
	By 1st set, 39.94 chs.
	By 2nd set, 40.06 chs.; the mean of which is
40.00	S. 2.55 ft. from the secant,
	Set a granite stone, 15×8×8 ins., 10 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 8 lks.; position of middle point
	By 1st set, 80.04 chs.
	By 2nd set, 79.96 chs.; the mean of which is
80.00	S. 2.72 ft. from the secant,
	Set a granite stone, 21×8×4 ins., 16 ins., in the ground, for standard cor. of secs. 33 and 34, marked S. C., on N.; with 3 grooves on E. and W. faces; dig pits, 24×18×12 ins., crosswise on each line. E. and W., 3 ft., and N. of stone, 7 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, N. of cor.
	Land, mountainous, and rolling.
	Soil, stony; 4th rate.
	No timber.
	Mountainous land, 27.00 chs.
	N. 89° 59′ E., on the secant, through sec. 34.
	Over gently rolling land.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 6 lks.; position of middle point
	By 1st set, 39.97 chs.
	By 2nd set, 40.03 chs.; the mean of which is
40.00	S. 2.55 ft. from the secant,
	Set a sandstone, 19×7×5 ins., 15 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.

*This method for correcting a standard parallel may be employed when the deviation does not exceed one minute of arc; but, if greater error is discovered, the corners already set will be corrected as far back on the line as the stated limit of deviation (1′), is exceeded.

Chains.	
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 10 lks.; position of middle point By 1st set, 80.05 chs. By 2nd set, 79.95 chs.; the mean of which is
80.00	S. 2.04 ft. from the secant, Set a sandstone, 24×7×5 ins., 18 ins. in the ground, for standard cor. of secs. 34 and 35, marked S. C., on N.; with 2 grooves on E. and 4 grooves on W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable. Land, gently rolling. Soil, stony; 4th rate. No timber.

East, on the secant, through sec. 35.
Over rolling, stony ground.

8.10	Creek 10 lks. wide, in ravine 20 ft. deep, course N. E.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 8 lks.; position of middle point By 1st set, 39.96 chs. By 2nd set, 40.04 chs.; the mean of which is
40.00	S. 1.19 ft. from the secant, Set a sandstone. 15×8×5 ins., 10 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼, on N. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 6 lks.; position of middle point is By 1st set, 80.03 chs. By 2nd set, 79.97 chs.; the mean of which is:
80.00	Set a sandstone, 16×8×6 ins., 11 ins. in the ground, for standard cor. of secs. 35 and 36, marked S. C., on N., with 1 groove on E. and 5 grooves on W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable. Land, gently rolling. Soil, stony; 4th rate. No timber.

S. 89° 59′ E. on the secant, S. of sec. 36.
Over gently rolling land.

	Difference of measurements of 40.00 chs., by two sets of chainmen, is 10 lks.; position of middle point By 1st set, 39.95 chs. By 2nd set, 40.05 chs.; the mean of which is
40.00	N. 1.53 ft. from the secant, Set a sandstone, 17×8×4 ins., 11 ins. in the ground, for standard ¼ sec. cor. marked S. C. ¼, on N. face; dig pits, 18×8×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
	Difference of measurements of 80.00 chs., by two sets of chainmen, is 6 lks.; position of middle point By 1st set, 80.03 chs. By 2nd set, 79.97 chs.; the mean of which is
80.00	N. 3.39 ft. from the secant, Set a sandstone, 20×8×5 ins., 15 ins. in the ground, for standard cor. of Tps. 13 N., Rs. 22 and 23 E., marked S. C., 13 N. on N., 23 E. on E., and 22 E. on W. faces; with 6 grooves on N., E., and W. faces; dig pits 30×24×12 ins., crosswise on each line, E. and W., 4 ft., and N. of stone, 8 ft. dist.; and raise a mound of earth, 5 ft base, 2½ ft. high, N. of cor. Land, gently rolling. Soil, stony; 4th rate. No timber.

NOTE.—This day I discharge John Short, chainman, to whom I administer the proper final oath. I employ Lewis Link to perform the duties of

Third Standard Parallel North, through Range 22 East—Concluded.

Chains.	
	chainman, and administer to him the required *preliminary* oath. No person authorized to administer oaths, other than myself, is available without great delay and expense. (See pages 64 and 65.) RICHARD ROODS, *U. S. Deputy Surveyor.* August 27, 1890.

[These specimen field notes of the survey of the third standard parallel north will be continued through range 23 east, to illustrate the method by offsets from a tangent to the latitude curve at a township corner; *see* "Tangent Method," page 124, and Plate II, fig. 3.]

Third Standard Parallel North, through Range 23 East.

Chains.	
	Survey commenced August 27, 1890, and executed with a W. and L. E. Gurley light mountain transit, No.—, the horizontal limb being provided with two opposite verniers reading to 30″ of arc.
	At the standard corner of townships 13 north, ranges 22 and 23 east, in latitude 45° 34′.5 N., longitude 107° 39′ W., at 9^h. 00^m. p. m. by my watch, which is 2^m. fast of local mean time, I observe Polaris at eastern elongation, in accordance with instructions in the Manual,* and mark the line thus determined, by a tack driven in a wooden plug set in the ground five chains north of my station.
	August 28, 1890: At 6 a. m., I turn off the azimuth of Polaris, 1° 50′ to the west, and mark the TRUE MERIDIAN thus determined by cutting a mark on a stone firmly set in the ground, west of the mark established last night; the *magnetic* bearing of said true meridian is N. 18° 08′ W., which reduced by the table on page 100 of the manual, gives the *mean magnetic declination 18° 04′ east.*†
	I lay off from the *true meridian*, an angle of 90°, from north to east, and run
	East on the tangent, S. ‡ of sec. 31.
	Over level prairie.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 4 lks.; position of middle point
	By 1st set, 40.02 chs.
	By 2nd set, 39.98 chs.; the mean of which is
40.00	§N. 0.17 ft. from the tangent,
	Set a sandstone, 15×9×6 ins., 10 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼, on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
50.00	Leave prairie, enter heavy oak timber, bears N. and S.
68.44	An oak, 29 ins. diam., on line, I mark with 2 notches on E. and W. sides.
	Difference between measurements of 80. chs., by two sets of chainmen, is 8 lks.; position of middle point
	By 1st set, 79.96 chs.
	By 2nd set, 80.04 chs.; the mean of which is
80.00	N. 0.68 ft. from the tangent,
	An oak, 32 ins. diam., for standard cor. of secs. 31 and 32, I mark
	S. C., T. 13 N., R. 23 E. on N.,
	S. 32 on E., and
	S. 31 on W. sides; with 5 notches on E. and 1 notch on W. sides; from which
	An oak, 28 ins. diam., bears N. 31½° E., 18 lks. dist., marked T. 13 N., R. 23 E., S. 32, B. T.
	An oak, 13 ins. diam., bears N. 74¼° W., 24 lks. dist., marked T. 13 N., R. 23 E., S. 31, B. T.

* See page 105.

† See footnote, page 106.

‡ The tangent leaves the parallel as soon as started, and will always lie *south* of the sec. bdy., not *on* it. See Plate III, fig. 3.

§ The form given above will always be employed for stating the dist. between the tan. and the cor.; the word "offset" will not be used for such purpose. See page 124.

Chains.	
	Land, level. Soil, gravelly loam; 3rd rate. Timber, oak, with some beech and white ash. Heavily timbered land, 30.00 chs.
	S. 89° 59′ E. on the tangent, S. of sec. 32. Over level ground, through heavy oak timber.
14.73	An oak, 14 ins. diam., on line, I mark with 2 notches, on E. and W. sides.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 6 lks.; position of middle point By 1st set, 40.03 chs. By 2d set, 39.97 chs.; the mean of which is
40.00	N. 1.53 ft.* from the tangent, Set an oak post, 3 ft. long, 3 in. sq., 24 ins. in the ground, for standard ¼ sec. cor., marked S. C., ¼ S. on N. face.; from which An oak, 17 ins. dia., bears N. 21½° E., 37 lks. dist., marked S. C. ¼ S., B. T. A white ash, 16 ins. diam., bears N. 69° W., 41 lks. dist., marked S. C. ¼ S., B. T.
64.00	Leave heavy oak timber, enter prairie land, bears N. W. and S. E.
74.50	Spring of pure water, 3 ft. deep, bears N. 7 chs. dist.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 8 lks.; position of middle point By 1st set, 79.96 chs. By 2nd set, 80.04 chs.; the mean of which is
80.00	N. 2.72 ft. from the tangent, Set a sandstone, 19×6×5 ins., 15 ins. in the ground, for standard cor. of secs. 32 and 33, marked S. C., on N.; with 4 grooves on E. and 2 grooves on W. faces; dig pits, 24×18×12 ins., crosswise on each line, E. and W., 3 ft., and N. of stone, 7 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, N. of cor. Land, level and gently rolling. Soil, sandy loam; 2nd rate. Timber, oak, with some ash and beech. Heavily timbered land, 56.00 chs.
	S. 89° 58′ E. on the tangent, S. of sec. 33. Over broken, stony ground.
7.10	Spring branch, pure water, 3 lks. wide, course S. E.
18.30	Clear Creek, 12 lks. wide, course N. E.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 12 lks.; position of middle point By 1st set, 40.06 chs. By 2nd set, 39.94 chs.; the mean of which is
40.00	N. 4.24 ft. from the tangent, Set a sandstone, 17×7×5 ins., 12 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼, on N. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
75.80	Clear Creek, 15 lks. wide, 1 ft. deep, course S. E.
76.00	Begin very steep ascent, bears N. W. and S. E.
79.60	Top of ridge, 70 ft. above Clear Creek, bears N. W. and S. E.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 18 lks.; position of middle point By 1st set, 79.91 chs. By 2nd set, 80.09 chs.; the mean of which is
80.00	N. 6.11 ft. from the tangent, Set a granite stone, 20×6×6 ins., 15 ins. in the ground, for standard cor. of secs. 33 and 34, marked S. C. on N., with three grooves on E. and W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.

* Table V. In lat. 45° 3′.5, offset at 3 miles, is $5.99+[(6.20-5.99)\times 0°.575]=6.11$ ft.; and $\frac{6.11}{4}=1.53$ ft., the required offset a 1¼ miles from the tangential point. See rules, and table, page 126.

Chains.	
	Land, broken and hilly. Soil, gravelly; 3rd and 4th rate. No timber.
	S. 89° 57′ E. on the tangent, S. of sec. 34. Descend east side of ridge, over rocky ground. Foot of descent bears N. and S.; thence, over rolling ground.
5.50 5.80	Rock Creek, 20 lks. wide; rapid current over stony bottom; clear water, 2 ft. deep; banks, 4 ft. high; course S. This creek is the outlet of Catfish Lake, 4 chs. N.
	East end of Catfish Lake, bears N., 10 chs. dist.
34.00	Difference between measurements of 40.00 chs., by two sets of chainmen, is 20 lks.; position of middle point By 1st set, 40.10 chs. By 2nd set, 39.90 chs.; the mean of which is N. 8.32 ft. from the tangent,
40.00	Set a sandstone, 15×8×6 ins., 10 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	Begin descent from upland to bottom land, bears N. and S. E.
75.10	Foot of descent, 20 ft. below upland, bears N. and S. E.; enter cottonwood timber.
77.70	A cottonwood,* 15 ins. in diam., on line, I mark with 2 notches on E. and W. sides.
79.10	Difference between measurements of 80.00 chs., by two sets of chainmen, is 12 lks.; position of middle point By 1st set, 79.94 chs. By 2nd set, 80.06 chs.; the mean of which is N. 10.86 ft. from the tangent,
80.00	A cottonwood, 18 ins. diam., for Standard Cor. of Secs. 34 and 35, I mark S. C., T. 13 N., R. 23 E. on N., S. 35 on E., and S. 34 on W. sides; from which A cottonwood, 13 ins. diam., bears N. 75½° E., 72 lks. dist., marked T. 13 N., R. 23 E., S. 35, B. T. A cottonwood, 12 ins. diam., bears N. 12¾° W., 14 lks. dist., marked T. 13 N., R. 23 E., S. 34, B. T.
	Land, rolling and level. Soil, stony and alluvial; 3rd and 1st rate. Timber, cottonwood, with some sycamore.
	S. 89° 56′ E. on the tangent, S. of sec. 35. Through cottonwood timber. At 11.10 chs.† intersect right bank of Turtle River, course S. E. At this point, the distance between the tangent and standard, is 11.65 feet, or 18 lks., nearly; the bank of the stream bears about N. 47½° W.; therefore, N. 47½° W., 26 lks., determines the point for the meander cor. at
11.21	On the *standard parallel*, where I Set a cedar post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for meander cor. on S. bdy. sec. 35, marked S. C., T. 13 N. on N., M. C.; on E. and R. 23 E., S. 35 on W. faces; from which A sycamore, 34 ins. diam., bears N. 81¾° W., 22 lks. dist., marked S. C., M. C., T. 13 N., R. 23 E., S. 35, B. T. A cottonwood, 15 ins. diam., bears N. 54½° W., 34 lks. dist., marked S. C., M. C., T. 13 N., R. 23 E., S. 35, B. T. Turtle River is a turbid stream, with muddy banks 3 to 5 ft. high; water, 4 to 10 ft. deep; sluggish current, over mud bottom. To determine the distance across the river, I set a flag on line,‡ on the left bank; then measure a base line, S. 0° 04′ W., 6.00 chs., to a point, from which

* This tree is supposed to stand on the *standard parallel;* which is nearly 11 ft. N. of the tangent. Great care will be taken to note topography on the *true line.*

† See Plate II, fig. 4. In actual practice the diagram will be placed in the field notes; for these specimen notes it is more convenient to place the diagram on a plate.

‡ On the *tangent* line, as a matter of course.

Chains.	
	the flag bears N. 37° 31′ E. Therefore, tan. 37° 30′ × base, or 0.767 × 6.00 = 4.60 chs., the distance across; which, added to 11.40 chs., makes 16.00 chs., measured on the tangent, to left bank of river. At the point thus determined, the distance between the tangent and standard, is 11.97 ft. or 18 lks. nearly; the bank bears about N. 52° W.; therefore, N. 52° W., 29 lks., determines the point for the meander cor. at
15.77	On the *standard parallel*, where I
	Set a cedar post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for meander cor. on S. bdy. sec. 35, marked
	S. C., T. 13 N. on N.,
	M. C. on W., and
	R. 23 E., S. 35; on E. faces, from which
	A cottonwood, 19 ins. diam., bears N. 40° E., 36 lks. dist., marked S. C., M. C., T. 13 N., R. 23 E., S. 35, B. T.
	A sycamore, 34 ins. diam., bears N. 51½° W., 28 lks. dist., marked S. C., M. C., T. 13 N., R. 23 E., S. 35, B. T.
	Enter heavy sycamore and cottonwood timber.
	Difference between measurements of 40.00 chs., by two sets of chainmen is 6 lks.; position of middle point
	By 1st set, 40.03 chs.
	By 2nd set, 39.97 chs.; the mean of which is
40.00	N. 13.75 ft. from the tangent,
	Set a cedar post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for standard ¼ sec. cor. marked, S. C., ¼ S., on N. face; from which
	A sycamore, 28 ins. diam., bears N. 14½° E., 27 lks. dist., marked S. C., ¼ S., B. T.
	A cottonwood, 14 ins. diam., bears N. 74¼° W., 42 lks. dist., marked S. C., ¼ S., B. T.
51.30	Sycamore Creek, 10 lks. wide, course S. 10° W.
70.00	Leave heavy sycamore and cottonwood timber; enter meadow land, bears N. 10° E. and S. 10° W.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 4 lks.; position of middle point
	By 1st set, 79.98 chs.
	By 2d set, 80.02 chs.; the mean of which is
80.00	N. 16.97 ft. from the tangent,
	Set a cedar post, 3 ft. long, 4 ins. sq., 24 ins., in the ground, for standard cor. of secs. 35 and 36, marked
	S. C., T. 13 N., R. 23 E. on N.
	S. 36 on E., and
	S. 35 on W. faces; with 1 groove on E. and 5 grooves on W. faces; dig pits, 24×18×12 ins., E. and W., 3 ft., and N. of post, 7 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, N. of cor.
	Land, level.
	Soil, alluvial; 1st rate.
	Timber, sycamore and cottonwood.
	Heavily timbered land, 52.23 chs.

	S. 89° 56′ E. on the tangent, S. of sec. 36.
	Over meadow land.
	Difference between the measurements of 40.00 chs., by the two sets of chainmen, is 4 lks.; position of middle point
	By 1st set, 40.02 chs.
	By 2nd set, 39.98 chs.; the mean of which is
40.00	N. 20.54 ft. from the tangent,
	Set a sandstone, 19×7×5 ins., 15 ins. in the ground, for standard ¼-sec. cor. marked S. C. ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
42.00	Leave meadow land, bears N. 10° E. and S.; begin ascent of ridge.
71.50	Top of granite ridge 300 ft. above meadow, bears N. and S.
	Difference between measurements of 80.00 chs., by two sets of chainmen is 22 lks.; position of middle point
	By 1st set, 79.89 chs.
	By 2nd set, 80.11 chs.; the mean of which is

Third Standard Parallel North, through Range 23 East—Concluded.

Chains.	
80.00	N. 24.44 ft. from the tangent, Set a granite stone, 22×7×5 ins., 17 ins. in the ground, for standard cor. of Tp. 13 N., Rs. 23 and 24 E., marked S. C., on N.; with 6 grooves on N., E., and W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable. August 28, 1890.

For the purpose of illustration, these specimen field notes of the survey of the third standard parallel north, will be continued through range 24 east; assuming that the survey has been executed with a *solar compass or a transit with solar attachment.*

Third Standard Parallel North, through Range 24 East.

Chains.	
	Survey commenced August 28, 1890, and executed with a light mountain transit with solar attachment, No. ——, made by W. & L. E. Gurley. The horizontal limb is provided with two opposite verniers, reading to 30″ of arc, which is also the least count of the verniers of the latitude and declination arcs. I begin at the Standard Corner of Townships 13 North, Ranges 23 and 24 East, which I established August 28, 1890.* Latitude 45° 34′.5 N., longitude 107° 31′ W. In order to test the solar apparatus, by comparing the results of observations on the sun, made during a. m. and p. m. hours, with a *true meridian*, determined by observations on Polaris, I proceed as follows: At 4^h 2^m p. m., local mean time, I set off 45° 34′.5 on the latitude arc; 9° 30′.5 N., on the declination arc; and mark the *true meridian* thus determined with the solar, by a cross on a stone firmly set in the ground, 5 chs. N. of the instrument. At 8^h 56^m 1 p. m., by my watch, which is 2^m fast of local mean time, I observe Polaris at *eastern elongation*, in accordance with instructions in the Manual, and mark the line thus determined, by a tack driven in a wooden plug set in the ground, 5 chains north of my station. August 28, 1890.
	August 29: At 6 a. m., I lay off the azimuth of Polaris, 1° 49′.5, to the *west* and mark the TRUE MERIDIAN thus determined, by cutting a small groove in the stone set last evening, on which the true meridian falls 0.2 ins. *west* of the mark determined by the solar. At 8^h a. m., I set off 45° 34′.5, on the lat. arc; 9° 16′ N., on the decl. arc, and mark the true meridian determined with the solar, by a cross on the stone already set 5 chs. N. of my station; this mark falls 0.3 ins. *west* of the *true meridian* established by the Polaris observation. The solar apparatus, by p. m. and a. m. observations, defines positions for true meridians, about 0′ 11″* *east*, and 0′ 16″* *west* of the meridian established by the Polaris observation; therefore, I conclude that the adjustments of the instrument are satisfactory. The *magnetic* bearing of the *true meridian*, at 8^h a. m., is N. 18° 10′ W.; the angle thus determined, reduced by the table, page 100, gives the *mean mag. decl. 18° 04′ east.* From the standard cor. above described, I run East, on S. bdy. sec. 31. Over stony ground.
20.40	Begin descent from ridge, bears N. and S.

* When the corner at which the survey begins, shall have been established under a prior contract, the words "which I established August 28, 1890," will be omitted; and in describing the corner, the deputy will write (e. g.), "which is a sandstone, 5×7×5 ins. above ground, firmly set, and marked and witnessed as described by the surveyor general;" in all cases making the description agree with the facts. The latitude and longitude, to the nearest whole minute, will be supplied by the surveyor general in his special written instructions and will be marked on the accompanying diagram, at the point where the survey will begin; and, from the data thus provided, the deputy will determine the geographical position of other points, by application of the rules following Table X, page 135.

† These angles are too small to measure with ordinary field instruments; but, when the mark is 5 chs. dist., as in this case, the angles may be obtained, in *seconds* of arc, by dividing the fallings, 0.2 and 0.3 ins., by 0.019.

Chains.	
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 20 lks.; position of middle point
	By 1st set, 39.90 chs.
	By 2nd set, 40.10 chs.; the mean of which is
40.00	Set a granite stone, 20×7×5 ins., 15 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼, on N. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
46.00	Foot of descent, 320 ft. below top of ridge, bears N. and S.; thence over level land.
56.00	Enter heavy pine timber, bears N. and S. 16° E.
71.26	A pine, 22 ins. diam., on line, I mark with 2 notches on E. and W. sides.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 18 lks.; position of middle point
	By 1st set, 80.09 chs.
	By 2nd set, 79.91 chs.; the mean of which is
80.00	Set a granite stone, 22×8×6 ins., 17 ins. in the ground, for standard cor. of secs. 31 and 32, marked S. C., on N., with 5 grooves on E. and 1 groove on W. faces; from which
	A pine, 26 ins. diam., bears N. 22° E., 15 lks. dist., marked T. 13 N., R. 24 E., S. 32, B. T.
	A pine, 30 ins. diam., bears N. 67° W., 21 lks. dist., marked T. 13 N., R. 24 E., S. 31, B. T.
	Land, mountainous and level.
	Soil, stony and loam; 2nd and 4th rate.
	Timber, pine and some ash.
	Mountainous or heavily timbered land, 70.00 chs.
	East, on S. bdy. sec. 32.
	Through heavy pine timber.
3.80	Creek, 7 lks. wide in ravine, 9 ft. deep; course S.
20.50	Creek, 10 lks. wide in ravine, 12 ft. deep; course S. 21° E.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 6 lks.; position of middle point
	By 1st set, 40.03 chs.
	By 2nd set, 39.97 chs.; the mean of which is
40.00	A pine, 19 ins. diam., for standard ¼ sec. cor., I mark S. C., ¼ S. on N. side; from which
	A pine, 22 ins. diam., bears N. 41° E., 24 lks. dist., marked S. C., ¼ S., B. T.
	An ash, 18 ins. diam., bears N. 47° W., 31 lks. dist., marked S. C., ¼ S., B. T.
40.50	Leave heavy pine timber, bears N. and S.; begin steep ascent.
56.00	Top of bare granite ridge, 200 ft. high, bears N. and S.
59.50	Begin descent of E. slope.
68.50	Creek, 10 lks. wide; in ravine 20 ft. deep, 230 ft. below top of ridge; course S.
72.00	Enter heavy pine timber, bears N. and S.; thence over level land.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 8 lks.; position of middle point
	By 1st set, 79.96 chs.
	By 2nd set, 80.04 chs.; the mean of which is
80.00	Set a granite stone, 24×8×4 ins., 18 ins. in the ground, for standard cor. of secs. 32 and 33, marked S. C. on N., with 4 grooves on E. and 2 grooves on W. faces; from which
	A pine, 18 in. diam., bears N. 62½° E., 26 lks. dist., marked T. 13 N., R. 24 E., S. 33., B. T.
	A pine, 28 ins. diam., bears N. 26¼° W., 31 lks. dist., marked T. 13 N., R. 24 E., S. 32 B. T.
	Land, level and mountainous.
	Soil, loam and rock; 1st and 4th rate.
	Timber, pine.
	Mountainous or heavily timbered land, 80.00 chs.

chains.	
	East, on S. bdy. sec. 33.
	Through heavy pine timber, over level land.
4.20	Indian trail, bears N. 18° W. and S. 18° E.
16.00	Leave heavy pine timber, bears N. 15° W. and S.
22.30	Indian trail, bears N. 31° E. and S. 31° W.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 8 lks.; position of middle point
	By 1st set, 39.96 chs.
	By 2nd set, 40.04 chs.; the mean of which is
40.00	Set a granite stone, 15 × 8 × 6 ins., 10 ins. in the ground, for standard ¼ sec. cor., marked S. C. ¼ on N. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	Leave level land, begin ascent of stony ridge, bears N. and S.
44.00	Indian trail, bears N. 22 W. and S. 22 E.
51.00	Top of ridge, 130 ft. high, bears N. and S.
55.00	Begin descent of E. slope.
70.50	Foot of descent, enter heavy oak timber on level land, bears N. and S.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 18 lks.; position of middle point
	By 1st set, 80.09 chs.
	By 2nd set, 79.91 chs.; the mean of which is
80.00	An oak, 20 ins. diam., for standard cor. of secs. 33 and 34, I mark
	S. C., T. 13 N., R. 24 E. on N.,
	S. 34 on E., and
	S. 33 on W. sides; from which
	An oak, 25 ins. diam., bears N. 71° E., 22 lks. dist., marked T. 13 N., R. 24 E., S. 34, B. T.
	An oak, 27 ins. diam., bears N. 18¼° W., 26 lks. dist., marked T. 13 N., R. 24 E., S. 33, B. T.
	Land, level and mountainous.
	Soil, stony and gravelly loam; 2nd and 3rd rate.
	Timber, pine and oak.
	Mountainous or heavily timbered land, 56.00 chs.

	August 29, 1890: I set off 9° 12′.5 on the decl. arc; and, at 12h 00m 44s by my watch, which is 3m fast of local mean time, observe the sun on the meridian, and obtain on the lat. arc the reading 45° 35′, which is the lat., nearly.
	East, on S. bdy. sec. 34.
	Through heavy oak timber.
9.32	An oak, 28 ins. diam., on line, I mark with 2 notches on E and W. sides.
10.00	Leave heavy oak timber, bears N. and S.
13.80	Creek, 6 lks. wide, in ravine 13 ft. deep, course S.
25.90	Enter dense aspen thicket, extends N. about 14 chs. and S. about 10 chs.
36.00	Leave dense aspen thicket, bears N. 22° E. and S. 22° W.
	At 38.10 chs., right bank of shallow stream.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 14 lks.; position of middle point
	By 1st set, 39.93 chs.
	By 2nd set, 40.07 chs.; the mean of which, 40.00 chs., falls in stream with quicksand bottom; therefore, I perpetuate the corner on solid ground, as follows:
37.00	Set a granite stone, 15 × 9 × 6 ins., 10 ins. in the ground, for witness cor. to standard ¼ sec. cor., marked W. C., S. C. ¼, on N. face; from which
	An aspen, 4 ins. diam., bears N. 88¼° W., 102 lks. dist., marked W. C., S. C. ¼ S., B. T.
	An aspen, 3 ins. diam., bears N. 55° W., 110 lks. dist., marked W. C. S. C. ¼ S., B. T.
38.10	Right bank of shallow stream; bank 1 ft. high; clear water, 2 to 6 ins. deep; gentle current, over quicksand bottom; course S. 17° W.
40.00	Point for ¼ sec. cor falls in stream.
42.20	Leave shallow stream; bank, 2 ft. high, bears S. 17° W.
42.50	Leave level land, begin ascent of ridge, bears N. and S.
75.20	Top of ridge, 250 ft. high, bears N. and S.

Third Standard Parallel North, through Range 24 East—Continued.

Chains.	
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 20 lks.; position of middle point
	By 1st set, 79.90 chs.
	By 2nd set, 80.10 chs.; the mean of which is
80.00	Set a granite stone, 16×8×6 ins., 11 ins. in the ground, for standard cor. of secs. 34 and 35, marked S. C. on N., with 2 grooves on E. and 4 grooves on W. faces; and raise a mound of stone, 2 ft. high, 1½ ft. high, N. of cor. Pits impracticable.
	At this cor. I erect a signal for a test sight from some point to the east.
	Land, mountainous and level.
	Soil, stony and sandy; 3rd and 4th rate.
	Timber, oak, pine, and young aspen.
	Mountainous or heavily timbered land, or land covered with dense undergrowth, 47.60 chs.

	East, on S. bdy. sec. 35.
	Over stony ground.
2.50	Begin descent.
36.00	Foot of descent, 280 ft. below top of ridge, bears N. 15° E. and S. 15° W.
36.50	Creek, 12 lks. wide, in ravine 40 ft. deep, course N. 15° E.; begin steep ascent.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 18 lks.; position of middle point
	By 1st set, 40.09 chs.
	By 2nd set, 39.91 chs; the mean of which is
40.00	Falls on a boulder, 7×6×4 ft. above ground:
	I cut a cross (×) at the exact cor. point for standard ¼ sec. cor., mark S. C., ¼, on the N. side; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
45.30	Top of ridge, 160 ft. above ravine, bears N. 15° E. and S. 15° W.
49.90	Begin descent of E. slope.
59.50	Foot of descent, 140 below top of ridge, bears N. 15° E. and S. 15° W.; thence over level ground.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 16 lks.; position of middle point
	By 1st set, 79.92 chs.
	By 2nd set, 80.08 chs.; the mean of which is
80.00	Set a granite stone, 15×7×6 ins., 10 ins. in the ground, for standard cor. of secs. 35 and 36, marked S. C., on N., with 1 groove on E. and 5 grooves on W. faces; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	Land, mountainous and level.
	Soil stony; 3rd and 4th rate.
	No timber.
	Mountainous land, 59.50 chs.

	East, on S. bdy. sec. 36.
	Ascend over rough, stony ground.
4.80	Top of ridge, 50 ft. high, bears N. and S.
10.00	Begin descent of E. slope.
16.50	Enter dense aspen thicket, extends N. and S., about 15 chs.
20.00	Foot of descent, about 50 ft. below top of ridge, bears N. and S.; thence over level land.
26.00	Leave dense aspen thicket, bears N. and S.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 14 lks.; position of middle point
	By 1st set, 40.07 chs.
	By 2nd set, 39.93 chs.; the mean of which is
40.00	Deposit a marked stone, 12 ins. in the ground, for standard ¼ sec. cor.; dig pits, 18×18×12 ins., E. and W. of cor., 4 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, over deposit.
	In E. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked ¼ S. on N. face.
41.50	Enter dense willow and cottonwood undergrowth, extends N., 12, and S., 8 chs.

Chains.

56.00 Leave dense undergrowth, bears N. and S.

61.00 Enter dense cottonwood brush, extends N. and S., 9 to 14 chs.

72.00 Leave dense cottonwood brush, bears N. and S.

78.10 Creek, 8 lks. wide, in ravine 20 ft. deep, course N. 35° E.; ascend.

Difference between measurements of 80.00 chs., by two sets of chainmen, is 12 lks.; position of middle point

By 1st set, 79.94 chs.

By 2nd set, 80.06 chs.; the mean of which is

80.00 Set a granite stone, 20×6×5 ins., 15 ins. in the ground, for standard cor. of Tps. 13 N., Rs. 24 and 25 E., marked S. C., on N., with 6 grooves on N., E., and W. faces; dig pits, 30×24×12 ins., crosswise on each line, E. and W., 4 ft., and N. of stone, 8 ft. dist.; and raise a mound of earth, 5 ft. base, 2½ ft. high, N. of cor.

This cor. is about 40 ft. above bottom of ravine.

Land, mountainous and level.

Soil, stony and sandy loam; 2nd and 4th rates.

Timber, small aspens; cottonwood and willow undergrowth.

Mountainous land, or land covered with dense undergrowth, 51.50 chs.

August 29, 1890: I set up the instrument at the last described Tp. cor. and immediately after sunset, at $6^h\ 39^m$ p. m., l. m. t., direct the telescope to the signal established at the cor. of secs. 34 and 35, and note the readings of the horizontal limb, as follows:

	°	′	″
Vernier A,	3	47	30
Vernier B,	3	47	00
Mean,	3	47	15

At $7^h\ 13^m$ p. m., I unclamp the vernier plate, observe Polaris in accordance with instructions in the manual, and mark the *direction* thus determined by a tack driven in a wooden plug firmly set in the ground, 5 chs. north of the corner. The readings of the horizontal limb at the instant of observation are as follows:

	°	′	″
Vernier A,	92	07	40
Vernier B,	92	07	30
Mean,	92	07	35
1st mean,	3	47	15
Angle,	88	20	20

	h.	m.	h.	m.
Astron. l. m. t. of obs., Aug. 29			7	13.0
U. C. Polaris, Aug. 15	15	40.1		
Red. to Aug. 28		51.0		
U. C. Polaris, Aug. 28	14	49.1	14	49.1
Hour angle of Polaris at obs			16	23.9
Subtract from			23	56.1
Time argument for Table III			7	32.2

Azimuth of Polaris at obs	1°	39′	00″	E.
Add above angle	88	20	20	
The *observed* bearing of signal is	N. 89	59	20	W.
The *true* bearing is	N. 89	59	07	W.

The difference 0 00 13 is the deviation of the last two miles of the standard parallel, *north* of east; which, being less than the probable errors of observation, I deem the standard parallel satisfactorily established.

August 29, 1890.

GENERAL DESCRIPTION.

Through ranges 21 and 22 this line runs across low mountain ridges and streams having a northeasterly trend, while low level prairies are traversed through ranges 22 and 23, and low-timbered ridges with a northerly trend in range 24.

The land south of the line is of a mountainous and broken character, well watered and containing large groves of pine, oak, and fir timber of a fair quality, while that to the north consists of rolling prairie and meadow land, which should be subdivided.

RICHARD ROODS,
U. S. Deputy Surveyor.

FINAL OATHS OF DEPUTY SURVEYORS AND THEIR ASSISTANTS.

LIST OF NAMES.

A list of the names of the individuals employed by Richard Roods, U. S. deputy surveyor, to assist in running, measuring, and marking the lines and corners described in the foregoing field notes of the survey of the Third Standard Parallel North, through Ranges Nos. 21, 22, 23, and 24 East of the Principal Base and Meridian in the State of Montana, showing the respective capacities in which they acted.

PETER LONG	Chainman.
JOHN SHORT	Chainman.
ELI MARKER	Chainman.
WILLIAM TALLY	Chainman.
LEWIS LINK	Chainman.
HENRY CLAY	Moundman.
WILLIAM STONE	Moundman.
GEORGE SHARP	Axman.
ADAM DULL	Axman.
JAMES BANNER	Flagman.

FINAL OATHS OF ASSISTANTS.

I hereby certify that I assisted Richard Roods, United States deputy surveyor, in surveying all those parts or portions of the Third Standard Parallel North, through Ranges Nos. 21 and 22 East of the Principal Base and Meridian in the State of Montana, which are represented in the foregoing field notes as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of our knowledge and belief, well and faithfully surveyed, and the corner monuments established according to the instructions furnished by the United States surveyor general for Montana.

JOHN SHORT, *Chainman.*

Subscribed and sworn to before me this 27th day of August, 1890.

RICHARD ROODS,
U. S. Deputy Surveyor.

We hereby certify that we assisted Richard Roods, United States deputy surveyor, in surveying all those parts or portions of the Third Standard Parallel North, through Ranges Nos. 21, 22, 23, and 24 East of the Principal Base and Meridian in the State of Montana, which are represented in the foregoing field notes as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of our knowledge and belief, well and faithfully surveyed, and the corner monuments established according to the instructions furnished by the United States surveyor general for Montana.

PETER LONG, *Chainman.*
ELI MARKER, *Chainman.*
WILLIAM TALLY, *Chainman.*
HENRY CLAY, *Moundman.*
WILLIAM STONE, *Moundman.*
GEORGE SHARP, *Axman.*
ADAM DULL, *Axman.*
JAMES BANNER, *Flagman.*

Subscribed and sworn to before me this first day of September, 1890.

[SEAL.] WILLIAM MARTIN, *Notary Public.*

I hereby certify that I assisted Richard Roods, United States deputy surveyor, in surveying all those parts or portions of the Third Standard Parallel North, through Ranges Nos. 23 and 24 East of the Principal Base and Meridian in the State of Montana, which are represented in the foregoing field notes, as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of our knowledge and belief, well and faithfully surveyed, and the corner monuments established according to the instructions furnished by the United States surveyor general for Montana.

LEWIS LINK. *Chainman.*

Subscribed and sworn to before me, this first day of September, 1890.

[SEAL.] WILLIAM MARTIN,
Notary Public.

FINAL OATH OF UNITED STATES DEPUTY SURVEYOR.

I, Richard Roods, United States deputy surveyor, do solemnly swear that in pursuance of a contract received from A—— B——, United States surveyor general for Montana, bearing date of the tenth day of July, 1889, I have well, faithfully, and truly, in my own proper person, and in strict conformity with the instructions furnished by the United States surveyor general for Montana, the Manual of Surveying Instructions, and the laws of the United States, surveyed all those parts or portions of the Third Standard Parallel North through Ranges Nos. 21, 22, 23 and 24 East of the Principal Base and Meridian in the State of Montana, which are represented in the foregoing field notes as having been surveyed by me and under my direction; and I do further solemnly swear that all the corners of said surveys have been established and perpetuated in strict accordance with the Manual of Surveying Instructions and the special instructions of the United States surveyor general for Montana, and in the specific manner described in the field notes, and that the foregoing are the *original* field notes of such survey; and should any fraud be detected I will suffer the penalty of perjury under the provisions of an act of Congress approved August 8, 1846.

RICHARD ROODS,
U. S. Deputy Surveyor.

Subscribed by said Richard Roods and sworn to before me this first day of September, 1890.

[SEAL.] A—— B——,
U. S. Surveyor General for Montana.

SPECIMEN FIELD NOTES.

No. 2.

TITLE PAGE.

(See Plate III.)

FIELD NOTES

OF THE SURVEY OF THE

SIXTH GUIDE MERIDIAN EAST

THROUGH

Townships No. 13 North

Between Ranges Nos. 24 and 25 East

OF THE

PRINCIPAL BASE AND MERIDIAN

IN THE

STATE OF MONTANA,

AS SURVEYED BY

RICHARD ROODS,

U. S. DEPUTY SURVEYOR,

UNDER HIS CONTRACT No. 97,

DATED JULY 10, 1890.

Survey commenced August 29, 1890.

Survey completed August 30, 1890.

[Second Page.]

NAMES AND DUTIES OF ASSISTANTS.

PETER LONG ..... Chainman.
JOHN SHORT ..... Chainman.
ELI MARKER ..... Chainman.
WILLIAM TALLY ..... Chainman.
HENRY CLAY ..... Moundman.
WILLIAM STONE ..... Moundman.
GEORGE SHARP ..... Axman.
ADAM DULL ..... Axman.
JAMES BANNER ..... Flagman.

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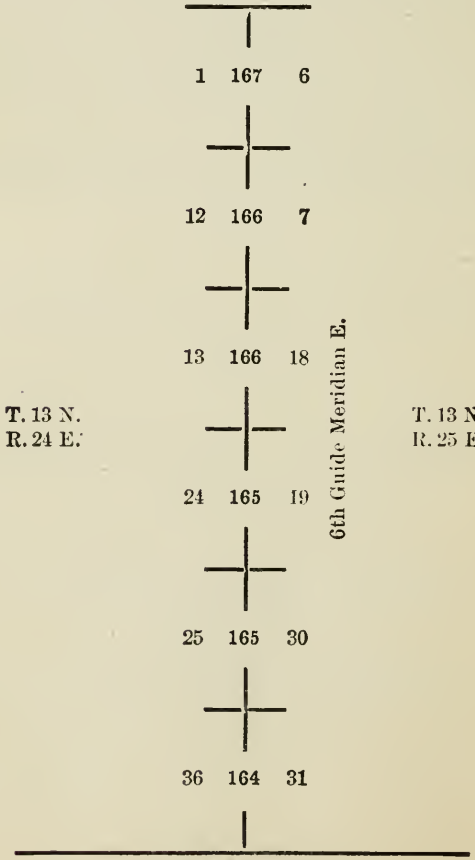

[Third Page.]

PRELIMINARY OATHS OF ASSISTANTS.

We, Peter Long, John Short, Eli Marker, and William Tally, do solemnly swear that we will well and faithfully execute the duties of chainmen; that we will level the chain upon even and uneven ground, and plumb the tally pins, either by sticking or dropping the same; that we will report the true distances to all notable objects, and the true lengths of all lines that we assist in measuring, to the best of our skill and ability, and in accordance with instructions given us, in the survey of the Sixth Guide Meridian East, through Townships No. 13 North, between Ranges 24 and 25 East of the Principal Base and Meridian, in the State of Montana.

PETER LONG, *Chainman.*
JOHN SHORT, *Chainman.*
ELI MARKER, *Chainman.*
WILLIAM TALLY, *Chainman.*

Subscribed and sworn to before me this second day of August, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

We, Henry Clay and William Stone, do solemnly swear that we will well and truly perform the duties of moundmen, in the establishment of corners, according to the instructions given us, to the best of our skill and ability, in the survey of the Sixth Guide Meridian East, through Townships No. 13 North, between Ranges 24 and 25 East of the Principal Base and Meridian, in the State of Montana.

HENRY CLAY, *Moundman.*
WILLIAM STONE, *Moundman.*

Subscribed and sworn to before me this second day of August, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

We, George Sharp and Adam Dull, do solemnly swear that we will well and truly perform the duties of axmen, in the establishment of corners and other duties, according to the instructions given us, and to the best of our skill and ability, in the survey of the Sixth Guide Meridian East, through Townships No. 13 North, between Ranges 24 and 25 East of the Principal Meridian in the State of Montana.

GEORGE SHARP, *Axman.*
ADAM DULL, *Axman.*

Subscribed and sworn to before me this second day of August, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

I, James Banner, do solemnly swear that I will well and truly perform the duties of flagman, according to instructions given me, to the best of my skill and ability, in the survey of the Sixth Guide Meridian East, through Townships No. 13 North, between Ranges 24 and 25 East of the Principal Base and Meridian, in the State of Montana.

JAMES BANNER, *Flagman.*

Subscribed and sworn to before me this second day of August, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

6th Guide Meridian East, through Tps. 13 N., between Rs. 24 and 25 E.

Chains.	
	Survey commenced August 29, 1890, and executed with a W. & L. E. Gurley light mountain transit, No. —, the horizontal limb being provided with two opposite verniers reading to 30″ of arc.
	I begin at the Standard Corner of Township 13 North, Ranges 24 and 25 East, which I established August 29, 1890.* Latitude 45° 34′.5 N., longitude 107° 24′ W.
	At this corner, at 8^h 54^m p. m., by my watch, which is 3^m 49^s fast of local mean time, I observe Polaris at *eastern elongation* in accordance with instructions in the manual,† and mark the point in the line thus determined by a tack driven in a wooden plug set in the ground, 5.00 chs. north of my station.
	August 29, 1890.
	August 30: At 6^h 30^m a. m., I lay off the azimuth of Polaris, 1° 49′.5 to the *west*, and mark the TRUE MERIDIAN thus determined by a cross on a stone firmly set in the ground, west of the point established last night.
	The *magnetic bearing*‡ of the true meridian is N. 18° 05′ W., which reduced by the table on page 100 of the Manual gives the *mean mag. decl. 18° 02′ E.*
	From the standard cor. I run
	North, bet. Secs. 31 and 36.
	Descend over ground sloping N. W.
2.60	Creek 10 lks. wide in ravine, 45 ft. below the Tp. cor., course N. 32° W.
7.50	To edge of table land, bears N. E. and S. W.; thence over level land.
17.40	Bluff bank, bears N. 58° W. and S. 58° E.; descend abruptly 40 ft.
19.00	Bottom of ravine, course S. 58° E.; ascend 50 feet to
22.00	Edge of table land, bears S. 58° E. and N. 58° W.; thence over level land.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 18 lks.; position of middle point
	By 1st set, 40.09 chs.
	By 2nd set, 39.91 chs.; the mean of which is
40.00	Set a limestone, 16×7×5 ins., 11 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face, and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor.
42.60	Stream, 6 lks. wide, in ravine 15 ft. deep, course N. 60° W.
47.00	Enter heavy oak timber, bears E. and W.
53.00	An oak, 30 ins. diam., on line, I mark with 2 notches on E. and W. sides.
55.20	Creek, 20 lks. wide, 1 ft. deep, course N. 83° W.
55.40	Right bank of creek, begin very steep rocky ascent.
60.00	Top of ridge, 250 ft. above creek, bears N. 80° W. and S. 80° E.
64.00	Begin descent.
	Difference bet. measurements of 80.00 chs., by two chainmen, is 22 lks.; position of middle point
	By 1st set, 79.89 chs.
	By 2nd set, 80.11 chs.; the mean of which is
80.00	The point for sec. cor., 150 ft. below top of ridge, falls on a flat rock *in place*, 10 ft. E. and W. by 6 ft. N. and S., on which I
	Cut a cross (×) at the exact cor. point, for cor. of secs. 25, 30, 31, and 36, marked with 5 grooves on N and 1 groove on S. sides; from which
	An oak, 10 ins. diam., bears N. 22° E., 54 lks. dist., marked T. 13 N., R. 25 E., S. 30, B. T.
	A dogwood, 5 ins. diam., bears S. 64½° E., 40 lks. dist., marked T. 13 N., R. 25 E., S. 31, B. T.
	An ash, 13 ins. diam., bears S. 51° W., 37 links dist., marked T. 13 N., R. 34 E., S. 36, B. T.
	An oak, 9 ins. in diam., bears N. 34° W., 42 lks. dist., marked T. 13 N., R. 24 E., S. 25, B. T.
	Land, level and mountainous.
	Soil, gravel and rock; 4th rate.
	Timber, oak.
	Mountainous or heavily-timbered land, 33.00 chs.

* See footnote, page 154. † See page 105. ‡ See footnote, page 106.

Chains.	
	North, bet. secs. 25 and 30.
	Descend through heavy oak timber.
2.00	Precipitous descent of 60 ft., down which I can not chain; set a flag on line at foot of precipice; measure a base east 4 chs. to a point, from which the flag bears N. 68° W.; which gives for the distance (by traverse table) 1.50 chs., which, added to 2.00 chs., makes
3.50	To foot of precipice, bears E. and W.; thence, descend.
8.50	Leave heavy oak timber, bears E. and W.
13.00	Begin abrupt descent.
17.10	To creek, 10 lks. wide, pure water, course N. 70° W.; 240 ft. below top of ridge. Ascend 20 ft. to
20.90	Edge of level plain, bears N. 80 W. and S. 80° E.
	Difference bet. measurements of 40.00 chs., by two sets of chainmen, is 20 lks.; position of middle point
	By 1st set, 39.90 chs.
	By 2nd set, 40.10 chs.; the mean of which is
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	Diff. between measurements of 80.00 chs., by two sets of chainmen, is 6 lks.; position of middle point
	By 1st set, 80.03 chs.
	By 2nd set, 79.97 chs.; the mean of which is
80.00	Set a cedar post, 3 ft. long, 4 ins. sq., with marked stone, 24 ins. in the ground, for cor. of secs. 19, 24, 25, and 30, marked
	T. 13 N., S. 19 on N. E.
	R. 25 E., S. 30 on S. E.
	S. 25 on S. W., and
	R. 24 E., S. 24 on N. W. faces; with 4 notches on N. and 2 notches on S. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, mountainous and level.
	Soil, stony and sandy; 4th rate.
	Timber, oak.
	Mountainous or heavily-timbered land, 20.90 chs.

	North, bet. secs. 19 and 24.
	Over descending ground.
35.00	Ravine, 20 ft. wide, 8 ft. deep, course E.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 6 lks.; position of middle point
	By 1st set, 39.97 chs.
	By 2nd set, 40.03 chs.; the mean of which is
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
40.30	Enter willow brush, bears E. and W.
44.00	Leave willow brush, bears E. and W.; Ford's Creek, 22 lks. wide; banks, 3 ft. high; pure water, gentle current; course E.
48.50	Ford's Creek, 24 lks. wide, course W.
55.00	Ford's Creek, 26 lks. wide, course N. 70° E.
61.70	Ravine, 15 ft. wide, 6 ft. deep, course E.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 12 lks.; position of middle point
	By 1st set, 80.06 chs.
	By 2nd set, 79.94 chs.; the mean of which is
80.00	Deposit a quart of charcoal, 12 ins. in the ground, for cor. of secs. 13, 18, 19, and 24; dig pits, 18×18×12 ins., in each sec., 4 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, over deposit.
	In S. E. pit drive a stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked
	T. 13 N., S. 18 on N. E.,
	R. 25 E., S. 19 on S. E.,
	S. 24 on S. W., and
	R. 24 E., S. 13 on N. W. faces; with 3 notches on N. and S. edges.

6th Guide Meridian East, through Tps. 13 N., etc.—Continued.

Chains.	
	Land, nearly all level. Soil, sandy loam and clay; 1st and 4th rate. No timber.
	North, bet. secs. 13 and 18. Over nearly level plain; gradually ascend.
29.00	Begin ascent to ridge, bears E. and W.
34.10	Top of ridge, 60 ft. above plain, bears E. and W.
35.20	Begin descent from ridge.
37.50	Foot of descent; branch, 10 lks. wide in ravine 5 ft. deep; course E. ascend. Difference between measurements of 40.00 chs., by two sets of chainmen, is 16 lks.; position of middle point By 1st set, 39.92 chs. By 2nd set, 40.08 chs.; the mean of which is
40.00	Set a granite stone, 15×8×5 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
47.00	Begin ascent of ridge, bears E. and W.
56.50	Top of ridge, 400 ft. above plain, bears E. and W.
63.00	Begin descent. Difference between measurements of 80.00 chs., by two sets of chainmen, is 22 lks.; position of middle point By 1st set, 80.11 chs. By 2nd set, 79.89 chs.; the mean of which is
80.00	Set a granite stone, 15×8×6 ins., 10 ins. in the ground, for cor. of secs. 7, 12, 13, and 18, marked with 2 notches on N. and 4 notches on S. edges; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable. This cor. stands on a bench, about 350 ft. below top of ridge. Land, level and mountainous. Soil, sandy loam and rocky; 2nd and 4th rate. No timber. Mountainous land, 11.50 chs.
	North, bet. secs. 7 and 12. Over level land.
2.00	Begin ascent, bears E. and W.
7.50	Top of low ridge, 20 ft. above sec. cor., bears E. and W.; thence, descend gradually.
37.00	Branch, 6 lks. wide, in ravine, 10 ft. deep, course E. Difference between measurements of 40.00 chs., by two sets of chainmen, is 12 lks.; position of middle point By 1st set, 39.94 chs. By 2nd set, 40.06 chs.; the mean of which is
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with a marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor. Thence over plain gradually ascending.
71.00	Begin descent to creek, bears E. and W.
74.00	Foot of descent; creek, 12 lks. wide, course E. Ascend.
79.50	To top of ascent and edge of level plain, bears E. and N. 75° W. Difference between measurements of 80.00 chs., by two sets of chainmen, is 14 lks.; position of middle point By 1st set, 80.07 chs. By 2nd set, 79.93 chs.; the mean of which is
80.00	Set a cedar post, 3 ft. long, 11 ins. sq., with marked stone, 24 ins. in the ground, for cor. of secs. 7, 12, 13, and 18, marked T. 13 N., S. 6 on N. E., R. 25 E., S. 7 on S. E., S. 12 on S. W., and R. 24 E., S. 1 on N. W. faces; with 1 notch on N. and 5 notches on S. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.

6th Guide Meridian East, through Tps. 13 N., etc.—Concluded.

Chains.	
	Land, nearly level. Soil, sandy loam; 2nd rate. No timber.
	North, bet. secs. 1 and 6. Over level land.
18.00	Branch 4 lks. wide, in ravine 6 ft. deep, course E.
	Difference between measurements of 40.00 chs., by two sets of chainmen, is 6 lks.; position of middle point By 1st set, 39.97 chs. By 2nd set, 40.03 chs; the mean of which is
40.00	Deposit a marked stone, 12 ins. in the ground, for ¼ sec. cor., dig pits, 18×18×12 ins., N. and S. of cor., 4 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, over deposit. In S. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked ¼ S. on W. face.
61.00	Creek, 12 lks. wide, course S. 23° E.
	Difference between measurements of 80.00 chs., by two sets of chainmen, is 4 lks.; position of middle point By 1st set, 80.02 chs. By 2nd set, 79.98 chs.; the mean of which is
80.00	Set a cedar post, 3 ft. long, 4 ins. sq., with quart of charcoal, 24 ins. in the ground, for cor. of Tps. 13 and 14 N., Rs. 24 and 25 E., marked T. 14 N., S. 31 on N. E., R. 25 E., S. 6 on S. E., T. 13 N., S. 1 on S. W., and R. 24 E., S. 36 on N. W. faces; with 6 notches on each edge; dig pits, N., E., and W., 4 ft. and S. of post, 8 ft. dist.; and raise a mound of earth, 5 ft. base, 2½ ft. high, S. of cor. Land, level. Soil, sandy loam; 1st rate. No timber. August 30, 1890.

GENERAL DESCRIPTION.

Townships 13 N., Ranges 24 and 25 East, are generally rolling table-lands, producing an abundant growth of grass, and there is some good land along Ford's Creek and its tributaries. About two miles east of the corner of Tps. 13 and 14 N., Rs. 24 and 25 E., is a lake some two and half miles long by two miles wide, lying in Tps. 13 and 14 N., R. 25 E.

RICHARD ROODS,
U. S. Deputy Surveyor.

AUGUST 30, 1890.

FINAL OATHS OF DEPUTY SURVEYORS AND THEIR ASSISTANTS.

LIST OF NAMES.

A list of the names of the individuals employed by Richard Roods, U. S. deputy surveyor, to assist in running, measuring, and marking the lines and corners described in the foregoing field notes of the survey of the Sixth Guide Meridian East, through Townships 13 North, between Ranges 24 and 25 East, of the Principal Base and Meridian in the State of Montana, showing the respective capacities in which they acted.

PETER LONG	Chainman.
JOHN SHORT	Chainman.
ELI MARKER	Chainman.
WILLIAM TALLY	Chainman.
HENRY CLAY	Moundman.
WILLIAM STONE	Moundman.
GEORGE SHARP	Axman.
ADAM DULL	Axman.
JAMES BANNER	Flagman.

FINAL OATHS OF ASSISTANTS.

We hereby certify that we assisted Richard Roods, U. S. deputy surveyor, in surveying all those parts or portions of the Sixth Guide Meridian East, through Townships 13 North, between Ranges 24 and 25 East, of the Principal Base and Meridian in the State of Montana, which are represented in the foregoing field notes as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of our knowledge and belief, well and faithfully surveyed, and the corner monuments established according to the instructions furnished by the United States surveyor general for Montana.

PETER LONG, *Chainman.*
JOHN SHORT, *Chainman.*
ELI MARKER, *Chainman.*
WILLIAM TALLY, *Chainman.*
HENRY CLAY, *Moundman.*
WILLIAM STONE, *Moundman.*
GEORGE SHARP, *Axman.*
ADAM DULL, *Axman.*
JAMES BANNER, *Flagman.*

Subscribed and sworn to before me this first day of September, 1890.
[SEAL.] WILLIAM MARTIN, *Notary Public.*

FINAL OATH OF UNITED STATES DEPUTY SURVEYOR.

I, Richard Roods, United States deputy surveyor, do solemnly swear that in pursuance of a contract received from A—— B——, United States surveyor general for Montana, bearing date of the tenth day of July, 1890, I have well, faithfully, and truly, in my own proper person, and in strict conformity with the instructions furnished by the United States surveyor general for Montana, the Manual of Surveying Instructions, and the laws of the United States, surveyed all those parts or portions of the Sixth Guide Meridian East, through Townships 13 North, between Ranges 24 and 25 East, of the Principal Base and Meridian in the State of Montana, which are represented in the foregoing field notes as having been surveyed by me and under my direction; and I do further solemnly swear that all the corners of said surveys have been established and perpetuated in strict accordance with the Manual of Surveying Instructions, and the special instructions of the United States surveyor general for Montana, and in the specific manner described in the field notes, and that the foregoing are the *original* field notes of such survey; and should any fraud be detected I will suffer the penalty of perjury under the provisions of an act of Congress approved August 8, 1846.

RICHARD ROODS,
U. S. Deputy Surveyor.

Subscribed by said Richard Roods and sworn to before me this first day of September, 1890.
[SEAL.]

A—— B——,
U. S. Surveyor-General for Montana.

SPECIMEN FIELD NOTES.

No. 3.

TITLE PAGE.

[See Plate III.]

FIELD NOTES

OF THE SURVEY OF THE

EAST AND NORTH BOUNDARIES

OF

TOWNSHIP No. 13 NORTH, RANGE No. 21 EAST

OF THE

PRINCIPAL BASE AND MERIDIAN

IN THE

STATE OF MONTANA,

AS SURVEYED BY

RICHARD ROODS,

U. S. DEPUTY SURVEYOR,

UNDER HIS CONTRACT No. 97,

DATED JULY 10, 1890.

Survey commenced September 8, 1890.

Survey completed September 13, 1890.

[Second Page.]

NAMES AND DUTIES OF ASSISTANTS.

PETER LONG ..... Chainman.
JOHN SHORT ..... Chainman.
HENRY CLAY ..... Moundman.
WILLIAM STONE ..... Moundman.
GEORGE SHARP ..... Axman.
ADAM DULL ..... Axman.
JAMES BANNER ..... Flagman.

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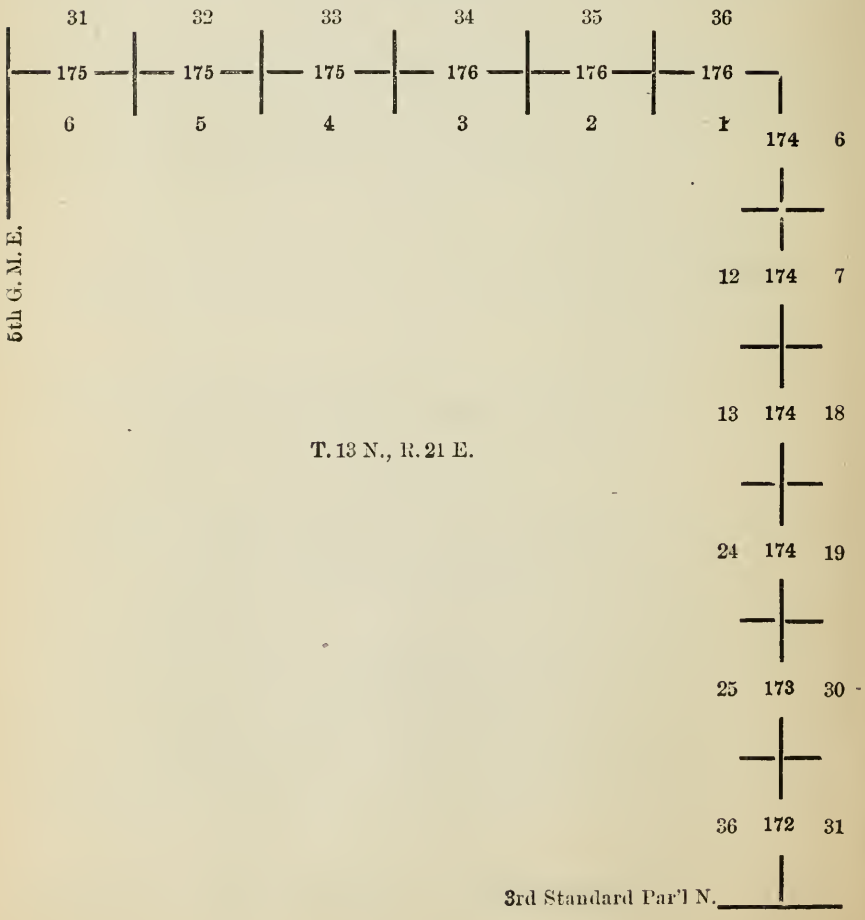


[Third page.]

PRELIMINARY OATHS OF ASSISTANTS.

We, Peter Long and John Short, do solemnly swear that we will well and faithfully execute the duties of chainmen; that we will level the chain upon even and uneven ground, and plumb the tally pins, either by sticking or dropping the same; that we will report the true distances to all notable objects and the true lengths of all lines that we assist in measuring, to the best of our skill and ability, and in accordance with instructions given us, in the survey of the East and North boundaries of Township No. 13 North, Range No. 21 East, of the Principal Base and Meridian, in the State of Montana.

PETER LONG, *Chainman.*
JOHN SHORT, *Chainman.*

Subscribed and sworn to before me this second day of September, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

We, Henry Clay and William Stone, do solemnly swear that we will well and truly perform the duties of moundmen in the establishment of corners, according to the instructions given us, to the best of our skill and ability, in the survey of the East and North Boundaries of Township No. 13 North, Range No. 21 East, of the Principal Base and Meridian, in the State of Montana.

HENRY CLAY, *Moundman.*
WILLIAM STONE, *Moundman.*

Subscribed and sworn to before me this second day of September, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

We, George Sharp and Adam Dull, do solemnly swear that we will well and truly perform the duties of axmen, in the establishment of corners and other duties, according to instructions given us, and to the best of our skill and ability, in the survey of the East and North Boundaries of Township No. 13 North, Range No. 21 East, of the Principal Base and Meridian, in the State of Montana.

GEORGE SHARP, *Axman.*
ADAM DULL, *Axman.*

Subscribed and sworn to before me this second day of September, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

I, James Banner, do solemnly swear that I will well and truly perform the duties of flagman, according to instructions given me, to the best of my skill and ability, in the survey of the East and North Boundaries of Township No. 13 North, Range No. 21 East, of the Principal Base and Meridian, in the State of Montana.

JAMES BANNER, *Flagman.*

Subscribed and sworn to before me this second day of September, 1890.
[SEAL.] WILLIAM MARTIN,
Notary Public.

East boundary of T. 13 N., R. 21 E.

Chains.	
	Survey commenced September 8, 1890, and executed with a Young & Sons light mountain transit, No. —, with solar attachment. The horizontal limb is provided with two double verniers placed opposite to each other, reading to single minutes of arc, which is also the least count of the verniers of the latitude and declination arcs.
	The instrument was examined, tested on the true meridian at Helena, found correct, and was approved by the surveyor general for Montana, September 1, 1890.
	I examine the adjustments of the transit, and correct the level and collimation errors; then, to test the solar apparatus by comparing its indications, resulting from solar observations made during a. m. and p. m. hours, with a true meridian determined by observations on Polaris, I proceed as follows:
	September 8: At the standard corner of Tps. 13 N., Rs. 21 and 22 E., latitude 45° 34′.5 N., longitude 107° 46′ W., at $4^h\ 57^m$ p. m., l. m. t., I set off 45° 35′ on the lat. arc; 5° 29′ N. on the decl. arc (these settings being the nearest practicable to the true minutes and fractions thereof required); determine with the solar a *true meridian;* and mark a point thereof on a stone set firmly in the ground, 5.00 chs. N. of the cor.
	At $8^h\ 15^m.5$ p. m., by my watch, which is $4^m\ 23^s$ fast of l. m. t., I observe Polaris at eastern elongation, in accordance with Manual of Instructions,* and mark a point on the line thus determined on a plug driven in the ground, 5.00 chs. N. of my station.
	September 8, 1890.
	September 9: At $6^h\ 30^m$ a. m., l. m. t., I lay off the azimuth of Polaris, 1° 49′.6, to the west and mark the TRUE MERIDIAN thus determined, by cutting a small groove in the stone set September 8, on which the true meridian falls 0.25 ins. *west* of the mark determined by the solar.
	At $6^h\ 58^m$ a. m., l. m. t., I set off 45° 35′ on the lat. arc; 5° 15′ N., on the decl. arc; and mark a point in the *true meridian* determined with the solar, by a cross on the stone already set 5.00 chs. N. of my station; this mark falls 0.3 ins. *west* of the *true meridian established by the Polaris observation.*
	The solar apparatus, by p. m. and a. m. observations, defines positions for *true meridians,* respectively about 0′ 13″ *east* and 0′ 16″ *west* of the true meridian established by the Polaris observations; therefore, I conclude the adjustments of the instrument are satisfactory.
	The *magnetic bearing* of the true meridian,† at 7 a. m., is N. 18° 10′ W.; the angle thus determined, reduced by the table, page 100, gives the *mean mag. decl. 18° 07′ E.*
	I begin at the standard corner of Tps. 13 N., Rs. 21 and 22 E., which I established August 25, 1890.
	Thence I run
	North, bet. secs. 31 and 36.
7.00	Descend abruptly over stony ground, sloping N. W.
	Creek, 80 ft. below Tp. cor., 15 lks. wide, clear water, course S. 75° W.;
10.00	ascend.
19.00	Road, bears N. 60° E. and S. 60° W.
24.50	Top of ridge, 200 ft. above creek, bears E. and W.
31.00	Begin descent.
	Foot of descent, 150 ft. below top of ridge, bears E. and W. Branch 2
34.00	lks. wide, clear water, course E. Thence over level land.
39.50	Begin descent.
	Foot of descent, 30 ft. below bench, bears E. and W.; thence over level
40.00	land.
	Set a sandstone, 15×8×6 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face; dig pits, 18×18×12 ins., N. and S. of stone, 3 ft.
43.00	dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	Creek 10 lks. wide, pure water, 8 ins. deep, course E. Begin ascent.
49.50	Top of ridge, bears N. 70° E. and N. 80° W., 50 ft. above creek.
50.00	Begin descent.

* See page 105.

† See footnotes, pages 106 and 142.

East boundary of T. 13 N., R. 21 E.—Continued.

Chains.	
54.00	Branch 6 lks. wide, in ravine 3 chs. wide, 30 ft. deep, course E.; thence, over level land.
62.50	Creek 12 lks. wide, 1 ft. deep, pure water, course S. 60° E.
73.00	Enter cedar timber, bears E. and W.
74.79	A cedar, 10 ins. diam., on line, I mark with 2 notches on N. and S. sides.
80.00	A cedar, 8 ins. diam., for cor. of secs. 25, 30, 31, and 36, I mark T. 13 N., S. 30 on N. E., R. 22 E., S. 31 on S. E., S. 36 on S. W., and R. 21 E., S. 25 on N. W. sides; with 5 notches on N. and 1 notch on S. sides; from which A cedar, 7 ins. diam., bears N. 30½° E., 20 lks. dist., marked T. 13 N., R. 22 E., S. 30, B. T. A cedar, 6 ins. diam., bears S. 63¼° E., 18 lks. dist., marked T. 13 N., R. 22 E., S. 31, B. T. A cedar, 9 ins. diam., bears S. 23¼° W., 21 lks. dist., marked T. 13 N., R. 21 E., S. 36, B. T. A cedar, 8 ins. diam., bears N. 64½° W., 19 lks. dist., marked T. 13 N., R. 21 E., S. 25, B. T. Land, mountainous and level. Soil, stony and loam; 2nd and 4th rate. Timber, cedar. Mountainous land, 54.00 chs.

North, bet. secs. 25 and 30.
Over level land, through cedar timber.

9.00	Creek 13 lks. wide, pure water, 1 ft. deep, gentle current, course S. 80° E.
20.40	Creek 15 lks. wide, pure water, 2 ft. deep, gentle current, course S. 70° E.
27.50	Leave cedar timber, begin ascent, bears S. 70° E. and N. 70° W.
39.50	Top of ascent of 40 ft., enter level plain, bears E. and W.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits, 18×17×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor. September 9: At this ¼ sec. cor. I set off 5° 9′ N., on the decl. arc; and at 11h 57m.1 l. m. t., observe the sun on the meridian; the resulting lat. is 45° 36.0′ which is about 0.2′ greater than the proper lat.
75.00	Creek 12 lks. wide, pure water, 1 ft. deep, gentle current, course S. 80° E.
80.00	Set a cedar post, 3 ft. long, 4 ins. sq., with quart of charcoal, 24 ins. in the ground, for cor. of secs. 19, 24, 25, and 30; marked T. 13 N., S. 19 on N. E., R. 22 E., S. 30 on S. E., S. 25 on S. W., and R. 21 E., S. 24 on N. W. faces; with 4 notches on N. and 2 notches on S. edges; dig pits, 18×18×12 ins., in each sec. 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor. Land, level. Soil, sandy loam; 2nd rate. Timber, cedar.

North, bet. secs. 19 and 24.
Over level land.

6.00	Branch 4 lks. wide, course S. 70° E.; ascend.
17.00	Top of ridge, 40 ft. high, bears E. and W.
22.00	Begin descent.
36.50	Foot of descent, bears E. and W.; thence over level land.
40.00	Set a sandstone, 15×8×6 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face; dig pits, 18×18×12 ins., N. and S. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
47.50	Creek 15 lks. wide, pure water, low banks, course N. 70° W.
64.00	Creek 16 lks. wide, pure water, low banks, course S. 65 E.

East boundary of T. 13 N., R. 21 E.—Concluded.

Chains.	
80.00	Set a cedar post, 3 ft. long, 4 ins. sq., with charred stake, 24 ins. in the ground, for cor. of secs. 13, 18, 19, and 24, marked T. 13 N., S. 18 on N. E., R. 20 E., S. 19 on S. E., S. 24 on S. W., and R. 21, S. 13 on N. W. faces; with 3 notches on N. and S. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor. Land, level. Soil, sandy loam; 1st rate. No timber. September 9, 1890.

September 10: At 7h 56.8m a. m., I set off 45° 37′ on the lat. arc; 4° 47′ N., on the decl. arc; and determine a true meridian with the solar, at the cor. of secs. 13, 18, 19, and 24.

Thence I run

North, bet. secs. 13 and 18.

40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
80.00	Set a limestone, 20×8×4 ins., 15 ins. in the ground, for cor. of secs. 7, 12, 13, and 18, marked with 2 notches on N. and 4 notches on S. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor. Land, level. Soil, sandy loam; 1st rate. No timber.

North, bet. secs. 7 and 12.

Over level land.

40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
55.00	Creek, 8 lks. wide, in ravine 1 ch. wide, 20 ft. deep, course N. 60° E.
80.00	Set a limestone, 19×8×6 ins., 15 ins. in the ground, for cor. of secs. 1, 6, 7, and 12, marked with 1 notch on N. and 5 notches on S. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor. Land, level. Soil, sandy loam; 1st rate. No timber. September 10: At this cor. I set off 4° 44′ N. on the decl. arc; and at 11h 56m.8 l. m. t., observe the sun on the meridian; the resulting lat. is 45° 39′, which is about 0′.1 more than the proper lat.

North, bet. secs. 1 and 6.

32.50	Creek, 15 lks. wide, impure water, sluggish current, low muddy banks, course E.
40.00	Set a locust post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
80.00	Set a limestone, 15×8×7 ins., 10 ins. in the ground, for cor. of Tps. 13 and 14 N., Rs. 21 and 22 E., marked with 6 notches on each edge; dig pits, 24×24×12 ins., on each line, N., E., and W., 4 ft., and S. of stone, 8 ft. dist., and raise a mound of earth, 5 ft. base, 2½ ft. high, S. of cor. September 10, 1890.

Chains.	
	September 11: At 7h 56.4m a. m., l. m. t.. I set off 45° 40′ on the lat. arc; 4° 25′ N., on the decl. arc; and determine a true meridian with the solar, at the cor. of Tps. 13 and 14 N., Rs. 21 and 22 E.
	Thence I run
	West on a random line, along the N. bdy. of Tp. 13 N., R. 21 E., setting temp. ¼ sec. and sec. cors. at intervals of 40.00 chs.; and, at 479.25 chs., intersect the 5th Guide Meridian, 42 lks. N. of the cor. of Tps. 13 and 14 N., Rs. 20 and 21 E., which is a limestone, 5×8×6 ins. above ground, marked and witnessed as described by the surveyor general. The falling answers to a correction of 0° 03′, or 7 lks. S. per mile. counting from the N. E. cor. of the Tp.; therefore I run
	N. 89°//57′E., bet. secs. 6 and 31.
	Over level land.
39.25	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
79.25	Set a limestone, 20×8×4 ins., 15 ins. in the ground, for cor. of secs. 5, 6, 31, and 32, marked with 5 notches on E. and 1 notch on W. edges; dig pits 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level.
	Soil, sandy loam; 1st rate.
	No timber.
	September 11, 1890.

	September 12: At —h —m a. m., l. m. t., I set off 45° 40′ on the lat. arc; 4° 02′ N., on the decl. arc; and determine a true meridian with the solar, at the cor. of secs. 5, 6, 31, and 32.
	Thence I run
	N. 89° 57′ E., bet. secs. 5 and 32.
40.00	Set a juniper post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
47.00	Creek 15 lks. wide, good water, sluggish current, course S. E.
80.00	Deposit a quart of charcoal, 12 ins. in the ground, for cor. of secs. 4, 5, 32, and 33; dig pits, 18×18×12 ins., in each sec., 4 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, over deposit.
	In S. E. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked T. 14 N., S. 33 on N. E., R. 21 E., S. 4 on S. E., T. 13 N., S. 5 on S. W., and S. 32 on N. W. faces; with 4 notches on E. and 2 notches on W. edges.
	Land, level.
	Soil, sandy loam; 1st rate.
	No timber.
	September 12: At this cor., I set off 4° 53′ N., on the decl. arc; and, at 11h 5m.1, l. m. t., observe the sun on the meridian; the resulting lat. is 45° 40′, which is about 0′.3 greater than the proper lat.
	September 12, 1890.

	N. 89° 57′ E., bet. secs. 4 and 33.
7.00	Branch, 4 lks. wide, course S. 35° W.
40.00	Set a limestone, 15×8×5 ins., 10 ins. in the ground, for ¼ sec. cor. marked ¼ on N. face; dig pits, 18×18×12 ins., E. and W., of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
55.00	Enter heavy oak timber, bears N. and S.
57.13	An oak, 38 ins. diam., on line, I mark with 2 notches on E, and W. sides.
68.00	Branch, 3 lks. wide, course N. 30° E.

Chains.	
80.00	An oak, 14 ins. diam., for cor. of secs. 3, 4, 33, and 34, I mark T. 14 N., S. 34 N. E., R. 21 E., S. 3 on S. E., T. 13 N., S. 4 on S. W., and S. 33 on N. W. sides; with 3 notches on E. and W. sides; from which An oak, 12 ins diam., bears N. 13½° E., 21 lks. dist., marked T. 14 N., R. 21 E., S. 34 B. T. An oak, 14 ins. diam., bears S. 78½° E., 25 lks. dist., marked T. 13 N., R. 21 E., S. 3, B. T. An ash, 10 ins. diam., bears S. 63¾° W., 34 lks. dist., marked T. 13 N., R. 21 E., S. 4, B. T. A dogwood, 7 ins. diam., bears N. 26° W., 32 lks. dist., marked T. 14 N., R. 21 E., S. 33, B. T. Land, level. Soil, sandy loam; 1st rate. Timber, oak. Heavily timbered land, 25.00 chs.
	September 13: At —^{h} —^{m}, l. m. t., I set off 45° 40′ on the lat. arc; —° —′ N., on the decl. arc; and determine a true meridian with the solar, at the cor. of secs. 3, 4, 33, and 34. Thence I run N. 89° 57′ E., bet. secs. 3 and 34. Over level land, through heavy oak timber.
28.00	Branch, 4 lks. wide, course S. 10° E.
40.00	An oak, 18 ins. diam., for ¼ sec. cor., I mark ¼ S., on N. side; from which An oak, 14 ins. diam., bears N. 42° E., 27 lks. dist., marked T. 14 N., R. 21 E., S. 34, B. T. An ash, 13 ins. diam., bears S. 48½° E., 25 lks dist., marked T. 13 N., R. 21 E., S. 3, B. T.
63.00	Leave heavy oak timber, bears N. and S.
80.00	Set a limestone, 22×8×7 ins., 17 ins. in the ground, for cor. of secs. 2, 3, 34, and 35, marked with 2 notches on E. and 4 notches on W. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor. Land, level. Soil, sandy loam; 1st rate. Timber, oak. Heavily timbered land, 63.00 chs.
	N. 89° 57′ E., bet. secs. 2 and 35. Over level land.
30.00	South fork of Spring Creek, 22 lks. wide, pure water, gentle current, low banks, course N. 38° E.
10.00	Set a locust post, 3 ft. long, 3 in. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
80.00	Set a limestone, 15×8×6 ins., 10 ins. in the ground, for cor. of secs. 1, 2, 35, and 36, marked with 1 notch on E. and 5 notches on W. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor. Land, level. Soil, sandy loam; 1st rate. No timber. September 13: At this cor., I set off —°—′ N., on the decl. arc: and at —^{h} —^{m} l. m. t., observe the sun on the meridian; the resulting lat. is 45° 39′, which is about 0′.7 less than the proper lat.
	N. 89° 57′ E., bet. secs. 1 and 36. Over level land.
40.00	Set a limestone, 18×18×12 ins., 12 ins. in the ground, for ¼ sec. cor.,

North boundary of T. 13 N., R. 21 E.—Concluded.

Chains.	
	marked ‡ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
58.00	Branch 4 lks. wide, course N. 30° E.
70.00	Same branch, 6 lks. wide, course S.
80.00	The cor. of Tps. 13 and 14 N., Rs. 21 and 22 E.
	Land, level.
	Soil, sandy loam; 1st rate.
	No timber.

September 13, 1890.

Boundaries of T. 13 N., R. 21 E.

Latitudes, departures, and closing errors.

Line designated.	True bearing.	Distance.	Latitudes.		Departures.	
			N.	S.	E.	W.
		Chs.	*Chs.*	*Chs.*	*Chs.*	*Chs.*
3rd Standard Parallel N	West	480.00				480.00
5th G. Meridian E	North	480.00	480.00			
N. bdy. T. 13 N., R. 21 E.	N. 89° 57' E.	479.25	0.42		479.25	
E. bdy. T. 13 N., R. 21 E	South	480.00		480.00		
Convergency*					0.74	
Totals			480.42	480.00	479.99	480.00
			480.00			479.99
Error in lat			0.42	Error in dep		0.01

* The convergency will always be entered in the column containing the departure of the north boundary.

This township is rough and mountainous in the southern part, rolling in the interior, and nearly level in the north and east, while prairie land is found in the vicinity of the southwest corner. The township is well watered, and well timbered in the interior; and the soil along the south fork of Spring Creek and its tributaries is very fertile. The township should be subdivided.

RICHARD ROODS,
U. S. Deputy Surveyor.

September 13, 1890.

FINAL OATHS OF DEPUTY SURVEYORS AND THEIR ASSISTANTS.

LIST OF NAMES.

A list of the names of the individuals employed by Richard Roods, U. S. deputy surveyor, to assist in running, measuring, and marking the lines and corners described in the foregoing field notes of the survey of the east and north boundaries of Township No. 13 North, Range No. 21 East, of the Principal Base and Meridian, in the State of Montana.

PETER LONG ..... Chainman.
JOHN SHORT ..... Chainman.
HENRY CLAY ..... Moundman.
WILLIAM STONE ..... Moundman.
GEORGE SHARP ..... Axman.
ADAM DULL ..... Axman.
JAMES BANNER ..... Flagman.

FINAL OATHS OF ASSISTANTS.

We hereby certify that we assisted Richard Roods, United States deputy surveyor, in surveying all those parts or portions of the east and north boundaries of Township No. 13 North, Range No. 21 East, of the Principal Base and Meridian, in the

State of Montana, which are represented in the foregoing field notes as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of our knowledge and belief, well and faithfully surveyed, and the corner monuments established according to the instructions furnished by the United States surveyor general for Montana.

PETER LONG, *Chainman.*
JOHN SHORT, *Chainman.*
HENRY CLAY, *Moundman.*
WILLIAM STONE, *Moundman.*
GEORGE SHARP, *Axman.*
ADAM DULL, *Axman.*
JAMES BANNER, *Flagman.*

Subscribed and sworn to before me this fifteenth day of September, 1890.
[SEAL.] WILLIAM MARTIN, *Notary Public.*

FINAL OATH OF UNITED STATES DEPUTY SURVEYOR.

I, Richard Roods, United States deputy surveyor, do solemnly swear that in pursuance of a contract received from A—— B——, United States surveyor general for Montana, bearing date of the tenth day of July, 1890, I have well, faithfully, and truly, in my own proper person, and in strict conformity with the instructions furnished by the United States surveyor general for Montana, the Manual of Surveying Instructions, and the laws of the United States, surveyed all those parts or portions of the east and north boundaries of Township No. 13 North, Range No. 21 East, of the Principal Base and Meridian in the State of Montana, which are represented in the foregoing field notes as having been surveyed by me and under my direction; and I do further solemnly swear that all the corners of said surveys have been established and perpetuated in strict accordance with the Manual of Surveying Instructions, and the special instructions of the United States surveyor general for Montana, and in the specific manner described in the field notes, and that the foregoing are the *original* field notes of such survey; and should any fraud be detected I will suffer the penalty of perjury under the provisions of an act of Congress approved August 8, 1846.

RICHARD ROODS,
U. S. Deputy Surveyor.

Subscribed by said Richard Roods and sworn to before me this fifteenth day of September, 1890.
[SEAL.] A—— B——,
U. S. Surveyor General for Montana.

Specimen Field Notes.—No. 4.

Resurvey of the E. bdy. of T. 25 N., R. 2 W., Willamette Meridian.

Chains.	
	(Note.—Field notes of retracements and resurveys will be incorporated with the field notes of the subdivisions to which they are directly related, and will be covered by the preliminary and final oaths of said subdivisional field notes. (See page 71.)
	In case the deputy does not know from recent observations that his instrument is in adjustment, he will make the observations prescribed at the beginning of specimen field notes No. 2, or No. 5, as the character of the instrument employed may require.
	A transit with solar attachment is the instrument employed for this resurvey.)
	Preliminary to commencing the subdivision of this township, I run north on a blank line, on the east boundary of sec. 36; at 40.00 chs. I find the ¼ sec. cor., N. 80° E., 30 lks. dist., and at 80.00 chs., the cor. of secs. 25, 30, 31 and 36, east, 58 lks. dist.; therefore, I continue my line north, find no part of the E. bdy. in alinement, and that many of the corners are nearly obliterated. At 5 miles 79.83 chs., intersect E. and W. line, 42 lks. E. of the cor. of Tps. 25 and 36 N., Rs. 1 and 2 W., and as these townships have not been subdivided, I resurvey the range line between them, as follows:
	The old standard cor. of Tps. 25 N., Rs. 1 and 2 W., is a post greatly decayed, and the marks are nearly obliterated. I destroy all traces of the old corner and reëstablish it at the same point, as follows:
	Set a sandstone, 18×8×5 ins., 12 ins. in the ground, for standard cor. of Tps. 25 N., Rs. 1 and 2 W. marked S. C., on N. face, with 6 grooves on N., E., and W. faces; dig pits, 30×24×12 ins., crosswise on each line, E. and W., 4 ft., and N. of stone, 8 ft. dist.; and raise a mound of earth, 5 ft. base, 2½ ft. high, N. of cor.
	Thence I run
	N. 0° 3′ W., bet. secs. 31 and 36.
18.00	Through timber. Ascend.
40.00	Top of ridge, about 10 ft. high, bears E. and W.
	Set a sandstone, 20×8×4 ins. 15 ins. in the ground, for ¼ sec. cor. marked ¼ on W. face; from which
	A pine 20 ins. diam., bears N. 20° E., 24 lks. dist. marked ¼ S. B. T.
	An oak, 16 ins. diam., bears N. 68½° W., 27 lks. dist., marked ¼ S. B. T.
	From this point, the old ¼ sec. cor., which is a decayed stake, with marks almost obliterated, bears N. 80° E., 33 lks. dist. I destroy this stake and the marks on the stump of a beech tree, described as a bearing tree in the field notes of the original survey. No trace can be found of a poplar, described as a bearing tree.
52.74	An oak, 14 ins. diam., on line, I mark with 2 notches on E. and W. sides. Descend.
57.00	Foot of ridge, bears E. and W.; enter rich level land.
72.00	Leave timber, bears N. E. and S. W.
80.00	Set a cedar post, 3 ft. long, 4 ins. sq., with marked stone, 24 ins. in the ground, for corner of secs. 25, 30, 31, and 36, marked
	T. 25 N., S. 30 on N. E.,
	R. 1 W., S. 31 on S. E.,
	S. 36 on S. W., and
	R. 2 W., S. 25 on N. W. faces; with 5 notches on N. and 1 notch on S. edges; dig pits, 18×18×12 ins. in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	From this cor. the old cor., a decayed post, bears E. 65 lks. I destroy all traces of the old cor.
	Land, rolling and level.
	Soil, N. and S. parts, rich loam; 1st rate: middle part, sandy; 2nd rate.
	Timber, pine and oak.

Resurvey of the E. bdy. of T. 25 N., R. 2 W., etc.—Continued.

Chains.	
	N. 0° 3′ W., bet. secs. 25 and 30.
	Over level land.
40.00	Set a locust post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	All indications of the old cor. have disappeared.
80.00	Set a granite stone, 15×8×7 ins., 10 ins. in the ground, for cor. of secs. 19, 24, 25 and 30, marked with 4 notches on N. and 2 notches on S. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft high, W. of cor.
	From this point, the old sec. cor., a post, bears N. 50° E., 41 lks. dist. I destroy the cor.
	Land, level prairie.
	Soil, rich loam; 1st rate.
	No timber.

	N. 0° 3′ W., bet. secs. 19 and 24.
	Over level prairie.
40.00	Set an oak post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits, 18 × 18 × 12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	From this point, the old ¼ sec. cor., a decayed post, bears N. 51½° E., 47 lks. dist. I destroy this post, and marks on old bearing trees.
50.00	Elk Creek, 130 lks. wide, shallow at this point, good water, gentle current, course N. W.
80.00	Set a limestone, 18 × 8 × 5 ins., 12 ins. in the ground, for cor. of secs. 13, 18, 19 and 24, marked with 3 notches on N. and S. edges; dig pits, 18 × 18 × 12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	After diligent search no signs of the old cor. can be found.
	Land, level prairie.
	Soil, rich loam; 1st rate.
	No timber.

	N. 0° 3′ W., bet. secs. 13 and 18.
	Over prairie land.
16.50	Coon Creek, 60 lks. wide, 2 ft. deep, good water, course W.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	I can find no traces of old cor. post, but find slight traces of pits N. 86° E. 46 lks. dist., which I destroy.
80.00	Set a limestone, 22×8×4 ins., 17 ins. in the ground, for cor. of secs. 7, 12, 13 and 18, marked with 2 notches on N. and 4 notches on S. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	The old cor. which was a post, has disappeared, but indistinct remains of the pits, nearly in their proper places, still remain. The new pits sufficiently obliterate the old ones.
	Land, gently rolling prairie.
	Soil, rich loam; 1st rate.
	No timber.
	April 12, 1892: I set off 9° 6′ N., on the decl. arc; and at $12^h\ 0.3^m$ p. m., l. m. t., observe the sun on the meridian; the resulting lat., is 47° 35′ N.

	N. 0° 3′ W., bet. secs. 7 and 12.
	Over prairie land.
17.50	Maple Creek, 10 lks. wide, 1 ft. deep, good water, gentle current, course S. W.

Chains.	
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
80.00	Set a limestone, 20×8×5 ins., with marked stone. 24 ins. in the ground, for cor. of secs. 1, 6, 7, and 12, marked with 1 notch on N. and 5 notches on S. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	The old cor. which was a post, has been entirely destroyed by fire, no signs of pits.
	Land, level prairie.
	Soil, rich loam; 1st rate.
	No timber.

April 12, 1892: At 4 p. m., l. m. t., I set off 47° 36′ on the lat. arc; —° —′, on the decl. arc; and determine a true meridian, at the cor. of secs. 1, 6, 7, and 12.

Thence I run

N. 0° 3′ W., bet. secs. 1 and 6.

Over prairie land.

10.40	A spring branch, 3 lks. wide, good water, course S. 70° W.
22.00	Spring of pure water, 3 ft. diam., 2 ft. deep, bears E., 6.00 chs. dist.
40.00	Set a locust post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S., on W. face.; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	After diligent search no old ¼ sec. cor. can be found.
46.00	Small branch, 3 lks. wide, sluggish current, course N. W. Enter timber, bears N. W. and S. E.
79.83	The old cor. of Tps. 25 and 26 N., Rs. 1 and 2 W., which is an oak post, burned off at the surface of the ground. I reëstablish the cor. at the same point, as follows: Set a cedar post, 3 ft. long, 4 ins. sq., with charred stake and the old post, 24 ins. in the ground, for cor. of Tps. 25 and 26 N., Rs. 1 and 2 W. marked T. 26 N., S. 31 on N. E., R. 1 W., S. 6 on S. E., T. 25 N., S. 1 on S. W., and R. 2 W., S. 36 on N. W. faces; with 6 notches on each edge; from which A cherry, 6 ins. diam., bears N. 40¼° E., 14 lks. dist., marked T. 26 N., R. 1 W., S. 31, B. T. A white oak, 5 ins. diam., bears S. 51¼° E., 24 lks. dist., marked T. 25 N., R. 1 W., S. 6, B. T. A hickory, 8 ins. diam., bears S. 37¼° W., 30 lks. dist., marked T. 25 N., R. 2 W., S. 1, B. T. A chestnut, 6 ins. diam., bears N. 52¾° W., 13 lks. dist., marked T. 26 N., R. 2 W., S. 36, B. T.
	Land, level.
	Soil, rich loam, 1st rate.
	Timber, oak, hickory, and chestnut.

April 12, 1892.

The field notes of the subdivision of this township read in part as follows:

* * * * * * *

"N. 89° 57′ W., on a random line bet. secs. 7 and 18.

10.00	Set temp. ¼ sec. cor.
79.61	The cor. of secs. 7, 12, 13, and 18 can not be found.
	I find the ¼ sec. cor. bet. secs. 13 and 18, which is a locust post, 1 ft. high, 3 ins. sq., marked and witnessed as described by the surveyor general.
	Thence I run
	North, on a random line bet. secs. 13 and 18.

Chains.	
40.00	Set temp. sec. cor. At this point I again make careful search for the sec. cor., which is described by the surveyor general, as a post, with pits and mound of earth W. of cor., but am unable to find any traces of post, pits, or mound. Thence, bet. secs. 7 and 12.
79.95	Intersect E. and W. line, 5 lks. E. of the ¼ sec. cor. bet. secs. 7 and 12, which is a sandstone, 5×10×4 ins. above ground, marked and witnessed as described by the surveyor general.
	Thence I run
	S. 0° 2′ E., on a true line bet. secs. 7 and 12.
	Over rolling land.
38.00	Fence, bears E. and W., enter plowed ground.
39.97½	Reëstablish the cor. as follows:
	Set a cedar post, 3 ft. long, 4 ins. sq., with marked stone, 24 ins. in the ground, for cor. of secs. 7, 12, 13, and 20, marked
	T. 25 N. S. 7 on N. E.,
	R. 2 W. S. 18 on S. E.,
	S. 13 on S. W., and
	R. 3 W., S. 12 on N. W. faces; with 2 notches on N. and 4 notches on S. edges: dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	April 18, 1892."
	* * * * * * *

SPECIMEN FIELD NOTES.

No. 5.

TITLE PAGE.

(See Plate IV.)

FIELD NOTES

OF THE SURVEY OF THE

SUBDIVISION AND MEANDER LINES

OF

TOWNSHIP NO. 15 NORTH, RANGE NO. 20 EAST,

OF THE

PRINCIPAL BASE AND MERIDIAN

IN THE

STATE OF MONTANA,

AS SURVEYED BY

ROBERT ACRES,
U. S. DEPUTY SURVEYOR,

UNDER HIS CONTRACT, No. 207,
DATED MARCH 22, 1893.

Survey commenced August 4, 1893.
Survey completed August 19, 1893.

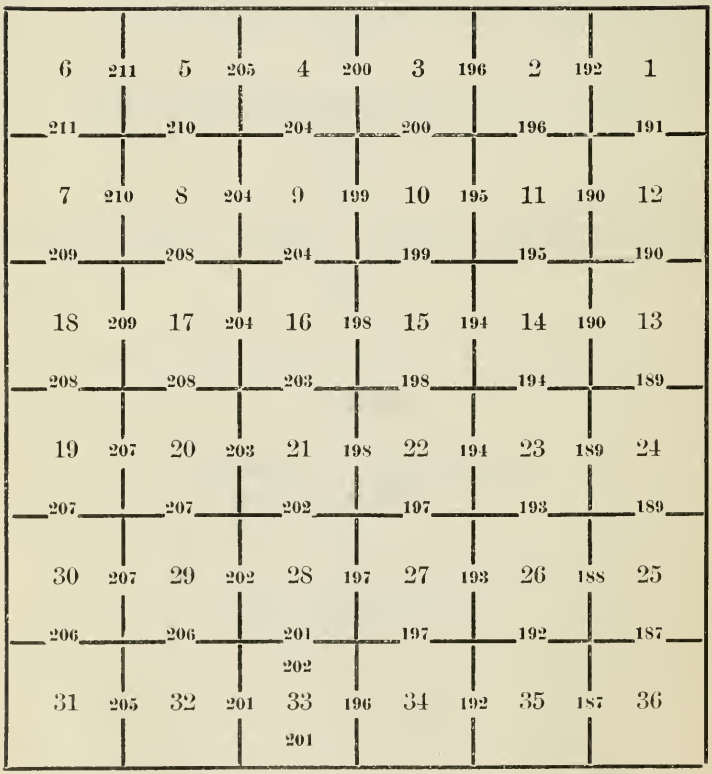
[Second page.]

NAMES AND DUTIES OF ASSISTANTS.

PETER LONG ..... Chainman.
JOHN SHORT ..... Chainman.
CYRUS CLAY ..... Moundman.
HENRY ROCK ..... Moundman.
GEORGE SHARP ..... Axman.
ADAM DULL ..... Axman.
JAMES BANNER ..... Flagman.
EDWARD ENSIGN ..... Flagman.

INDEX.

Township 15 north. R. 20 east.



NOTE.—When practicable, the diagram will show *meander* lines with the page references written upon them.

[Third Page.]

PRELIMINARY OATHS OF ASSISTANTS.

We, Peter Long and John Short, do solemnly swear that we will well and faithfully execute the duties of chainmen; that we will level the chain over even and uneven ground, and plumb the tally pins either by sticking or dropping the same; that we will report the true distances to all notable objects, and the true lengths of all lines that we assist in measuring, to the best of our skill and ability, and in accordance with instructions given us in the survey of the subdivision and meander lines of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian in the State of Montana.

PETER LONG, *Chainman.*
JOHN SHORT, *Chainman.*

Subscribed and sworn to before me this second day of August, 1893.
[SEAL.] HENRY DOOLITTLE,
Notary Public.

We, Cyrus Clay and Henry Rock, do solemnly swear that we will well and truly perform the duties of moundmen, in the establishment of corners, according to the instructions given us, to the best of our skill and ability, in the survey of the subdivision and meander lines of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian in the State of Montana.

CYRUS CLAY, *Moundman.*
HENRY ROCK, *Moundman.*

Subscribed and sworn to before me this second day of August, 1893.
[SEAL.] HENRY DOOLITTLE,
Notary Public.

We, George Sharp and Adam Dull, do solemnly swear that we will well and truly perform the duties of axmen in the establishment of corners and other duties, according to instructions given to us, and to the best of our skill and ability, in the survey of the subdivision and meander lines of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian in the State of Montana.

GEORGE SHARP, *Axman.*
ADAM DULL, *Axman.*

Subscribed and sworn to before me this second day of August, 1893.
[SEAL.] HENRY DOOLITTLE,
Notary Public.

I, James Banner, do solemnly swear that I will well and truly perform the duties of flagman according to instructions given me, to the best of my skill and ability, in the survey of the subdivision and meander lines of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian in the State of Montana.

JAMES BANNER, *Flagman.*

Subscribed and sworn to before me this second day of August, 1893.
[SEAL.] HENRY DOOLITTLE,
Notary Public.

I, Edward Ensign, do solemnly swear that I will well and truly perform the duties of flagman according to instructions given me, to the best of my skill and ability, in the survey of the subdivision and meander lines of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian in the State of Montana.

EDWARD ENSIGN, *Flagman.*

Subscribed and sworn to before me this eleventh day of August, 1893.
ROBERT ACRES,
U. S. Deputy Surveyor.

Chains. Survey commenced August 4, 1893, and executed with a Young & Sons light mountain transit, No.—, with solar attachment. The horizontal limb is provided with two double verniers placed opposite to each other, reading to single minutes of arc, which is also the least count of the verniers of the latitude and declination arcs.

The instrument was examined, tested on the true meridian at Helena, found correct, and was approved by the surveyor general for Montana, August 1, 1893.

I examine the adjustments of the transit, and correct the level and collimation errors;* then, to test the solar apparatus, by comparing its indications, resulting from solar observations made during a. m. and p. m. hours, with a true meridian determined by observations on Polaris, I proceed as follows:

At the cor. of Tps. 14 and 15 N., Rs. 20 and 21 E.; latitude 45° 45′ N., longitude 107° 54′ W.; I set off 45° 45′ N., on the lat. arc; 17° 1′ N., on the decl. arc; and, at 4^h 6^m p. m., l. m. t., determine with the solar a *true meridian* and mark a point thereof, on a stone firmly set in the ground, 5 chs. N. of the cor.

At 10^h 24^m 3 p. m. by my watch, which is 3^m 43^s slow of l. m. t., I observe Polaris at *eastern elongation*, in accordance with Manual of Instructions,† and mark a point in the line thus determined, on a plug driven in the ground, 5 chs. N. of my station.

August 4, 1893.

August 5: At 6 a. m., l. m. t., I lay off the azimuth of Polaris, 1° 48′, to the west, and mark the TRUE MERIDIAN thus determined, by cutting a small groove in the stone set August 4, on which the *true meridian* falls 0.4 ins. *east* of the mark determined by the solar.

At 8^h 6^m a. m., l. m. t., I set off 45° 45′, on the lat. arc; 16° 50′ N., on the decl. arc; and mark a point in the true meridian determined with the solar, by a cross on the stone already set 5 chs. N. of my station; this mark falls 0.3 ins. *east* of the *true meridian* established by the Polaris observation.‡

The solar apparatus, by p. m. and a. m. observations, defines positions for true meridians, respectively about 0′21″ *west*§ and 0′16″ *east*§ of the meridian established by the Polaris observations; therefore, I conclude that the adjustments of the instrument are satisfactory.

The *magnetic* bearing‖ of the true meridian, at 8^h 30^m a. m., is N. 18° 15′ W.; the angle thus determined, reduced by the table, page 100, gives the *mean mag. decl. 18° 10′ E.*

From the Tp. cor. already described, I run

North, on the 5th Guide Meridian and E. bdy. of sec. 36; and, at 40.01 chs., intersect the ¼ sec. cor.; and, at 79.98 chs., fall 1 lk. W. of the cor. of secs. 25, 30, 31 and 36; therefore, the line bears north.

From the Tp. cor. I run N. 89° 57′ W., on the S. bdy. of sec. 36; at 39.99 chs., fall 0½ lk. N. of the ¼ sec. cor.; and at 80.01 chs. fall 1 lk. S. of the cor. of secs. 1, 2, 35, and 36, on S. bdy. of the Tp.; consequently, the S. bdy. of the sec. 36 bears N. 89° 57′ W.

Therefore, the bearings are as stated by the surveyor general, and my chaining practically agrees with the field notes of the original survey.

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*The instrument will not necessarily be in adjustment at the beginning of the survey *because it was found correct when approved by the surveyor general.* The deputy should clearly understand that he is required to *know* that his instrument is in adjustment when he *commences* work and at *all other times* when he employs said instrument to determine directions and run lines, from proper observations personally conducted.

† See page 105.

‡ The observations here recorded have a twofold object; first, to determine a *true meridian;* second, *to test the solar apparatus thereon.* When a *transit* is employed, true meridians, determined by Polaris observations, will be regarded as reference, or directing lines of the survey; and from them all other directions and bearings will be initiated *by angular measurements on the horizontal limb of the instrument.*

§ To determine these small angles in *seconds* of arc, divide the fallings, expressed in *inches*, by 0.019. (See footnote, page 154.)

‖ When this *magnetic bearing* shall have been taken, the deputy will have no further use for the *magnetic needle* on this survey, and it might be removed from the compass box, and left in camp, without affecting the subdivision of the township in any manner.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	I commence at the cor. of secs. 1, 2, 35, and 36, on the S. bdy. of the Tp., which is a sandstone, 6 × 8 × 5 ins. above ground, firmly set, and marked and witnessed as described by the surveyor general.
	Thence I run
	N. 0° 01′ W., bet. Secs. 35 and 36.
	Over level bottom land.
4.50	Wire fence, bears E. and W.
20.00	Enter scattering cottonwood timber, bears E. and W. F. G. Alexander's house bears N. 28° W.
29.30	Leave scattering cottonwoods, bearing E. and W.; enter road, bears N.
30.00	S. E. cor. of F. G. Alexander's field; thence, along west side of road.
39.50	To crossroads, bears E. to Mound City; N. to Lake City. F. G. Alexander's house bears S. 40° W. The ¼ sec. cor. point will fall in road; therefore
	Set a cedar post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for witness cor. to ¼ sec. cor., marked W. C. ¼ S., on W. face; dig pits, 18×18×12 ins. N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
40.00	The point for ¼ sec. cor. falls in road.
	Deposit a marked stone, 24 ins. in the ground, for ¼ sec. cor.
	The S. E. cor. of Pat. Curran's field bears W., 5 lks. dist.
40.50	Set a limestone, 15×8×6 ins., 10 ins. in the ground, for witness cor. to ¼ sec. cor., marked W. C. ¼ S. on W. face; dig pits, 18×18×12 ins. N. and S. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	Thence along E. side of field.
50.50	N. E. cor. of Pat. Curran's field, bears W., 4 lks. dist.
51.50	Leave road; which turns to N. 70° W., leads to ferry on Yellowstone River; thence to Lake City.
57.50	Enter dense cottonwood and willow undergrowth, bears N. 54 E. and S. 54 W.
72.50	Leave undergrowth, enter scattering timber, bears N. 60° E. and S. 60° W.
80.00	Set a locust post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for cor. of secs. 25, 26, 35 and 36, marked
	T. 15 N., S. 25 on N. E.,
	R. 20 E., S. 36 on S.E.,
	S. 35 on S.W., and
	S. 26 on N.W. faces; with 1 notch on S. and E. faces; from which
	An ash, 13 ins. diam., bears N. 22° E., 26 lks. dist., marked T. 15 N., R. 20 E., S. 25, B. T.
	A sycamore, 23 ins. diam., bears S. 71¼° E., 37 lks. dist., marked T. 15 N., R. 20 E., S. 36, B. T.
	A walnut, 17 ins. diam., bears S. 64° W., 41 lks. dist., marked T. 15 N., R. 20 E., S. 35, B. T.
	A cottonwood, 13 ins. diam., bears N. 21¼° W., 36 lks. dist., marked T. 15 N., R. 20 E., S. 26, B. T.
	Last 20.00 chs. of this mile subject to overflow, 2 to 4 ft. deep.
	Land, level bottom.
	Soil, alluvial; 1st rate.
	Timber, scattering cottonwood, sycamore, ash, and walnut; undergrowth, cottonwood and willow.
	Dense undergrowth, 15.00 chs.

	S. 89° 57′ E., on a random line bet. secs. 25 and 36.
40.00	Set temp. ¼ sec. cor.
79.96	Intersect E. bdy. of Tp. 3 lks. N. of cor. of secs. 25, 30, 31, and 36, which is a sandstone, 5×8×5 ins. above ground, marked and witnessed as described by the surveyor general.
	Thence I run
	N. 89° 56′ W., on a true line bet. secs. 25 and 36.
	Over level bottom land, through scattering timber.
13.00	Leave scattering timber, bears N. and S.
18.60	Cherry Creek, 12 lks. wide; clear water, 1 ft. deep; gentle current, sandy bottom; course N.
20.50	Enter heavy timber, bears N. and S.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
32.50	Leave heavy timber, bears N. W. and S. E.
39.98	Deposit a quart of charcoal, 12 ins. in the ground, for ¼ sec. cor.; dig pits, 18×18×12 ins., E. and W. of cor., 4 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, over deposit. In E. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked ¼ S. on N. face.
46.50	Enter heavy timber, bears N. and S.
76.00	Leave heavy, enter scattering timber, bears N. 25° E. and S. 25° W.
79.96	The cor. of secs. 25, 26, 35, and 36.
	Land nearly level; mostly subject to overflow 2 to 5 ft. deep.
	Heavily timbered land, 41.50 chs.
	N. 0° 1′ W., bet. secs. 25 and 26.
	Over level bottom land, through scattering timber.
25.36	Right bank of Yellowstone River.
	Set a locust post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for meander cor. of fracl. secs. 25 and 26, marked M. C. on N., T. 15 N. on S., R. 20 E., S. 25 on E., and S. 26 on W. faces; from which A cottonwood, 12 ins. diam., bears S. 18¼° E., 16 lks. dist., marked T. 15 N., R. 20 E., S. 25, M. C. B. T. A sycamore, 31 ins. diam., bears S. 74½° W., 25 lks. dist., marked T. 15 N., R. 20 E., S. 26, M. C. B. T.
	Enter shallow channel, 1 to 2 ft. deep.
26.00	Across shallow channel, 64 lks. wide, to sand bar parallel to river bank; thence on sand bar.
32.12	To right bank of main channel, course E.; point for triangulation.
40.00	Point for ¼ sec. cor. falls in river.
	To determine the dist. across, I set a flag on line, on left bank; then measure a base, N. 89° 59′ E., 20.00 chs. to a point, from which the flag bears N. 49° 06′ W.; from the flag the E. end of base bears S. 49° 6′ E.; therefore, the dist. is tan. 40° 55′×base, or 0.867×20.00=17.34 chs.;* making the whole distance from meander cor., 0.64+6.12+17.34=24.10 chs., which added to 25.36, makes
49.46	To left bank of Yellowstone River; bank, 12 ft. high.
	Deposit a marked stone, 12 ins. in the ground for meander cor. of fracl. secs. 25 and 26, dig a pit, 36×36×12 ins., 5 ft. N. of cor. and raise a mound of earth, 4 ft. base, 2 ft. high, over deposit.
	In the pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked M. C. on S., T. 15 N. on N., R. 20 E., S. 26 on W., and S. 25 on E. faces.
	Thence over level bottom land. Some small cottonwoods, none within limits suitable for bearing trees.
52.60	Leave bottom, begin ascent, bears E. and W.
53.60	Top of ascent and edge of sandy plain, 40 ft. above river, bears E. and W.
55.70	Wire fence, bears E. and W.
62.80	Telegraph line, bears E. and W.
80.00	Set a cedar post, 3 ft. long, 4 ins. sq., with marked stone, 24 ins. in the ground, for cor. of secs. 23, 24, 25, and 26, marked T. 15 N., S. 24 on N. E., R. 20 E., S. 25 on S. E., S. 26 on S. W., and S. 23 on N. W. faces; with 2 notches on S. and 1 notch on E. edges; dig pits, 18×18×12 ins. in each sec. 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level.

* See page 136.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	Soil, alluvial and sandy; 1st and 2nd rate.
	Timber, cottonwood and sycamore.
	August 5: At this cor. I set off 16° 47′ N., on the decl. arc; and, at 0ʰ 6ᵐ p. m., l. m. t., observe the sun on the meridian; the resulting lat. is 45° 47′.0 or about 0′.3 greater than the proper lat.
	S. 89° 56 E., on a random line bet. secs. 24 and 25.
40.00	Set temp. ¼ sec. cor.
79.98	Intersect E. bdy. of Tp. 3 lks. N. of cor. of secs. 19, 24, 25, and 30, which is a sandstone, 5×9×4 ins. above ground, marked and witnessed as described by the surveyor general.
	Thence I run
	N. 89° 55′ W., on a true line bet. secs. 24 and 25.
	Over level land.
20.00	Fletcher's Station bears S. 64° W.
39.99	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on N. face; dig pits, 18×18×12 ins., E. and W. 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high. N. of cor.
	Fletcher's Station bears S. 7° E.
58.00	Short Creek, 3 lks. wide, alkali water, 8 ins. deep, course S. 20° E.
79.98	The cor. of secs. 23, 24, 25, and 26.
	Land, level.
	Soil, sandy; 3rd rate.
	No timber.
	N. 0° 1′ W., bet. secs. 23 and 24.
	Over level land.
21.00	Enter alkali flat, bears N. 70 W. and S. 70 E.
40.00	Set a sandstone, 16×8×16 ins., 11 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face; dig pits, 18×18×12 ins., N. and S. of stone, 3 ft. dist., and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	Alkali flat extends about 65.00 chs. E. and 35.00 chs. W.
73.50	Leave alkali flat, bears E. and W.
78.00	Alkali creek (dry), course E.
80.00	Set a sandstone, 20×7×5 ins., 15 ins. in the ground, for cor. of secs. 13, 14, 23 and 24, marked with 3 notches on S. and 1 notch on E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level.
	Soil, sandy and alkali; 4th rate.
	No timber.
	S. 89° 55′ E., on a random line, bet. secs. 13 and 24.
	Over level land.
40.00	Set temp. ¼ sec. cor.
80.01	Intersect E. bdy. of the Tp. at the cor. of secs. 13, 18, 19, and 24, which is a locust post 1 ft. above ground, 4 ins. sq., marked and witnessed as described by the surveyor general.
	Thence I run
	N. 89° 55′ W., on a true line bet. secs. 13 and 24.
	Over sandy alkali land.
40.00½	Set a juniper post, 3 ft. long, 3 ins. sq., with marked stone, 21 ins. in the ground, for ¼ sec. cor. marked ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
80.01	The cor. of secs. 13, 14, 23, and 24.
	Alkali creek (now dry), runs eastward about 4.00 chs. south of this line.
	Land, level.
	Soil, alkali sand; 4th rate.
	No timber.

Chains.	
	N. 0° 1′ W., bet. secs. 13 and 14.
	Over level land.
40.00	Set an oak post 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits 18×18×12 ins. N. and S. of post, 3 ft. dist., and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	Thence gradually ascending.
58.00	Begin steep ascent, sloping S. W.; broken, stony ground.
80.00	Set a limestone, 20×8×6 ins., 15 ins. in the ground, for cor. of secs. 11, 12, 13, and 14, marked with 4 notches on S., and 1 notch on E. edges; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	This cor. is about 150 ft. above last ¼ sec. cor.
	Land, level and mountainous.
	Soil, sandy and rocky; 3rd and 4th rate.
	No timber.
	Mountainous land, 22.00 chs.

	S. 89° 55′ E., on a random line, bet. secs. 12 and 13.
40.00	Point for ¼ sec. cor. falls in Rancho San Blas.
80.03	Intersect E. bdy. of Tp. 7 lks. N. of the cor. of secs. 7, 12, 13, and 18, which is a sandstone 5×6×6 ins. above ground, marked and witnessed as described by the surveyor general.
	Thence, I run
	N. 89° 52′ W., on a true line bet. secs. 12 and 13.
	Over level land.
31.49	Intersect E. bdy. of Rancho San Blas, at a point, from which the 5 mile post on the rancho bdy. bears S. 33° E. 7.00 chs. dist.
	Set a limestone, 15×8×5 ins., 10 ins. in the ground, for closing cor. of fracl. secs. 12 and 13, marked C. C. on E. and S. B., on W. faces; dig pits, crosswise on each line, 30×24×12 ins., N. 33° W., 3 ft., and 24×18×12 ins., E. of stone, 7 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, E. of cor.
	Thence, across the rancho on a *blank line.*
67.07	Intersect W. bdy. of Rancho San Blas at a point, from which the 3½ mile post on the rancho bdy., bears N. 19½° W., 12.20 chs. dist.
	Set a granite stone, 15×7×6 ins., 10 ins. in the ground, for closing cor. of fracl. secs. 12 and 13, marked S. B. on E., with 4 grooves on S. and C. C. on W. faces; and raise a mound of stone 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	This cor. is on a granite ridge 220 ft. above closing cor. on E. bdy. of the rancho. Thence, over rough stony ground.
76.00	Begin descent of rocky slope, bears N. and S.
80.03	The cor. of secs. 11, 12, 13, and 14.
	This cor. is 40 ft. below top of ridge.
	Land, level and mountainous.
	Soil, sandy loam and stony; 3rd and 4th rate.
	No timber.
	Across Rancho San Blas, 35.58 chs. of *blank line.*
	Mountainous land, 12.96 chs.

	August 5: At 4ʰ 35ᵐ p. m., l. m. t., I set off 45° 49′ on the lat. arc; 16° 45′ N., on the decl. arc; and determine a true meridian with the solar, at the corner of secs. 11, 12, 13, and 14.
	Thence I run
	N. 0° 1′ W., bet. secs. 11 and 12.
	Ascend over rough stony ground sloping W.
11.00	Top of ascent, bears about N. 50° W., and S. 50° E.
	Thence over level land.
36.60	Intersect W. bdy. of Rancho San Blas at a point from which the N. W. cor. of the rancho bears N. 19½° W., 7.40 chs. dist.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	Set a cedar post, 3 ft. long, 4 ins. sq., with marked stone, 24 ins. in the ground, for closing cor. of fracl. secs. 11 and 12, marked S. B. on E., C. C. T. 15 N., R. 20 E. on S., and S. 11 on W. faces; dig pits, crosswise on each line, 30×24×12 ins., N. 19½° W., 3 ft., and 24×18×12 ins., S. of stone, 7 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, S. of cor.
	Thence, across the rancho on a *blank line.*
40.00	The point for ¼ sec. cor. falls in the rancho.
44.32	Intersect N. bdy. of Rancho San Blas at a point from which the N. W. cor. of the rancho bears S. 73° W., 2.58 chs. dist.
	Set a juniper post 3 ft. long, 4 ins. sq., with a quart of charcoal, 24 ins. in the ground, for closing cor. of fracl. secs. 11 and 12, marked C. C., T. 15 N., R. 20 E. on N., S. B. on S., and S. 11 on W. faces; dig pits, crosswise on each line, 30×24×12 ins., S. 73° W., 3 ft., and 24×18×12 ins., N. of stone, 7 ft. dist., and raise a mound of earth, 4 ft. base, 2 ft high, N. of cor.
	Leave rancho, enter public land; thence, over rolling ground.
59.50	Branch, 6 lks. wide, course S. E.
80.00	Deposit a marked stone, 12 ins. in the ground, for cor. of secs. 1, 2, 11, and 12, dig pits, 18×18×12 ins., in each sec., 4 ft. dist. and raise a mound of earth, 4 ft. base, 2 ft. high, over deposit. In S. E. pit, drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked T. 15 N., S. 1 on N. E., R. 20 E., S. 12 on S. E., S. 11 on S. W., and S. 2 on N. W. faces; with 5 notches on S. and 1 notch on E. edges.
	Land, mountainous and level.
	Soil stony, clay, and loam; 3rd and 4th rate.
	No timber.
	Across Rancho San Blas, 7.72 chs. of blank line.
	Mountainous land, 11.00 chs.

	S. 89° 52′ E., on a random line bet. secs. 1 and 12.
40.00	Set temp. ¼ sec. cor.
80.04	Intersect E. bdy. of Tp.; 7 lks. N. of cor. of secs. 1, 6, 7, and 12 which is a juniper post, 1 ft. high, 4 ins. sq., marked and witnessed as described by the surveyor general.
	Thence I run
	N. 89° 49′ W., on a true line bet. secs. 1 and 12.
	Over rolling land.
7.00	Enter oak timber, bears N. 20° E. and S. 20° W.
9.00	Begin ascent of ridge, bears N. 27° E. and S. 27° W.
11.50	Top of ridge, 50 ft. high, bears N. 27° E. and S. 27° W.
13.60	Begin descent, bears N. 30° E. and S. 30° W.
16.50	Foot of descent, bears N. 33° E. and S. 33° W.
18.07	An oak, 12 ins. diam., on line, I mark with 2 notches on E. and W. sides.
40.02	Set a cedar post, with charred stake, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
43.00	Ravine, 2.00 chs. wide, 18 ft. deep, course S. 20° W.
51.50	Ravine, 3.00 chs. wide, 22 ft. deep, course S. 30° W.
59.50	Ravine, 3.50 chs. wide, 25 ft. deep, course S. 20° E.
72.00	Leave oak timber, bears N. and S.
80.04	The cor. of secs. 1, 2, 11, and 12.
	Land, rolling.
	Soil, sandy loam; 3d rate.
	Timber, oak.

Chains.	
	N. 0° 1′ W., on a random line bet. secs. 1 and 2.
40.00	Set temp. ¼ sec. cor.
79.77	Intersect N. bdy. of Tp. at cor. of secs. 1, 2, 35, and 36, which is a limestone, 6×6×5 ins., above ground, marked and witnessed as described by the surveyor general.
	Thence I run
	S. 0° 1′ E. on a true line bet. secs. 1 and 2.
	Over rolling land.
30.50	Ravine, 3.50 chs. wide, 30 ft. deep, course N. 70° E.
39.77	Deposit a marked stone, 12 ins. in the ground, for ¼ sec. cor.; dig pits, 18×18×12 ins. N. and S. of cor., 4 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, over deposit.
	In S. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground marked ¼ S. on W. face.
79.77	The cor. of secs. 1, 2, 11, and 12.
	Land, rolling.
	Soil, clay and loam; 3rd and 4th rate.
	No timber.

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	From the cor. of secs. 2, 3, 34, and 35, on S. bdy. of the Tp., which is a locust post, 4 ins. sq., 12 ins. high, marked and witnessed as described by the surveyor general, I run
	N. 0° 2′ W., bet. secs., 34 and 35.
	Over local bottom land.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
42.00	Begin ascent of sand hills, bears N. 70° E. and S. 70° W.
46.00	Top of sand ridge, 35 ft. high, bears N. 65° E. and S. 65° W., begin descent.
50.50	Foot of descent, bears N. 70° E. and S. 70° W.; thence, over sandy plain, gently ascending.
80.00	Set a locust post, 3 ft. long, 4 ins. sq., with quart of charcoal, 24 ins. in the ground, for cor. of sec. 26, 27, 34 and 35, marked T. 15 N., S. 26 on N. E., R. 20 E., S. 25 on S. E., S. 34 on S. W., and S. 27 on N. W. faces; with 1 notch on S. and 2 notches on E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist., and raise a mound of earth, 4ft. base, 2 ft. high, W. of cor.
	Land, level.
	Soil, alluvial and sandy; 1st and 4th rate.
	No timber.

	S. 89° 57′ E., on a random line bet. secs. 26 and 35.
40.00	Set temp. ¼ sec. cor.
48.13	To left bank of Yellowstone River, set temp. meander cor.
	To determine the dist. across*, I set a flag on line on right bank of the river; then measure a base line S. 22° 58′ E. 15.00 chs. to a point, whence the flag bears N. 41° 47′ E. From the flag the S. end of the base bears S. 41° 47′ W.; therefore the angles taken in order of measurement are respectively 66° 59′, 64° 48′, and 48° 16′; their sum being 180° 03′, or 3′ too great. I diminish each angle by one-third of the excess and compute the distance across the river, as follows: $\frac{\sin 64^\circ 47'}{\sin 48^\circ 15'} \times$ base, or $\frac{0.905 \times 15}{0.746} = 18.19$ chst.; also, 48.13+18.19 makes
66.32	To right bank of river; set temp. meander cor.
80.06	Intersect N. and S. line, 3 lks. S. of cor. of secs. 25, 26, 35, and 36; thence I run
	N. 89° 58′ W., on a true line bet. secs. 26 and 35.

* The triangulation will always be made *on the random line* when a random line is run. See page 61; and Plate II, fig. 4.

† See page 136.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	Over level bottom land, through scattering timber.
13.74	To right bank of Yellowstone River.
	Set a limestone, 19×7×5 ins., 15 ins. in the ground, for meander cor. of fracl. secs. 26 and 35, marked M. C. on W. face, with 1 groove on S. face; from which
	A sycamore, 19 ins. diam.. bears N. 49¼° E., 26 lks. dist., marked T. 15 N., R. 20 E., S. 26, M. C. B. T.
	A cottonwood, 13 ins. diam.. bears S. 38½° E., 21 lks. dist., marked T. 15 N., R. 20 E., S. 35, M. C. B. T.
31.93	To left bank of Yellowstone River.
	A sycamore, 13 ins. diam., for meander cor. of fracl. secs. 26 and 35, I mark M. C on E., T. 15 N. on W., R. 20 E., S. 35 on S., and S. 26 on N. sides; dig a pit, 36×36×12 ins., 8 ft. W. of tree, and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
37.50	Leave scattering timber, bears N. W. and S. E.
40.03	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
80.06	The cor. of secs. 26, 27, 34, and 35.
	Land, level.
	Soil, alluvial and sandy; 1st and 3rd rate.
	Timber, sycamore and cottonwood.

	N. 0° 2′ W., bet. secs. 26 and 27.
	Over nearly level land.
4.50	Road from Mound City to Lake City, bears N. 65° W. and S. 60° E.
40.00	Set a locust post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
44.20	Telegraph line, bears N. 70° E. and S. 70° W.
48.50	Spring branch, 2 lks. wide, course S.E.; flows from a spring of pure water, 3 ft. diam., 2 ft. deep, which bears N. 63° W., 4.00 chs. dist.
57.50	Road from Mound City to Lake City, bears N. 60° E. and S. 60° W.
80.00	Set a cedar post, 3 ft. long, 4 ins. sq., with marked stone, 24 ins. in the ground, for cor. of secs. 22, 23, 26, and 27, marked T. 15 N., S. 23 on N.E., R. 20 E., S. 26 on S.E., S. 27 on S.W., and S. 22 on N.W. faces; with 2 notches on S. and E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level.
	Soil, sandy loam; 1st and 2nd rate.
	No timber.

	S. 89° 58′ E., on a random line bet. secs. 23 and 26.
40.00	Set temp. ¼ sec. cor.
80.01	Intersect N. and S. line, 5 lks. N. of cor. of secs. 23, 24, 25, and 26.
	Thence I run
	N. 89° 56′ W., on a true line bet. secs. 23 and 26.
	Over level land.
40.00½	Deposit a quart of charcoal, 12 ins. in the ground, for ¼ sec. cor.; dig pits, 18×18×12 ins., E. and W. of cor., 4 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, over deposit. In E. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked ¼ S., on N. face.
53.00	Road from Mound City to Lake City, bears N. 50° E. and S. 50° W.; wire fence bears S. 53° E.
80.01	The cor. of secs. 22, 23, 26, and 27.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	Land, level. Soil, sandy loam; 1st and 2nd rate. No timber.
	N. 0° 2′ W., bet. secs. 22 and 23. Over nearly level land.
37.50	Old Military Road, bears N. 65° W. and S. 65° E.
40.00	Set a limestone, 15×8×5 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	Begin ascent of steep slope, over stony ground.
55.00	Top of ascent and edge of table land, 90 ft. above ¼ sec. cor., bears E. and W.; thence, over hard mesa.
80.00	Set a limestone, 16×9×4 ins., 11 ins. in the ground, for cor. of secs. 14, 15, 22, and 23, marked with 3 notches on S. and 2 notches on E. edges; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	Land, level, except ascent of mesa. Soil, sandy loam on first half mile, remainder gravelly and stony; 2d and 4th rate. No timber.
	S. 89° 56′ E., on a random line bet. secs. 14 and 23.
40.00	Set temp. ¼ sec. cor.
79.84	Intersect N. and S. line, 7 lks. N. of cor. of secs. 13, 14, 23, and 24.
	Thence I run N. 89° 53′ W., on a true line bet. secs. 14 and 23. Over level land.
13.00	Begin steep rocky ascent to mesa, bears N. and S..
20.00	Top of ascent and edge of mesa, 80 ft. above sec. cor., bears N. and S.
39.92	Set a sandstone, 14×8×6 ins., 10 ins. in the ground, for ¼ sec. cor. marked ¼ on N. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
79.84	The cor. of secs. 14, 15, 22, and 23.
	Land, nearly all level. Soil, hard and gravelly; 4th rate. No timber.
	N. 0° 2′ W., bet. secs. 14 and 15. Over level mesa.
9.50	Edge of mesa, bears N. 80° E. and S. 80° W.; begin steep descent over rocky ground.
13.00	Foot of descent, 60 ft. below mesa; enter cedar timber, bears E. and W.
18.00	Leave cedar timber, bears E. and W.; begin ascent.
21.70	Top of round butte, 50 ft. high; thence, over level ground.
23.50	Begin descent.
27.00	Foot of descent, enter cedar timber, bears E. and W.
31.50	Leave cedar timber, bears E. and W.
34.50	Wood road, bears N. 65° E. and S. 65° W.
40.00	Deposit a quart of charcoal, 12 ins. in the ground, for ¼ sec. cor.; dig pits, 18×18×12 ins., N. and S. of cor., 4 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, over deposit. In S. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked ¼ S. on W. face.
	Begin steep rocky ascent.
44.00	Top of ascent and edge of mesa, 75 ft. above last ¼ sec. cor., bears N. 70° W. and S. 70° E.
	Thence over hard mesa, gradually ascending.
80.00	Set a limestone, 15×8×5 ins., 10 ins. in the ground, for cor. of secs. 10, 11, 14, and 15, marked with 4 notches on S. and 2 notches on E. edges; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	Land, level and broken.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	Soil, hard and gravelly; 4th rate.
	No timber.
	August 7: At this cor. I set off 16° 14′ N. on the decl. arc; and at 0h 6m p. m., l. m. t., observe the sun on the meridian; the resulting lat. is 45° 48′.
	S. 89° 53′ E., on a random line bet. secs. 11 and 14.
40.00	Set temp. ¼ sec. cor.
80.00	Intersect N. and S. line, 10 lks. N. of the cor. of secs. 11, 12, 13 and 14.
	Thence I run
	N. 89° 49′ W., on a true line bet. secs. 11 and 14.
	Descend rapidly over stony ground and boulders.
7.50	To bench, 110 ft. below sec. cor.; thence, over level bench, bears N. and S.
9.60	Begin steep descent to cañon, bears N. and S.
14.50	Foot of descent, 140 ft. below sec. cor.; dry bed of stream in cañon, 15 lks. wide, water in holes, course S.
16.00	Begin precipitous ascent to mesa.
19.50	Top of ascent and edge of mesa, 190 ft. above bottom of cañon, bears N. and S.; thence, over hard, level ground.
40.04	Set a limestone, 15×8×6 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ S. on N. face; and raise a mound of stone 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
80.08	The cor. of secs. 10, 11, 14, and 15.
	Land, mountainous and level.
	Soil, boulders and hard gravel; 4th rate.
	No timber.
	Mountainous land, 19.50 chs.
	N. 0° 2′ W., bet. secs. 10 and 11.
	Over gradually ascending ground.
28.00	Ravine, 18 ft. deep, course S. 30° E.
30.50	Begin ascent over stony ground, bears E. and W.
40.00	Set a granite stone, 16×6×6 ins., 11 ins. in the ground, for ¼ sec. cor. marked ¼ on W. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	This ¼ sec. cor. stands on S. slope of ridge, 50 ft. above the sec. cor.
42.00	Top of sharp rocky ridge, 20 ft. above the ¼ sec. cor., bears N. 75° E. and S. 75° W.
43.50	Begin descent.
48.50	Foot of descent, 25 ft. below top of ridge, bears E. and W.; thence, ascend along S. E. slope of spur.
53.00	Enter heavy oak and pine timber, bears E. and W.
60.00	A point, 200 ft. above ¼ sec. cor.; thence, descend into ravine, 50 ft. deep, course S. 35° E.; ascend very steep slope to
80.00	A pine, 27 ins. diam., for cor. of secs. 2, 3, 10 and 11, I mark T. 15 N., S. 12 on N. E., R. 20 E., S. 11 on S. E., S. 10 on S. W., and S. 3 on N. W. sides; with 5 notches on S. and 2 notches on E. sides; from which An oak, 12 ins. diam., bears N. 22° E., 17 lks. dist., marked T. 15 N., R. 20 E., S. 2, B. T. A pine, 14 ins. diam., bears S. 65½° E., 21 lks. dist., marked T. 15 N., R. 20 E., S. 11, B. T. A pine, 15 ins. diam., bears S. 41½° W., 27 lks. dist., marked T. 15 N., R. 20 E., S. 10, B. T. An oak, 14 ins. diam., bears N. 48¼° W., 23 lks. dist., marked T. 15 N., R. 20 E., S. 3, B. T.
	This cor. stands on a S. E. spur of the Little Snowy Mountains, 560 ft. above cor. of secs. 10, 11, 14, and 15.
	Land, mountainous.
	Soil, stony; 4th rate.
	Timber, oak and pine.
	Mountainous or heavily timbered land, 59.50 chs.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	S. 89° 49′ E., on a random line bet. secs. 2 and 11.
40.00	Set temp. ¼ sec. cor.
80.17	Intersect N. and S. line, 23 lks. S. of the cor. of secs. 1, 2, 11, and 12.
	Thence I run
	N. 89° 59′ W., on a true line bet. secs. 2 and 11.
	Over rolling land.
19.00	Enter heavy oak timber, bears N. 10° E. and S. 10° W.
19.90	Branch, 4 lks. wide, course S. 60° E.
26.00	Begin ascent of mountain spur, bears about S. 20° W.
40.08½	Top of spur, 80 ft. above sec. cor.
	Set a cedar post, 3 ft. long, 3 ins. sq., 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on N. face; from which
	An oak, 11 ins. diam., bears S. 54½° E., 24 lks. dist., marked ¼ S. B. T.
	A pine, 13 ins. diam., bears S. 36½° E., 18 lks. dist., marked ¼ S. B. T.
	Thence along south side of spur.
57.00	Leave heavy oak timber, bears N. and S.; descend abruptly.
61.00	Bottom of ravine, 40 ft. deep, course S. 60° E.; ascend very steep rocky slope.
71.00	Enter heavy pine timber, bears N. E. and S. W.
80.17	The cor. of secs. 2, 3, 10, and 11.
	Land, mountainous.
	Soil, rocky; 4th rate.
	Timber, oak and pine.
	Mountainous or heavily timbered land, 61.00 chs.

	N. 0° 2′ W., on a random line, bet. secs. 2 and 3.
40.00	Set temp. ¼ sec. cor.
80.15	Intersect N. bdy. of the Tp. 5 lks. W. of the cor. of secs. 2, 3, 34, and 35, which is a granite stone, 5×8×5 ins. above ground, marked and witnessed as described by the surveyor general.
	August 7: At 5ʰ 60ᵐ p. m., l. m. t., I set off 16° 11′ N., on the decl. arc; 45° 50′, on the lat. arc; and determine a true meridian with the solar, at the cor. of secs 2, 3, 34, and 35.
	Thence I run
	South, on a true line bet. secs. 2 and 3.
	Over rolling ground on the summit of the southern end of the Little Snowy Mountains, 1,200 ft. high.
5.00	Begin descent of eastern slope of mountain.
30.00	Head of ravine, 200 ft. below sec. cor., course S. 60° E.; thence, over broken ground.
40.15	Set a lava stone, 17×8×5 ins., 12 ins. in the ground, for ¼ sec. cor. marked ¼ on W. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
45.00	Enter heavy pine timber; bears E. and W.; descend rapidly.
54.00	Head of ravine, 170 ft. below ¼ sec. cor., course S. E.; thence ascend over rough stony ridges.
80.15	The cor. of secs. 2, 3, 10, and 11.
	Land, mountainous.
	Soil, rocky; 4th rate.
	Timber, pine and oak.
	Mountainous or heavily timbered land, 80.15 chs.
	August 7, 1893.

	From the cor. of secs. 3, 4, 33 and 34, on S. bdy. of the Tp., which is a cedar post, 4 ins. sq., 12 ins. high, marked and witnessed as described by the surveyor general, I run
	N. 0° 3′ W., bet. secs. 33 and 34.
	Over level land.
2.00	Creek, 14 lks. wide, good water, course S. 65° E.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist., and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
45.50	Branch, 8 lks. wide, pure water, course N. 60° E.; enter meadow land.
60.00	Leave meadow land, bears E. and W.
80.00	Deposit a quart of charcoal, 12 ins. in the ground, for cor. of secs. 27, 28, 33, and 34; dig pits, 18×18×12 ins., in each sec., 4 ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, over deposit. In S. E. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked T. 15 N., S. 27 on N.E., R. 20 E., S. 34 on S.E., S. 33 on S.W., and S. 28 on N. W. faces; with 1 notch on S. and 3 notches on E. edges.
	Land, level.
	Soil, rich loam; 1st rate.
	No timber.
	S. 89° 57′ E., on a random line bet. secs. 27 and 34.
40.00	Set temp. ¼ sec. cor.
79.87	Intersect N. and S. line, 3 lks. S. of the cor. of secs. 26, 27, 34, and 35.
	Thence I run
	N. 89° 58′ W., on a random line bet. secs. 27 and 34.
	Over level land.
39.93½	Set a limestone, 20×7×5 ins., 15 ins. in the ground, for ¼ sec. cor., marked ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
79.87	The cor. of secs. 27, 28, 33 and 34.
	Land, level.
	Soil, sandy loam; 1st rate.
	No timber.
	N. 0° 3′ W., bet. secs. 27 and 28.
	Over level land.
1.70	Branch, 7 lks. wide, good water, course S. W.
3.30	Same branch, 7 lks. wide, course E.
27.40	Telegraph line, bears E. and W.
30.00	Road from Mound City to Lake City, bears N. 73° W. and S. 73° E.
32.00	Road from Mound City to Lake City, bears E. and W.
40.00	Set a locust post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
80.00	Set an oak post, 3 ft. long, 4 ins. sq., with charred stake, 24 ins. in the ground, for cor. of secs. 21, 22, 27 and 28, marked T. 15 N., S. 22 on N. E., R. 20 E., S. 27 on S. E., S. 28 on S. W., and S. 21 on N. W. faces; with 2 notches on S. and 3 notches on E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level.
	Soil, sandy loam; 1st rate.
	No timber.
	S. 89° 58′ E., on a random line bet. secs. 22 and 27.
40.00	Set temp. ¼ sec. cor.
79.89	Intersect N. and S. line, 2 lks. S. of cor. of secs. 22, 23, 26 and 27.
	Thence I run
	N. 89° 59′ W., on a true line bet. secs. 22 and 27.
	Over level land.
39.94½	Set a limestone, 15×8×5 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
79.89	The cor. of secs. 21, 22, 27, and 28.
	Land, level.
	Soil, sandy loam; 1st rate.
	No timber.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	N. 0° 3′ W., bet. secs. 21 and 22.
	Over level land.
13.90	To the margin of an impassable swamp, bears E. and W.
	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for witness point, marked W. P., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	To pass the swamp I offset as follows:
	East, 18.00 chs.
	N. 0° 3′ W., 26.10 chs.
	West, 5.00 chs. to a point on margin of swamp * 13.00 chs. E. of
40.00	The point for ¼ sec. cor., in swamp.
	N. 0° 3′ W., 19.00 chs.
	West, 13.00 chs. to a point on line bet. secs. 21 and 22; thence, S. 0° 3′ E., 5.40 chs., to
53.60	North side of impassable swamp, on line.
	Set a juniper post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for witness cor. to ¼ sec. cor., marked W. C., ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	Thence, N. 0° 3′ W., 26.40 chs., to the point for sec. cor., which falls in Old Military Road, bears N. 55° W, and S. 55° E. Therefore at
79.40	Set a juniper post, 3 ft. long, 4 ins. sq., with marked stone, 24 ins. in the ground, for witness cor. to cor. of secs. 15, 16, 21 and 22, marked
	W. C., T. 15 N., S. 15 on N. E.,
	R. 20 E., S. 22 on S. E.,
	S. 21 on S. W., and
	S. 16 on N. W. faces; with 3 notches on S. and E. edges; dig pits, 18×18×12 ins., N. E., S. E., S. W., and N. W. of cor., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
80.00	Deposit a quart of charcoal, 24 ins. in the ground, for cor. of secs. 15, 16, 21 and 22.
	Land, level.
	Soil, rich loam; 1st rate.
	No timber.

	S. 89° 59′ E., on a random line bet. secs. 15 and 22.
40.00	Set temp. ¼ sec. cor.
79.97	Intersect N. and S. line 12 lks. N. of the cor. of secs. 14, 15, 22 and 23.
	Thence I run
	N. 89° 54′ W., on a true line bet. secs. 15 and 22.
	Over hard level mesa.
11.50	To edge of mesa, bears N. and S.; begin descent over stony ground.
16.00	Foot of descent, 60 ft. below mesa, bears N. and S.
17.50	Wood road, bears N. and S.
39.98½	Set a limestone, 15×8×5 ins., 10 ins. in the ground, for ¼ sec. cor. marked ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
79.97	The cor. of secs. 15, 16, 21 and 22.
	Land, level; except descent from mesa.
	Soil, loam and stony; 2nd and 4th rate.
	No timber.

	N. 0° 3′ W., bet. secs. 15 and 16.
	Over level land.
0.60	Deposit a marked stone, 12 ins. in the ground, for witness cor. to cor. of secs. 15, 16, 21 and 22; dig pits, 18×18×12 ins., N. E., S. E., S. W., and N. W. of cor., 4 ft. dist.; and raise a mound of earth, 4 ft. base, 2

* A *Witness Corner* to the ¼ sec. cor. would be established at this point, in case no witness corner could be placed *on line* within 20.00 chs. of the ¼ sec. cor.

Chains.	
	ft. high, over deposit. In S. E. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked W. C., T. 15 N., S. 15 on N. E. R. 20 E., S. 22 on S. E., S. 21 on S. W., and S. 16 on N. W. faces; with 3 notches on S. and E. edges.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
45.00	William Wells' house, bears W., 6.00 chs. dist.
46.00	East end of a clear water pond, bears W. about 11.00 chs.; its shores extend N. and W.
80.00	Set a limestone, 18×18×12 ins., 12 ins. in the ground, for cor. of secs. 9, 10, 15 and 16, marked with 4 notches on S. and 3 notches on E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level.
	Soil, loam; 1st and 2nd rate.
	No timber.
	August 10: At this cor., I set off 15° 22′ N., on the decl. arc; and, at 0^h 5^m p. m., l. m. t., observe the sun on the meridian; the resulting lat. is 45° 48′, which is about 0′.5 less than the proper lat.
	S. 89° 54′ E., on a random line bet. secs. 10 and 15.
40.00	Set temp. ¼ sec. cor.
79.95	Intersect N. and S. line 12 lks. S. of the cor. of secs. 10, 11, 14 and 15.
	Thence I run
	N. 89° 59′ W., on a random line bet. secs. 10 and 15.
	Over hard level mesa.
23.00	Begin descent from mesa, bears N. and S.
28.00	Foot of descent from mesa, bears N. W. and S. E.
39.97½	Set a limestone, 15×8×8 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
79.95	The cor. of secs. 9, 10, 15 and 16.
	Land, level.
	Soil, loam and hard clay and gravel; 1st and 4th rate.
	No timber.
	N.° 3′ W., bet. secs. 9 and 10.
	Over gently rolling land.
4.50	Enter heavy pine timber, bears N. 55° E. and N. 80° W.
22.00	Begin ascent of spur, bears N. E. and S. W.
39.00	Leave heavy timber, bears N. W. and N. 25° E.
40.00	Top of ridge, 60 ft. above sec. cor., descends towards the S. W.
	Set a granite stone, 15×8×7 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	Thence, along W. slope of spur, over ravines and rough stony ground.
60.00	Enter heavy pine timber.
72.00	Ravine, 40 ft. deep, course W.; thence up steep ascent.
80.00	A pine, 12 ins. diam., for cor. of secs. 3, 4, 9 and 10, I mark T. 15 N., S. 3 on N. E., R. 20 E., S. 10 on S. E., S. 9 on S. W., and S. 4 on N. W. sides; with 5 notches on S. and 3 notches on E. sides; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth around tree.
	This cor. stands about 300 ft. above the general level of the surrounding country.
	Land, rolling and mountainous.
	Soil, gravelly loam and rocky; 3rd and 4th rate.
	Timber, pine, with some oak.
	Mountainous or heavily timbered land, 58 00 chains.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	S. 89° 59′ E., on a random line bet. secs. 3 and 10.
40.00	Set temp. ¼ sec. cor.
80.23	Intersect N. and S. line at the cor. of secs. 2, 3, 10, and 11.
	Thence I run
	N. 89° 59′ W., on a true line bet. secs. 3 and 10.
	Ascend over rough ground, through heavy timber.
4.00	Leave heavy timber, bears N. E. and S. W.
15.00	A point about 600 ft. above base of mountain; descend.
18.00	Enter scattering timber, bears N. and S. W.
23.00	Leave scattering timber, bears N. E. and S. W.
40.11½	Set a granite stone, 15×8×5 ins., 10 ins. in the ground for ¼ sec. cor. marked ¼ on N. face; and raise a mound of stone, 2½ ft. base, 1½ ft. high, N. of cor.
52.00	Ravine, 40 ft. below ¼ sec. cor., course S. 60° W.; thence ascend over spur.
60.50	Enter heavy pine timber, bears N. and S.
80.23	The cor. of secs. 3, 4, 9, and 10.
	Land, mountainous.
	Soil, stony; 4th rate.
	Timber, pine.
	Mountainous or heavily timbered land, 80.23 chs..

	N. 0° 3′ W., on a random line bet. secs. 3 and 4.
40.00	Set temp. ¼ sec. cor.
80.19	Intersect N. bdy. of the Tp. 2 lks. E. of cor. of secs. 3, 4, 33, and 34, which is a granite stone, 6×8×4 ins. above ground, marked and witnessed as described by the surveyor general.
	August 10: At 5h 5m p. m., l. m. t., I set off 45° 50′ on the lat. arc; 15° 19′ N., on the decl. arc; and determine a true meridian with the solar, at the cor. of secs. 3, 4, 33, and 34.
	Thence I run
	S. 0° 4′ E., on a true line bet. secs. 3 and 4.
	Ascend spur extending west.
7.00	Top of spur, 20 ft. above sec. cor., bears E. and W.; descend.
18.00	Ravine, 20 ft. below top of ridge, course N. 85° W.; ascend spur.
27.00	Top of spur, 25 ft. above ravine, bears E. and W.; descend.
36.00	Ravine, 30 ft. below top of ridge, course N. 75° W.; ascend.
37.50	Enter heavy pine timber.
40.19	An oak, 9 ins. diam., for ¼ sec. cor., I mark ¼ S., on W. side; from which A pine, 8 ins. diam., bears S. 14° E., 20 lks. dist., marked ¼ S. B. T. An oak, 10 ins. diam., bears S. 75½° W., 19 lks. dist., marked ¼ S. B. T.
47.00	Top of spur, 65 ft. above ravine, bears N. 70° W. and S. 70° E.; descend.
51.00	Leave heavy pine timber, bears N. 70° W. and S. 70° E.
58.00	Foot of descent, 20 ft. below top of ridge, bears N. 85° W. and S. 85° E.; ascend.
63.00	Enter heavy pine timber, bears N. W. and E.
65.00	Top of ridge, 150 ft. above foot of spur, bears E. and W.; descend.
67.50	Leave heavy pine timber, bears N. 60° W. and S. 60° E; thence over broken, stony ground.
74.00	Begin ascent.
80.19	The cor. of secs. 3, 4, 9 and 10.
	Land, mountainous.
	Soil, stony; 4th rate.
	Timber, pine with some oak.
	Mountainous or heavily timbered land, 80.19 chs.

August 10, 1893.

This 11th day of August, 1893, I discharge James Banner and employ Edward Ensign, to perform the duties of flagman. No officer authorized to administer oaths, other than myself, being available, without great inconvenience, delay, and expense, I administer the required preliminary and final oaths.

ROBERT ACRES,
U. S. Deputy Surveyor.

Chains.	
	NOTE.—Clear Lake, a body of deep water, more than 25 acres in extent, not drainable or likely to dry up, situated about the middle of sec. 33, I prepare to meander, as follows:
	The sky is overcast and solar observations are impossible.
	I find the ¼ sec. cor. on S. bdy. of sec. 33, which is a limestone 5×8×5 ins., above ground, marked and witnessed as described by the surveyor general, on line with the section corners which are visible from said ¼ sec. cor.; therefore, from a sight on the S. W. cor. of sec. 33, I turn off an angle of 89° 53′ to the north, and run
	N. 0° 3′ W., bet. the E. and W. halves of sec. 33.
	Over level land.
17.80	Enter scattering timber, bears E. and W.
20.42	To bank of Clear Lake.
	Set a cedar post, 3 ft. long, 3 ins. sq., 24 ins. in the ground, for *special* meander cor. of fracl. E. and W. halves of sec. 33, marked
	S. M. C. on N.,
	T. 15 N. on S.,
	R. 20 E., S. 33 on E., and
	S. 23 on W. faces; from which
	A maple, 8 ins. diam., bears S. 21½° E., 15 lks. dist., marked T. 15 N., R. 20 E., S. 33, S. M. C. B. T.
	An ash, 12 ins. diam., bears S. 72¼° W., 21 lks. dist., marked T. 15 N., R. 20 E. S., 33, S. M. C. B. T.
	Land, level.
	Soil, rich loam; 1st rate.
	Timber, oak, ash, and maple.
	NOTE.—At 9 a. m., heavy rain prevents further work this day.
	August 11, 1893.

	August 12: At 7h 5m a. m., l. m. t., I set off 45° 45′ on the lat. arc; 14° 51′ N., on the decl. arc.; and determine a true meridian with the solar at the cor. of secs. 4, 5, 32, and 33, on the S. bdy. of the Tp., which is a limestone, 6×6×4 ins., above ground, marked and witnessed as described by the surveyor general.
	N. 0° 4′ W., bet. secs. 32 and 33.
	Over level land.
40.00	Set a juniper post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
59.50	Spring branch, 6 lks. wide, pure water, course S. 40° E.
80.00	Set a locust post, 3 ft. long., 3 ins. sq., with quart of charcoal, 24 ins. in the ground for cor. of secs. 28, 29, 32, and 33, marked
	T. 15 N., S. 28 on N. E.,
	R. 20 E., S. 33 on S. E.,
	S. 32 on S. W., and
	S. 29 on N. W. faces; with 1 notch on S. and 4 notches on E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level.
	Soil, rich loam; 1st rate.
	No timber.

	S. 89° 57′ E., on a random line bet. secs. 28 and 33.
40.00	Set temp. ¼ sec. cor.
79.90	Intersect N. and S. line, 7 lks. S. of cor. of secs. 27, 28, 33, and 44.
	Thence, I run
	West on a true line bet. secs. 28 and 33.
	Over level land.
3.00	Branch, 6 lks. wide, good water, course S. 20° E., flows from N. 60° E.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
40.00	Deposit a quart of charcoal, 12 ins. in the ground, for ¼ sec. cor.; dig pits, 18×18×12 ins., E. and W. of cor., 4 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, over deposit.
	In E. pit drive a cedar stake, 2 ft. long, 2 ins. sq., 12 ins. in the ground, marked ¼ S., on N. face.
43.00	Spring branch, 8 lks. wide, pure water, course S. 30° E.
80.00	The cor. of secs. 28, 29, 32, and 33.
	Land, level.
	Soil, rich loam; 1st rate.
	No timber.
	From the ¼ sec. cor. bet. secs. 28 and 33, I run
	S. 0° 3′ E., bet. the E. and W. halves of sec. 33.
	Over level land.
3.50	Spring branch, 8 lks. wide, pure water, course S. 80° E.
24.00	To bank of Clear Lake.
	Set a limestone, 20×6×6 ins., 15 ins. in the ground, for *special* meander cor. of fracl. E. and W. halves of sec. 33, marked S. M. C; on S. face; dig a pit, 36×36×12 ins., 8 ft. N. of stone; and raise a mound of earth, 4 ft. base, 2 ft. high, N. of cor.
	Land, level.
	Soil, rich loam; 1st rate.
	No timber.
	N. 0° 4′ W., bet. secs. 28 and 29.
	Over level land.
12.50	Begin ascent, bears E. and W.
14.50	Top of ascent and edge of sandy plain, 25 ft. above sec. cor., bears N. E., and W.
40.00	Set a juniper post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground for ¼ sec. cor., marked ¼ S., on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
41.50	Telegraph line, bears N. 70° W. and S. 70° E.
66.20	Road from Mound City to Lake City, bears N. 70° W. and S. 70° E.
50.00	Begin descent, bears S. E. and W.
50.70	Foot of descent, 18 ft. below plain, bears E. and W.
52.00	Spring branch, 4 lks. wide, pure water, course S. 60° E.; flows from spring, 3 ft. diam., 2 ft. deep, which bears N. 60° W., 7.00 chs. dist.
64.00	Begin ascent, bears E. and W.
65.00	Top of ascent of 20 ft., and edge of sandy plain, bears E. and W.
80.00	Set a limestone, 20×7×5 ins., 15 ins. in the ground, for cor. of secs. 20, 21, 28, and 29, marked with 2 notches on S. and 4 notches on E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level.
	Soil, sandy; 3rd and 4th rate.
	No timber.
	East, on a random line bet. secs. 21 and 28.
40.00	Set temp. ¼ sec. cor.
79.96	Intersect N. and S. line, 2 lks. N. of cor. of secs. 21, 22, 27, and 28.
	Thence I run
	N. 89° 59′ W., on a true line bet. secs. 21 and 28.
	Over level land.
2.50	Begin ascent, bears N. and S.
4.50	Top of ascent and edge of sandy plain, 20 ft. above sec. cor., bears N. and S.
39.98	Set an oak post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
79.96	The cor. of secs. 20, 21, 28, and 29. Land, level. Soil, sandy; 4th rate. No timber.
	N. 0° 4′ W., bet. secs. 20 and 21. Over level land.
28.00	Begin descent, bears E. and W.
31.00	Foot of descent, 25 ft. below plain, bears E. and W.
40.00	Set a limestone, 18×6×6 ins., 12 ins. in the ground, for ¼ sec. cor. marked ¼ on W. face; dig pits, 18×18×12 ins., N. and S. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
	August 12: At this ¼ sec. cor., bet. secs. 20 and 21, I set off 14° 46′ N., on the decl. arc; and, at 0h 5m p. m., l. m. t., observe the sun on the meridian; the resulting lat. is 45° 47′, which is about 0′.1 less than the proper lat.
66.00	W. end of a swamp, bears E. about 5.00 chs. dist.
80.00	Set a limestone, 18×8×4 ins., 12 ins. in the ground, for cor. of secs. 16, 17, 20, and 21, marked with 3 notches on S. and 4 notches on E. edges; dig pits, 18×18×12 ins., in each sec. 5½ ft. dist; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor. Land, level. Soil, sandy and rich loam; on plain, 4th rate, remainder 1st rate. No timber. August 12, 1893.
	Heavy rain prevented work until afternoon August 14, 1893. The cor. of secs. 15, 16, 21, and 22, being plainly visible,* I run for said cor. S. 89° 59′ E., on a random line bet. secs. 16 and 21.
12.90	To margin of impassable swamp; set a temp. witness point.† Then offset as follows: North, 9.50 chs.; then, on the *offset line:* S. 89° 59′ E., 40.00 chs.; set temp. witness cor. to ¼ sec. cor.; S. 89° 59′ E., 64.00 chs. (counted from sec. cor.); then, South, 9.50 chs. to the random line, on which, at
79.92	Intersect N. and S. line at cor. of secs. 15, 16, 21, and 22. Thence I run N. 89° 59′ W., on a true line bet. secs. 16 and 21. Over level land.
18.30	To margin of impassable swamp. Set a cedar post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for witness point, marked W. P. on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor. Thence, offset N., 9.50 chs.; then, run on *offset line*, N. 89° 59′ W.
39.96	Set a juniper post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for witness cor. to ¼ sec. cor., marked W. C. ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
67.02	Offset south 9.50 chs., to true line. Set an oak post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for witness point, marked W. P., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor. The swamp can be drained into Lin's Lake.
79.92	The cor. of secs. 16, 17, 20, and 21. Land, level. Soil, rich loam; 1st rate. No timber.

*Wherever this condition obtains, the random will be run and recorded as above stated.
†When offsets are made from random latitudinal section lines, temporary marks will be left for *Witness Points* and *Witness Corners*, as illustrated above.

Chains.	
	N. 0° 4′ W., bet. secs. 16 and 17.
	Over level land.
34.00	S. E. cor. of James Wilkie's field, extends W., 18.00 chs., and along line.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with quart of charcoal, 24 ins. the ground, for ¼ sec. cor., marked ¼ S., on W. face; dig pits 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
46.00	Old Military Road, bears N. 65° W. and S. 65° E.
47.00	Branch, 4 lks. wide, pure water, swift current, course S. 40° W.
	This branch is the outlet of the pond in sec. 16, fed by numerous fine springs in sec. 9.
50.20	Acequia, 8 lks. wide, course N. 86° W. Thence gradually ascending.
80.00	Set a limestone, 21×7×5 ins., 16 ins. in the ground, for cor. of secs. 8, 9, 16, and 17, marked with 4 notches on S. and E. edges; dig pits, 18×18×12 ins., in each sec.. 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, level and rolling.
	Soil, rich loam; 1st rate.
	No timber.

	S. 89° 59′ E., on a random line bet. secs. 9 and 16.
40.00	Set temp. ¼ sec. cor.
79.90	Intersect N. and S. line 9 lks. N. of cor. of secs. 9, 10, 15, and 16.
	Thence I run
	N. 89° 55′ W., on a true line bet. secs. 9 and 16.
	Over rolling land.
31.40	Spring branch, 3 lks. wide, course S.; enters pond about 6.00 chs. S.
39.95	Set a cedar post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
49.20	Spring branch, 3 lks. wide, course S; enters pond about 8.00 chs. S.
	The branches crossing this line are fed by numerous large springs 4.00 to 10.00 chs. N. of the line.
79.90	The cor. of secs. 8, 9, 16, and 17.
	Land, rolling.
	Soil, gravelly loam; 2nd rate.
	No timber.

	N. 0° 4′ W., bet. secs. 8 and 9.
	Over rolling land.
38.00	To S. bank of limestone quarry, bears E. and W. To pass the quarry, I offset 2.00 chs. E., then, N. 0° 4′ W., on the *offset line.*
40.00	The point for ¼ sec. cor. falls in quarry. Continue offset line to 40.60 chs.; then, W., 2.00 chs., to true line.
40.60	Set a limestone, 15×9×5 ins., 10 ins. in the ground, for witness cor. to ¼ sec. cor. marked W. C. ¼ on W. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
66.00	Middle of single track of the Montana and Manitoba Railroad, bears N. 42° E. and S. 42° W.
68.00	Telegraph line, bears N. 42° E. and S. 42° W.
80.00	Set a limestone, 17×9×5 ins., 12 ins. in the ground, for cor. of secs. 4, 5, 8, and 9, marked with 5 notches on S. and 4 notches on E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	From this cor. the U. S. mineral monument in sec. 5 bears N. 59½° W.
	Soil, thin and gravelly, with many limestone outcrops; 3rd and 4th rate.
	No timber.

	August 14: At 4h 30m p. m. l. m. t., I set off 45° 49′ on the lat. arc; 14° 6′ N. on the decl. arc; and determine a true meridian with the solar, at the cor. of secs. 4, 5, 8 and 9.
	Thence I run
	S. 89° 55′ E., on a random line bet. secs. 4 and 9.

Chains.	
40.00	Set temp. ¼ sec. cor.
79.94	Intersect N. and S. line, 5 lks. S. of cor. of secs. 3, 4, 9, and 10.
	Thence I run
	N. 89° 57′ W., on a true line bet. secs. 4 and 9.
	Descend through heavy pine timber.
20.00	Foot of spur, 300 ft. below sec. cor.; leave heavy pine timber, bears N. and S.
39.50	Wood road, bears N. 20° E. and S. 20° W.
39.97	Set a limestone, 18×18×6 ins., 12 ins. in the ground, for ¼ sec. cor., marked ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
68.50	Middle of single track of the Montana and Manitoba Railroad bears N. 38° E. and S. 38° W.
70.20	Telegraph line bears N. 38° E. and S. 38° W.
79.94	The cor. of secs. 4, 5, 8, and 9.
	Land, mountainous.
	Soil, thin and gravelly; 3rd and 4th rate.
	Timber, pine.
	Mountainous or heavily timbered land, 20.00 chs.

	N. 0° 4′ W., on a random line bet. secs. 4 and 5.
40.00	Set temp. ¼ sec. cor.
79.96	Intersect N. bdy. of the Tp. 2 lks. W. of cor. of secs. 4, 5, 32, and 33.
	Thence I run
	S. 0° 3′ E., on a true line bet. secs. 4 and 5.
	Over ridges and ravines; ascend.
4.00	Top of spur, bears E. and W.; descend.
10.00	Ravine 20 ft. deep, course E., ascend.
16.00	Top of spur, 40 ft. above ravine, bears S. 70° E. and N. 70° W.; descend.
27.00	Ravine, 30 ft. deep, course S. 80° E.; ascend.
32.00	Top of spur, bears S. 85° E. and N. 85° W.; descend.
37.00	Ravine, 25 ft. deep, course S. 65° E.; ascend.
39.96	Set a limestone, 15×6×6 ins. 10 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	This cor. stands on the N. E. slope of a spur descending southeasterly; ascend.
50.00	Top of spur, bears E. and W., about 35 ft. above ¼ sec. cor., bears E. and W.; descend.
55.00	Ravine, 20 ft. deep, course N. 55° E.; ascend.
62.00	Top of low spur, bears E. and W.; descend.
74.00	Foot of slope, bears N. 40° E. and S. 65° W.
79.96	The cor. of secs. 4, 5, 8, and 9.
	Land, mountainous.
	Soil, rocky; 4th rate.
	No timber.
	Mountainous land, 74.00 chs.

August 14, 1893.

	August 15: At 7h 35m a. m., l. m. t., I set off 45° 45′ on the lat. arc; 13° 54′ N., on the decl. arc; and determine a true meridian with the solar, at the cor. of secs. 5, 6, 31, and 32; which is a limestone, 5×8×6 ins., above ground, marked and witnessed as described by the surveyor general.
	Thence I run
	N. 0° 5′ W., bet. secs. 31 and 32.
	Over level land.
6.50	Trail, bears E. and W.
	The S. W. cor. of James Parker's Desert Land Claim, which is an oak post, 2 ft. high, 6 ins. sq., marked J. P. D. L. C. 3, bears N. 49½° W.
	The S. E. cor. of the same claim, which is a round pine post, 3 ft. high, 6 ins. diam., marked J. P. D. L. C. 4, bears N. 66° E.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
40.00	Set a locust post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S. on W. face; dig pits, 18×18×12 ins., N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
80.00	Set a limestone, 20×7×5 ins., 15 ins. in the ground, for cor. of secs. 29, 30, 31 and 32, marked with 1 notch on S. and 5 notches on E. edges; dig pits, 18×18×12 ins., in each sec., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	From this cor. the above described S. W. cor. of James Parker's Desert Land Claim bears S. 29¼° W.
	The N. W. cor., which is a post 3 ft. long, 5 ins. sq., marked J. P. D. L. C. 2, bears N. 42° W.
	Land, level.
	Soil, sand; 4th rate.
	No timber.

	S. 89° 57′ E., on a random line bet. secs. 29 and 32.
40.00	Set temp. ¼ sec. cor.
79.97	Intersect N. and S. line 7 lks. N. of cor. of secs. 28, 29, 32 and 33.
	Thence I run
	N. 89° 54′ W., on a true line bet. secs. 29 and 32.
	Over level land.
14.50	Begin ascent, bears N. and S.
16.50	Top of ascent and edge of sandy plain, bears N. and S.
28.50	A fine spring of good water, 3 ft. diam., 1 ft. deep, bears S., 2.50 chs. dist.
	The N. E. cor. of James Parker's Desert Land Claim, a mound of stone, without marks, bears N. 2¾° E.
39.98½	Set a sandstone, 18×6×5 ins., 12 ins. in the ground, for ¼ sec. cor., marked ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ base, 1½ ft. high, N. of cor.
	From this ¼ sec. cor. the above described S. E. cor. of James Parker's Desert Land Claim bears S. 11½° E.
79.97	The cor. of secs. 29, 30, 31, and 32.
	Land, level.
	Soil, sand; 4th rate.
	No timber.

	The cor. of secs. 25, 30, 31, and 36, on the W. bdy. of the Tp. being plainly visible, I run for said cor.
	N. 89° 57′ W., on a random line bet. secs. 30 and 31.
40.00	Set temp. ¼ sec. cor.
78.35	Intersect the W. bdy. of the Tp. at the cor. of secs. 25, 30, 31, and 32, which is a mound of earth, with stake and pit, marked and witnessed as described by the surveyor general.
	Thence I run
	S. 89° 57′ E., on a true line bet. secs. 30 and 31.
	Over level land.
38.35	Set a juniper post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground for ¼ sec. cor., marked ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
	From this ¼ sec. cor., the N. W. cor. of James Parker's Desert Land Claim bears N. 23° E.
78.35	The cor. of secs. 29, 30, 31, and 32.
	Land, level.
	Soil, sand; 4th rate.
	No timber.
	August 15: At this corner, I set off 13° 50′ N., on the decl. arc; and at 0^h 4^m p. m., l. m. t., observe the sun on the meridian; the resulting lat. is 45° 46′.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
	N. 0° 5′ W., bet. secs. 29 and 30.
	Over level land.
40.00	Deposit a marked stone, 12 ins. in the ground, for ¼ sec. cor.; dig pits, 18×18×12 ins.; N. and S. of cor., 4 ft dist; and raise a mound of earth, 3½ ft. base 1½ ft. high, over deposit. In S. pit drive a cedar stake, 2 ft. long, 2 ins. sq., marked ¼ S., on W. face.
	From this ¼ sec. cor. the N. E. cor. of James Parker's Desert Land Claim bears S. 80° E.
56.00	Telegraph line, bears E. and W.
59.00	Road leading to Lake City and Mound City, bears E. and W.
76.50	Begin descent over rocky ground, bears E. and W.
80.00	Set a sandstone, 15×8×6 ins., 10 ins. in the ground, for cor. of secs. 19, 20, 29, and 30, marked with 2 notches on S. and 5 notches on E. edges; and raise a mound of stone, 2 ft. base, 1½ ft. high, W. of cor. Pits impracticable.
	This cor. stands on stony ground sloping N., about 25 ft. below level of the plain.
	S. 89° 54′ E., on a random line bet. secs. 20 and 29.
40.00	Set temp. ¼ sec. cor.
79.93	Intersect N. and S. line at cor. of secs. 20, 21, 28, and 29.
	Thence I run
	N. 89° 54′ W., on a true line bet. secs. 20 and 29.
	Over level land.
16.50	Telegraph line, bears N. and S.
21.00	Road leading to Lake City, bears N. and S.
39.96½	Set a cedar post, 3 feet long, 3 ins. sq., with quart of charcoal, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post 3 ft. dist. and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
63.00	Begin descent from plain, bears N. and S.
66.00	Foot of descent, 35 ft. below plain, bears N. and S.; thence over broken ground to
79.93	The cor. of secs. 19, 20, 29 and 30.
	Land, level.
	Soil, sand and stony; 4th rate.
	No timber.
	N. 89° 57′ W., on a random line bet. secs. 19 and 30.
	Over rough stony ground.
40.00	Set temp. ¼ sec. cor.
78.21	Intersect W. bdy. of the Tp. 3 lks. N. of the cor. of secs. 19, 24, 25, and 30, which is a juniper post, 18 ins. above ground, 4 ins. sq., marked and witnessed as described by the surveyor general.
	Thence I run
	S. 89° 58′ E., on a true line bet. secs 19 and 30.
	Over level land.
38.21	Set a maple post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
72.21	Begin ascent, over stony ground.
78.21	The cor. of secs. 19, 20, 29, and 30.
	Land, level.
	Soil, sandy loam; 3rd and 4th rate.
	No timber.
	N. 0° 5′ W., bet. secs. 19 and 20.
	Descend over stony ground.
2.00	Foot of descent, 10 ft. below sec. cor., and 35 ft. below the sandy plain, bears E. and W. Thence gradual descent toward Lin's Lake.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
32.50	Enter scattering timber, bears E. and W.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on W. face; from which A maple, 22 ins. diam., bears N. 22° W., 19 lks. dist., marked ¼ S., B. T. An ash, 13 ins. diam., bears N. 70½° E., 28 lks. dist., marked ¼ S., B. T.
44.50	To bank of Lin's Lake. Set a cedar post, 3 ft. long, 4 ins. sq., 24 ins. in the ground, for meander cor. of fracl. secs. 19 and 20, marked M. C. on N., T. 15 N. on S., R. 20 E., S. 20 on E., and S. 19 on W. faces; from which A maple, 8 ins. diam., bears S. 22½° E., 21 lks. dist., marked T. 15 N., R. 20 E., S. 20, M. C. B. T. An ash, 12 ins. diam., bears S. 56¼° W., 27 lks. dist., marked T. 15 N., R. 20 E., S. 19, M. C. B. T. Land, gently rolling. Soil, mostly rich loam; 1st rate. Timber, maple, ash and oak. August 15, 1893.

August 16: At 7h. 4m. a.m., l. m. t., I set off 45° 48′ on the lat. arc; 13° 36′ N., on the decl. arc; and determine a true meridian at the cor. of secs. 16, 17, 20 and 21, described on page 203; thence I run
N. 89° 57′ W., on a true line*, bet. secs. 17 and 20.
Over gently rolling land, descending toward Lin's Lake.

16.40	Telegraph Line, bears N. and S.
20.50	Road to Lake City, bears N. and S.
30.00	Irrigating ditch, 8 lks. wide, course S. 60° W. Enter field cultivated by irrigation; extends N., 5.00 chs., and S. about 10.00 chs.
36.50	Leave field, enter scattering timber, bears N. 65° E. and S. 65° W.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., 24 ins. in the ground, for ¼ sec. cor., marked ¼ S., on N. face; from which A sycamore, 22 ins. diam., bears N. 22° W., 19 lks. dist., marked ¼ S., B. T. An ash, 13 ins. diam., bears S. 70½° W., 28 lks. dist., marked ¼ S., B. T.
43.20	To bank of Lin's Lake. A sycamore, 18 ins. diam., for meander cor. of fracl. secs. 17 and 20, I mark M. C. on W., T. 15 N. on E., R. 20 E., S. 17 on N., and S. 20 on S. sides; from which An ash, 10 ins. diam., bears N. 40¾° E., 20 lks. dist., marked T. 15 N., R. 20 E., S. 17, M. C. B. T. A maple, 9 ins. diam., bears S. 49½° E., 23 lks. dist., marked T. 15 N., R. 20 E., S. 20, M. C. B. T. Land, gently rolling. Soil, rich loam; 1st rate. Timber, ash, maple, and sycamore.

From the cor. of secs. 8, 9, 16, and 17, described on page 204, I run
N. 89° 57′ W., on a true line*, bet. secs. 8 and 17.
Over rolling land.

39.20	Telegraph line, bears N. 28° W. and S. 28° E.
40.00	Set a cedar post, 3 ft. long, 3 ins. sq., with charred stake, 24 ins. in the ground, for ¼ sec. cor., marked ¼ S., on N. face; dig pits, 18×18×12 ins., E. and W. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.

* See paragraph 8, page 55.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
55.00	Old Military Road, bears N. W. and S. E. The road branches abont 2.00 chs. S. E.
60.00	Enter road, leading to Lake City, bears W.; thence, along middle of road.
61.00	Middle of single track of the Montana and Manitoba Railroad, bears N. 60° E. and S. 60° W.
63.50	Telegraph line, bears N. 60° E. and S. 60° W.
80.00	The point for sec. cor. falls in the road; therefore
	Deposit a marked stone, 24 ins. in the ground, for cor. of secs. 7, 8, 17 and 18.
	Land, rolling.
	Soil, sandy loam; 3rd rate.
	No timber.
	From the cor. for secs. 7, 8, 17 and 18, which falls in road, I run
	S. 0° 5′ E., bet. secs. 17 and 18.
	Over rolling land; descending towards Lin's Lake.
0.50	Set a limestone,* 15×8×7 ins., 10 ins. in the ground, for witness cor. to cor. of secs. 7, 8, 17 and 18, marked W. C., on N. E. face; with 4 notches on S. and 5 notches on E. edges; dig pits, 18×18×12 ins., N. E., S. E., S. W., and N. W. of cor., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
4.00	Telegraph line, bears N. 84° E. and S. 84° W.
5.20	Middle of the single track of the Montana and Manitoba Railroad, bears N. 84° and S. 84° W.
20.19	To bank of Lin's Lake.
	Set a limestone, 15×9×6 ins., 10 ins. in the ground, for meander cor. of fracl. secs. 17 and 18, marked M. C. on S. face, with 5 grooves on E. face; and raise a mound of stone, 2 ft. base, 1½ ft. high, N. of cor. Pits impracticable.
	Limestone outcrops near the lake.
	Land, rolling.
	Soil, rocky; 4th rate.
	No timber.
	August 16: At this meander cor. I set off 13° 31′ N. on the decl. arc; and at $0^h\ 4^m$ p. m., l. m. t., observe the sun on the meridian; the resulting lat. is 45° 48′.
	From the cor. of secs. 7, 8, 17 and 18, established this day, I run
	N. 89° 57′ W., on a random line bet. secs. 7 and 18.
40.00	Set temp. ¼ sec. cor.
77.90	Intersect W. bdy. of the Tp., 3 lks. S. of the cor. of secs. 7, 12, 13, and 18, which is a limestone, 6×8×6 ins. above ground, marked and witnessed as described by the surveyor general.
	Thence I run
	S. 89° 56′ E., on a true line bet. secs. 7 and 18.
	Over gently rolling ground.
17.90	Intersect the W. bdy. of Lake City.
	The N. W. cor., which is an oak post, 2 ft. above ground, 12 ins. sq., marked N. W. cor. L. C., bears N. 0° 5′ W., 40.00 chs. dist. The S. W. cor., which is a limestone, 8×6×6 ins., above ground, marked S. W. cor. L. C., bears S. 0° 5′ E., 29.50 chs. dist.
	Methodist church bears S. 33° E.
18.20	Middle of West street, 40 ft. wide, bears N. 0° 5′ W. and S. 0° 5′ E.
	Thence along middle of Fourth street, 60 ft. wide.
23.70	Middle of Cedar street, 60 ft. wide, bears N. 0° 5′ W. and S. 0° 5′ E.
27.00	Baptist church bears N., 3.00 chs. dist.
29.20	Middle of Pine street, 60 ft. wide, bears N. 0° 5′ W. and S. 0° 5′ E. Methodist church bears S. 43° W.
35.00	Middle of Main street, 100 ft. wide, bears N. 0° 5′ W. and S. 0° 5′ E. Court house bears N. 4° W., 22.00 chs. dist. Wharf bears S. 0° 5′ E. 16.50 chs. dist. Catholic church bears N. 39° E.

*A *Witness Corner* to a section corner will always have the letters "W. C." *conspicuously* displayed on the northeast face.

Chains.	
37.90	Deposit a limestone, 12×8×6 ins., 24 ins. in the ground, for ¼ sec. cor., marked ×¼; from which A granite stone, 16×8×7 ins., set 11 ins. in the ground, marked W. C. ¼, on N. face, bears N., 45 lks. dist. A granite stone 20×9×6 ins., set 15 ins. in the ground, marked W. C. ¼, on N. face, bears S., 45 lks. dist. Pits impracticable.
	No natural bearing objects available.
40.80	Middle of Elm street, 60 ft. wide, bears N. 0° 5′ W. and S. 0° 5′ E.
46.30	Middle of Walnut street, 60 ft. wide, bears N. 0° 5′ W., and S. 0° 5′ E.
	Railroad station bears S. 14° E., 6.00 chs. dist.
51.80	Middle of East street, 40 ft. wide, bears N. 0° 5′ W. and S. 0° 5′ E. Catholic church bears N. 21° W.
52.10	Intersect E. bdy. of Lake City. The N. E. cor., which is a limestone, 14×9×7 ins. above ground, marked N. E. cor. L. C., bears N. 0° 5′ W., 40.00 chs. dist. The S. W. cor., which is a limestone, 9×6×6 ins. above ground, S. W. cor. L. C., bears S. 0° 5′ E., 7.53 chs. dist.
	Thence along the middle of the Mound City road.
77.90	The cor. of secs. 7, 8, 17, and 18.
	Land, gently rolling.
	Soil, sandy loam; 1st rate.
	No timber.

August 16, 1893.

August 17: At 7h 4m a. m., l. m. t., I set off 45° 49′ on the lat. arc; 13° 17′ N., on the decl. arc; and determine a true meridian with the solar, at the point for cor. of secs. 7, 8, 17 and 18, which falls in the road, and is described on page 209.

Thence I run

N. 0° 5′ W., bet. secs. 7 and 8.

Over rolling land.

0.50	Set a limestone* 15×8×7 ins., 10 ins. in the ground, for witness cor. to cor. of secs. 7, 8, 17 and 18, marked W. C., on N. E. face; with 4 notches on S. and 5 notches on E. edges; dig pits, 18×18×12 ins., N. E., S. E., S. W., and N. W. of cor., 5½ ft. dist.; and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
28.00	Road to Lake City, bears N. 75° W. and S. 75° E.
32.00	Old Military Road, bears N. 35° W. and S. 35° E.
40.00	Set a juniper post, 3 ft. long, 3 ins. sq., with marked stone, 24 ins. in the ground, for ¼ sec. cor. marked ¼ S., on W. face; dig pits, 18×18×12 ins. N. and S. of post, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
67.50	S. E. cor. of cemetery bears W., 5.00 chs. dist.
75.50	N. E. cor. of cemetery, bears W., 5.00 chs. dist.
80.00	Set a limestone, 20×8×4 ins., 15 ins. in the ground, for cor. of secs. 5, 6, 7, and 8, marked with 5 notches on S. and E. edges; dug pits, 18×18×12 ins., in each sec., 5¼ ft. dist., and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor.
	Land, rolling.
	Soil, gravelly loam; 2nd and 3rd rate.
	No timber.

S. 89° 57′ E., on a random line bet. secs. 5 and 8.

40.00	Set temp. ¼ sec. cor.
79.96	Intersect N. and S. line 3 lks. S. of the cor. of secs. 4, 5, 8 and 9.

Thence I run

N. 89° 58′ W., on a true line bet. secs. 5 and 8.

Over rolling land.

12.00	Begin ascent, bears N. E. and S. W.
25.00	Top of spur, bears N. and S.; descend.
35.00	Foot of descent, bears N. 35° W. and S. 35° E.

*See page 48 and footnote.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
39.98	Set a limestone, 14×8×6 ins., 10 ins. in the ground, for ¼ sec. cor. marked ¼ on N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
	From this ¼ sec. cor. the U. S. mineral monument in sec. 5 bears N. 37° 30′ E.
64.00	Road, bears N. and S.
79.96	The cor. of secs. 5, 6, 7, and 8.
	Land, rolling.
	Soil, gravelly loam; 2nd and 3rd rate.
	No timber.

N. 89° 56′ W., on a random line bet. secs. 6 and 7.

40.00	Set temp. ¼ sec. cor.
77.87	Intersect W. bdy. of the Tp. 9 lks. S. of the cor. of secs. 1, 6, 7, and 12, which is a limestone, 6×8×6 ins. above ground, marked and witnessed as described by the surveyor general.
	Thence I run
	S. 89° 52′ E., on a true line bet. secs. 6 and 7.
	Over rolling land.
37.87	Set a limestone, 15×8×6 ins., 10 ins. in the ground, for ¼ sec. cor., marked ¼ on the N. face; dig pits, 18×18×12 ins., E. and W. of stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, N. of cor.
51.00	Old Military road, bears N. 30° E. and S. 30° W.
57.50	The N. W. cor. of cemetery, bears S., 5.00 chs. dist.
72.00	The N. E. cor. of cemetery, bears S., 5.00 chs. dist.
77.87	The cor of secs. 5, 6, 7, and 8.
	Land, rolling.
	Soil, gravelly loam; 2nd rate.
	No timber.

N. 0° 5′ W., on a random line bet. secs. 5 and 6.

40.00	Set temp. ¼ sec. cor.
80.05	Intersect N. bdy. of the Tp. 3 lks. E. of the cor. of secs. 5, 6, 31 and 32, which is a limestone marked and witnessed as described by the surveyor-general.
	Thence I run
	S. 0° 6′ E., on a true line bet. secs. 5 and 6.
	Over rolling ground.
40.05	Set a limestone, 18×8×5 ins., 12 ins. in the ground, for ¼ sec. cor., marked ¼ on W. face; dig pits, 18×18×12 ins., N. and S. of the stone, 3 ft. dist.; and raise a mound of earth, 3½ ft. base, 1½ ft. high, W. of cor.
80.05	The cor. of secs. 5, 6, 7, and 8.
	Land, rolling.
	Soil, gravelly loam; 2nd rate.
	No timber.

11 a. m., August 17, 1893.

In order to locate Ivy Island, I proceed as follows:

I begin at the meander cor. of fracl. secs. 17 and 20, at 0h 45m p. m., which being too near noon to secure accurate results with the solar, I take a back sight on the cor. of secs. 16, 17, 20 and 21, prolong the direction, N. 89° 57′ W., bet. secs. 17 and 20, and set a flag on line, on the S. E. side of the island. To determine the distance to the flag, I lay off a base line, S. 30° 32′ W., 36.00 chs., to a point, at which the angle bet. flag and meander cor. measures 68° 01′; from the flag, the base line subtends an angle of 52° 31′. The sum of the three angles is 180° 03′; therefore the *corrected* angles, taken in the order of their measurement, are, respectively, 59° 30′, 68° 00′, and 52° 30′; and the distance is

$$\frac{\text{sin. } 68^\circ \times 36}{\text{sin. } 52^\circ\ 30'} \text{ or } \frac{0.9272 \times 36}{0.7934} = 42.07 \text{ chs.}^*$$

* For other methods of computing the distance, see page 136.

Subdivision of T. 15 N., R. 20 E.—Continued.

Chains.	
36.80	The point for cor. of secs. 17, 18, 19, and 20 falls in the lake; thence N. 89° 57′ W. bet. secs. 18 and 19.
5.27	In place of the flag, I Set a limestone, 15×8×6 ins., 10 ins. in the ground, for meander cor. of fracl. secs. 18 and 19, marked M. C. on E. face, with 3 grooves on S. face; dig a pit, 36×36×12 ins., 8 ft. W. of stone, and raise a mound of earth, 4 ft. base, 2 ft. high, W. of cor. Thence I run N. 89° 57′ W., on a true line bet. secs. 18 and 19. Over level land.
9.38	Intersect W. shore of island. Set a limestone, 18×8×5 ins., 12 ins. in the ground, for meander cor. of fracl. secs. 18 and 19, marked M. C. on W. face; dig a pit, 36×36×12 ins., 8 ft. E. of stone, and raise a mound of earth, 4 ft. base, 2 ft. high, E. of cor. August 17, 1893.

To locate a small island called Diamond Rock, in Lin's Lake, sec. 19, I proceed as follows:

From the meander cor. of secs. 19 and 24, on the W. bdy. of the township, I set a flag on the south point of the island, which bears N. 71° 30′ E.; then measure a base S. 48° 01′ E., 23.14 chs., to a point, from which the flag bears N. 8° E.; which gives for the distance to flag

$$\frac{\text{sin. } 60^\circ\ 29' \times 23.14}{\text{sin. } 63^\circ\ 30'} \text{ or } \frac{0.87 \times 23.14}{0.8949} = 22.50 \text{ chs., the required distance.}$$

22.50	In place of the flag, I Set a limestone, 15×8×6 ins., 12 ins. in the ground, for an auxiliary* meander cor. in sec. 19, marked A. M. C., on S. face; dig a pit, 36×36×12 ins., 8 ft. N. of stone, and raise a mound of earth, 4 ft. base, 2 ft. high, N. of cor. August 17, 1893.

* See pages 44 and 53.

Meanders, T. 15 N., R. 20 E.

Meanders of the right bank of Yellowstone River, up stream.

I commence at the meander cor. of fracl. secs. 25 and 30, on the E. bdy. of the Tp., which is a sandstone, 6×9×7 ins. above ground, marked and witnessed as described by the surveyor general.

At this cor., August 8, I set off 45° 46′ on the lat. arc: 16° 1′ N., on the decl. arc; and at 7h 35m a. m., l. m. t., determine a true meridian with the solar.

Thence I run with meanders in sec. 25.

Through heavy timber.

S. 85° W.	13.00 chs.	Bank 20 ft. high.
S. 72° W.	7.10 "	Bank 9 ft. high.
S. 64½° W.	13.00 "	
S. 40° W.	5.40 "	Low bank 5 ft. high. Head of course, leave heavy timber, enter dense willow and cottonwood undergrowth, bears S.
S. 77¾° W.	7.00 "	At 3.20 chs., mouth of Cherry Creek, 14 lks. wide, course N.
N. 76° W.	7.50 "	Bank 7 ft. high. At 2.00 chs., leave dense undergrowth, enter heavy timber, bears S.
S. 80° W.	12.00 "	At end of course, lower end of sand bar, bears N., 2.00 chs. dist.
S. 81° W.	19.39 "	Bank 4 ft. high. At 5.00 chs. leave heavy, enter scattering timber, bears S. To the meander cor. of fracl. secs. 25 and 26.

Meanders of the right bank of Yellowstone River, up stream—Continued.

Land, river bottom.
Soil, alluvial; 1st rate.
Timber, cottonwood, sycamore, ash, and walnut,
Heavily timbered land or land covered with dense undergrowth, 70.00 chs.

Thence in sec. 26.
Through scattering timber.

S. 81° W.	8.70 chs.	Bank 8 ft. high.
S. 70¾° W.	4.90 "	At 2.30 chs., upper end of bar, bears N. about 2.00 chs. dist.
S. 44¾° W.	3.60 "	
S. 21° W.	3.50 "	
S. 5¼° W.	4.20 "	
South.	4.30 "	
S. 9¼° E.	3.80 "	
S. 34¾° E.	5.27 "	To meander cor. of fracl. secs. 26 and 35.

Land, level.
Soil, alluvial; 1st rate.
Timber, scattering ash, hickory, walnut, and cottonwood.

Thence in sec. 35.
August 8: At the meander cor. of fracl. secs. 26 and 35, I set off 15° 57′ N., on the decl. arc.; and, at 0^{h} 5^{m} p. m., l. m. t., observe the sun on the meridian; the resulting lat. is 45° 46′.
Through scattering timber.

S. 28° E.,	8.80 chs.	Bank 8 ft. high.
S. 0¾° E.,	7.70 "	At 4.30 chs., leave scattering timber, enter dense cottonwood and willow undergrowth, bears N. 60° E.
S. 6½° W.	10.00 "	Low bank 4 ft. high. At end of course, road to Mound City, bears S. 70° E. Ferry, and road to Lake City, bears N. —° W.
S. 31° W.	12.00 "	At 5.50 chs. leave dense undergrowth, bears N. 65° E.; enter Pat Curran's field, bears E. At end of course, house bears S. 62° E., 5.00 chs. dist.
S. 38° W.	5.50 "	Bank 13 ft. high. At 5.10 chs., leave Pat Curran's field, fence bears E. At 5.30 chs. middle of road, bears E.
S. 43½° W.	7.70 "	At 1.50 chs., N. W. cor. of Alexander's field, bears E., 0.50 chs. dist.
S. 47½° W.	6.50 "	
S. 37½° W.	2.00 "	
S. 58° W.	2.10 "	
S. 42¼° W.	5.40 "	At 3.30 chs., wire fence, bears S. E.
S. 47° W.	4.80 "	
S. 50° W.	4.90 "	
S. 57° W.	9.50 "	
S. 48½° W.	16.68 "	To meander cor. of fracl. secs. 2 and 35, on S. bdy. of the Tp., which is a limestone 5×8×6 ins. above ground, marked and witnessed as described by the surveyor general.

Land, nearly level.
Soil, alluvial; 1st rate. North of Curran's field subject to inundation, 2 to 5 ft. deep.
Timber, scattering ash, walnut, and cottonwood.
Dense undergrowth, 18.90 chs.

August 8, 1893.

Meanders of the left bank of Yellowstone River, down stream.

I commence at the meander cor. of fracl. secs. 2 and 35, on the S. bdy. of the Tp., which is a limestone 6×7×5 ins. above ground, marked and witnessed as described by the surveyor general.

At this cor., August 9, I set off 45° 45′ on the lat. arc; 15° 44′ N., on the decl. arc; and at 7h 5m a. m., l. m. t., determine a true meridian with the solar.

Thence I run with meanders in sec. 35.

Over level bottom land.

N. 38¾° E.	9.10 chs.	Bank 12 ft. high.	From the meander cor. the S. end of sand ridge in sec. 34, bears N. 16½° W.
N. 31¾° E.	20.00 "		At end of course, N. E. end of sand ridge bears N. 3° E.
N. 51° E.	14.00 "		Sand ridge, parallel to river, N. W., about 25 chs. dist.
N. 61¼° E.	15.00 "		At end of course, S. end of sand ridge, bears S. 87½° W. N. E. end, bears N. 64° W.
N. 35¼° E.	7.50 "		
N. 42° E.	9.40 "		
N. 19° E.	7.10 "		At end of course, road to Lake City, bears N. 83° W. W. end of ferry.
N. 5¾° W.	8.90 "		Bank 9 ft. high. At 1.50 chs. enter scattering timber, bears N.W.
N. 29° W.	12.95 "		To the meander cor. of fracl. secs. 26 and 35.

Land, level.

Soil, sandy loam; 1st and 2nd rate.

Timber, scattering ash, cottonwood, and sycamore.

August 9: At this meander cor. I set off 15° 39′ N., on the decl. arc; and at 0h 5m., p. m., l. m. t., observe the sun on the meridian; the resulting lat. is 45° 46′, the true lat., nearly.

Thence in sec. 26.

Through scattering timber.

N. 22¼° W.	6.00 chs.	Bank 12 ft. high.	
N. 9½° W.	6.40 "		
North.	8.60 "		At 6.00 chs. leave scattering timber, bears W.; thence, over sandy loam.
N. 11¼° E.	7.50 "		
N. 25° E.	7.00 "		
N. 40° E.	7.60 "	Bank 15 ft. high.	
N. 57° E.	5.70 "		
N. 69½° E.	7.90 "		At 4.40 chs. enter scattering timber, bears N. Along the last six courses the bank is rapidly wearing away by action of the current which sets strong against the bank.
N. 74½° E.	7.40 "		
N. 76¼° E.	6.81 "		To the meander cor. of fracl. secs. 25 and 26.

Land, level.

Soil, alluvial; 1st and 2nd rate.

Timber, scattering cottonwood, sycamore and black walnut.

Thence in sec. 25.

Through scattering timber.

S. 86½° E.	9.70 chs.	Bank 12 ft. high.	
S. 74° E.	10.00 "		
S. 82½ E.	6.00 "		At 5.00 chs. leave scattering timber, bears N. W.
N. 82¼° E.	8.00 "		At end of course, wire fence, bears N. 60° W.
N. 69¼° E.	7.30 "		Bank 7 ft. high.
N. 61° E.	4.10 "		At 2.90 chs., mouth of short creek, 10 lks. wide, course S. 30° E.
N. 53¾° E.	8.30 "		
N. 66½° E.	10.00 "		
N. 77¾° E.	5.50 "	Bank 9 ft. high.	
N. 89° E.	13.00 "		

Meanders of the left bank of Yellowstone River, down stream—Continued.

N. 35° E. 3.79 " Bank 11 ft. high. To meander cor. of secs. 25 and 30 on E. bdy. of the Tp., which is a cedar post, 1 ft. high, 4 ins. sq., marked and witnessed as described by the surveyor general.

August 9, 1893.

Meanders of Clear Lake in Sec. 33.

I commence at the special meander cor. bet. the E. and W. halves of sec. 33, on the N. side of the lake.

Thence I run with meanders in E. ½ of sec. 33.

Over rolling ground.

S. 53° E. 17.00 chs. Bank 10 ft. high. At 11.00 chs. enter scattering timber, bears N. E.

S. 3° E. 13.00 " Bank 8 ft. high. At 12.50 chs. leave scattering timber, bears N. E.

S. 0¼° W. 7.20 " At end of course, outlet of lake, 10 lks. wide, course S. E.

S. 70° W. 15.11 " At 2.00 chs., enter scattering timber, bears S. To the special meander cor. bet. E. and W. halves of sec. 33, on S. side of the lake.

Thence in W. ½ of sec. 33.

N. 63¾° W. 10.00 chs. Bank 8 ft. high. At 7.00 chs. leave scattering timber, bears S. W.

N. 13° W. 21.00 " Bank 6 to 7 ft. high. At end of course, stream of clear, pure water, 8 lks. wide, enters lake, course S. 70° E. Along this line I discovered remarkable fossil remains of animals, well worthy the attention of naturalists.

N. 52° E. 17.34 " Bank 7 to 10 ft. high, enter scattering timber. At 8 chs., leave scattering timber, bears W. To the special meander cor. on N. side of lake.

This is a beautiful lake of pure, clear water, with well defined banks, 6 to 10 ft. high. Water about 14 ft. deep.

Land, rolling.

Soil, 1st rate.

Timber, scattering maple, oak, and elm.

August 12, 1893.

Meanders of the east end of Lin's Lake, in Secs. 17, 18, 19, and 20.

I commence at the meander cor. on W. bdy. of the Tp., which is a limestone 6×8×4 ins., above ground, marked and witnessed as described by the surveyor general.

August 18: At $8^h\ 4^m$ a. m., l, m. t., I set off 45° 48′ on the lat. arc; 12° 56′ N., on the decl. arc; and determine a true meridian with the solar, at the above described meander corner.

Thence I run with meanders in sec. 19.

Along gravelly beach.

S. 56° E. 7.20 chs.
S. 46½° E. 3.40 "
S. 44° E. 2.40 "
S. 43¼° E. 5.70 "
S. 45¼° E. 4.40 "
S. 44¾° E. 5.80 "
S. 45¼° E. 2.00 "
S. 49½° E. 4.00 "
S. 54¼° E. 5.00 "
S. 67¾° E. 2.00 "
S. 77¾° E. 6.60 "
N. 85½° E. 2.00 "

Meanders of the east end of Lin's Lake, in Secs. 17, 18, 19, and 20—Cont'd.

N. 77¾° E.	11.00	" At 6.50 chs., A. J. Smith's house bears S. 15° E., 1.00 ch. dist.
S. 77¾° E.	7.20	" At beginning of course enter scattering timber, bears S.E.
S. 74° E.	21.11	" To the meander cor. of fracl. secs. 19 and 20.

Land, level.
Soil, sandy loam; away from the beach, 2nd rate.
Timber, maple, ash, and oak.
August 18: At this meander cor. I set off 12° 52′ N., on the decl. arc; and at 0h 4m p. m., l.m.t., observe the sun on the meridian; the resulting lat., 45° 47′.

Thence in sec. 20.
Along gravelly beach, through scattering timber.

S. 89¾° E.	6.10 chs.	
N. 57° E.	12.00	" At 5.00 chs., leave scattering timber.
N. 37½° E.	10.50	"
N. 46° E.	5.00	" At end of course enter scattering timber, bears E.
N. 23½° E.	9.90	"
N. 39¾° E.	10.48	" To the meander cor. of fracl. secs. 17 and 20.

Land, level.
Soil, gravelly on beach; away from beach rich loam; 1st rate.
Timber, maple, ash, oak, and sycamore.

August 18, 1893.

August 19: At 7h 3m a. m., l.m.t., I set off 45° 48′ on the lat. arc; 12° 38′ N., on the decl. arc; and determine a true meridian at meander cor. of fracl. secs. 17 and 20.
Thence in sec. 17.
Along gravelly beach, through scattering timber.

N. 19° E.	10.00 chs.	
N. 15¾° E.	10.00	" At 6.50 chs., mouth of branch 7 lks. wide, the outlet of pond in sec. 16, course N. 70° W.
N. 80° W.	6.00	"
N. 68½° W.	7.10	"
N. 88° W.	6.70	" At end of course, leave scattering timber, bears N. E.
N. 38¼° W.	9.50	" At end of course, fence, bears N. 43° E.; enter irrigated field.
N. 27½° W.	5.00	"
N. 27½° W.	8.00	"
N. 10¼° W.	6.00	"
N. 38½° W.	2.80	"
N. 46¼° W.	9.50	" At 2.00 chs., leave irrigated field, bears N. 43° E.
N. 33½° W.	3.74	" To meander cor. of fracl. secs. 17 and 18.

Land, level.
Soil, gravelly on beach; away from beach, rich loam, rocky near meander cor.; 1st and 3rd rate.
Timber, maple, ash, oak, and sycamore.

Thence in sec. 18.
Along gravelly beach.

N. 38¾° W.	15.00 chs.	Bank 6 ft. high.
N. 63¼° W.	5.00	" At end of course, middle of main track of Montana and Manitoba Railroad, 70 lks. N.
S. 84° W.	13.00	" Bank 8 ft. high. At 12.00 chs., S. E. cor. of Lake City. Thence, along S. side of Water street, 100 ft. wide. At 12.30 middle of East street, bears N. 0° 5′ W.

Meanders of the east end of Lin's Lake, in Secs. 17, 18, 19 and 20—Cont'd.

S. 64½° W.	19.00	" Bank 9 ft. high. At 5.55 chs., middle of Walnut street, bears N. 0° 5′ W. Railroad station bears N. 3.00 chs. dist. At 11.80, middle of Elm street, bears N. 0° 5′ W. At 17.00, ascend from beach to top of bank 10 ft. high; N. E. cor. of wharf. At 18.00 chs., middle of Main street, bears N. 0° 5′ W. At end of course, N. W. cor. of wharf.
S. 43° W.	13.00	" Bluff bank 9 ft. high; no beach. At 8.50 chs., middle of Pine street, bears N. 0° 5′ W.
S. 55½° W.	4.00	" At 2.90 chs., middle of Cedar street, bears N. 0° 5′ W.
S. 74¾° W.	4.70	" Bank 7 ft. high; no beach.
S. 79° W.	5.60	" Bank 5 ft. high. At 0.10 chs., middle of West street, bears N. 0° 5′ W. At 0.42 chs., S. W. cor. of Lake City.
S. 86½° W.	12.31	" To the meander cor. of fracl. secs. 13 and 18, on W. bdy. of the Tp. which is a juniper post, 1 ft. high, 4 ins. sq., marked and witnessed as described by the surveyor general.

Land, gently rolling.
Soil, sandy loam; 1st rate. No timber.
I return to the meridian established Aug. 4, from Polaris. At 4 p. m. I set off —° —′ on the decl. arc, and test the adjustment of my solar, finding it gives the same meridian as before, and adjustments correct.
August 19, 1893.

Meanders of Ivy Island in secs. 18 and 19.
I commence at the meander cor. of fracl. secs. 18 and 19, on the east side of the island.
August 17: At 3 p. m., l. m. t., I set off 45° 48′ on the lat. arc; 13° 9′ N., on the decl. arc; and determine a true meridian at this meander cor.
Thence I run with meanders in sec. 19 along gravelly beach.
S. 47½° W. 2.50 chs. Low bank, 2 ft. high.
N. 52° W. 2.82 chs. To meander cor. bet. fracl. secs. 18 and 19.
Soil, gravel; off beach, loam, 1st rate. No timber.

Thence in sec. 18.
Along gravelly beach.

N. 5½° W.	2.90 chs.	
N. 35° W.	1.60	" Row of 2 cottages and pavilion, parallel to beach, 1.50 chs. dist.
S. 45½° W.	1.40	" At beginning of course, hotel bears N. 30° W.; at end of course, cottage bears N. 30° W., 2.00 chs. dist.
S. 56° W.	2.30	" Row of cottages, parallel to beach, 2.00 chs. dist.
N. 73½° W.	4.50	"
N. 38° W.	6.40	" At 2.00 chs., bank 3 ft. high; at 3.00 chs., bank 15 ft. high; narrow rocky beach.
N. 12° E.	4.20	" Bank, 25 ft. high; large rocks along narrow beach.
N. 59½° E.	5.30	" Bank, rock nearly vertical, 35 ft. high; narrow beach of rock and gravel.
East.	2.60	"
S. 36° E.	3.80	" At end of course, bank, 30 ft. high; narrow beach of rock and gravel.
S. 56½° E.	6.40	" At 2.00 chs., bank 9 ft. high; at 3.00 chs., 5 ft. high. Scattering timber off beach.
S. 29° E.	7.00	" Low bank 4 ft. high. Scattering timber off beach.
S. 47½° W.	3.40	" To the meander cor. of fracl. secs. 18 and 19.

Meanders of the east end of Lin's Lake, in Secs. 17, 18, 19 and 20—Conc'd.

Land, high on north part of island, low on S. E. part.
Soil, rich loam on east end; stony on west end of island; 1st and 3rd rate.
Timber, oak, maple and ash; undergrowth, on west end of island, hazel bushes and tangle of grape vines and wild ivy on the high ground; a few scattering water elms and sycamores on low part of island.

August 17, 1893.

Meanders of a small island, called Diamond Rock, in Sec. 19.

I commence at the auxiliary meander cor. on south side of the island.
Thence with meanders in sec. 19.
N. 16½° W. 2.70 chs.
N. 61¼° E. 2.90 "
S. 48⅔° E. 3.50 "
S. 27⅓° W. 2.20 "
N. 85° W. 3.30 " To auxiliary meander cor. and place of beginning.
Land, level.
Soil, gravelly loam; 3rd rate.
No timber.
This island is about 4 ft. above the water, not subject to inundation; has no vegetation, except grass; and is without improvements.

August 17, 1890.

GENERAL DESCRIPTION.

This township contains nearly every variety of land from plains to mountains, and the soil ranges from alkali to rich loam. The soil of the bottom land along the Yellowstone River and in the central part of the township is generally rich, black loam, capable of producing abundant crops without irrigation. The soil of the remaining portion of the township, except the alkali flat in secs. 23 and 24, and the mountainous land, can nearly all be classed as second rate, is covered with an abundant growth of rich and nutritious grasses, and will produce crops without irrigation. In the southwestern portion of the township is an arid plain, and irrigation will be necessary.

Cottonwood, sycamore, ash, and other kinds of timber are found along the Yellowstone River, and some scattering along the creeks. The Little Snowy Mountains are covered with a dense growth of pine, oak, and fir timber, many of the trees being very large.

There is one limestone quarry in secs. 8 and 9 which affords excellent building stone, and, from surface indications, it is probable that large bodies of limestone and sandstone underlie other portions of the township. Iron ore was found in sec. 3, and gold in secs. 4 and 5.

The township is well watered by the Yellowstone River, which runs through the southeastern portion, and by many small springs and brooks. The eastern end of Lin's Lake, comprising only a small portion thereof, is included in this township. This lake is about 10 miles long, and its greatest width is about 4 miles. The water is clear and pure, and varies in depth from 10 to 200 feet.

Ivy Island, in Lin's Lake, contains nearly seventeen acres of land. About the middle of the island is a fine large spring of pure, cold water, which supplies the hotel and cottages situated on the south shore. This island is a favorite resort for residents of Lake City and the surrounding country.

The town of Lake City, the county seat of Humboldt County, contains a courthouse, three churches, two hotels, several stores, and about 50 dwelling houses. Its estimated population is 300.

There are two settlers in sec. 35, and one each in secs. 16, 17, 19, and 25.

James Parker's desert-land claim in sec. 32 may be irrigated by an artesian well, which is now being driven.

ROBERT ACRES,
U. S. Deputy Surveyor.

FINAL OATHS OF DEPUTY SURVEYOR AND HIS ASSISTANTS.

LIST OF NAMES.

A list of the names of the individuals employed by Robert Acres, U. S. deputy surveyor, to assist in running, measuring, and marking the lines and corners described in the foregoing field notes of the survey of the subdivision and meander lines of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian, in the State of Montana, showing the respective capacities in which they acted:

PETER LONG	Chainman.
JOHN SHORT	Chainman.
CYRUS CLAY	Moundman.
HENRY ROCK	Moundman.
GEORGE SHARP	Axman.
ADAM DULL	Axman.
JAMES BANNER	Flagman.
EDWARD ENSIGN	Flagman.

FINAL OATHS OF ASSISTANTS.

I hereby certify that I assisted Robert Acres, United States deputy surveyor, in surveying all those parts or portions of the subdivision and meander lines in the east half of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian, State of Montana, which are represented in the foregoing field notes as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of my knowledge and belief, well and faithfully surveyed, and the corner monuments established, according to the instructions furnished by the U. S. surveyor general for Montana.

JAMES BANNER, *Flagman.*

Subscribed and sworn to before me this eleventh day of August, 1893.

ROBERT ACRES,
U. S. Deputy Surveyor.

We hereby certify that we assisted Robert Acres, U. S. deputy surveyor, in surveying all those parts or portions of the subdivision and meander lines of Township No. 15 North, of Range No. 20 east, of the Principal Base and Meridian, State of Montana, which are represented in the foregoing field notes as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of our knowledge and belief, well and faithfully surveyed, and the corner monuments established, according to the instructions furnished by the U. S. surveyor general for Montana.

PETER LONG, *Chainman.*
JOHN SHORT, *Chainman.*
CYRUS CLAY, *Moundman.*
HENRY ROCK, *Moundman.*
GEORGE SHARP, *Axman.*
ADAM DULL, *Axman.*

Subscribed and sworn to before me this twenty-third day of August, 1893.
[SEAL.] HENRY DOOLITTLE,
Notary Public.

I hereby certify that I assisted Robert Acres, United States deputy surveyor, in surveying all those parts or portions of the subdivision and meander lines in the west half of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian, State of Montana, which are represented in the foregoing field notes as having been surveyed by him and under his direction; and that said survey has been in all respects, to the best of my knowledge and belief, well and faithfully surveyed, and the corner monuments established, according to the instructions furnished by the U. S. surveyor general for Montana.

EDWARD ENSIGN, *Flagman.*

Subscribed and sworn to before me this twenty-third day of August, 1893.
[SEAL.] HENRY DOOLITTLE,
Notary Public.

FINAL OATH OF U. S. DEPUTY SURVEYOR.

I, Robert Acres, U. S. deputy surveyor, do solemnly swear that in pursuance of a contract received from A——— B———, U. S. surveyor general for Montana, bearing date of the twenty-second day of March, 1893, I have well, faithfully, and truly, in my own proper person, and in strict conformity with the instructions furnished by the U. S. surveyor general for Montana, the Manual of Surveying Instructions, and the laws of the United States, surveyed all those parts or portions of the subdivision and meander lines of Township No. 15 North, of Range No. 20 East, of the Principal Base and Meridian, in the State of Montana, which are represented in the foregoing field notes as having been surveyed by me and under my direction; and I do further solemnly swear that all the corners of said survey have been established and perpetuated in strict accordance with the Manual of Surveying Instructions, and the special written instructions of the U. S. surveyor general for Montana, and in the specific manner described in the field notes, and that the foregoing are the original field notes of such survey; and should any fraud be detected, I will suffer the penalty of perjury under the provisions of an act of Congress approved August 8, 1846.

ROBERT ACRES,
U. S. Deputy Surveyor.

Subscribed by said Robert Acres, and sworn to before me this thirty-first day of August, 1893.

[SEAL.]

A—— B——,
U. S. Surveyor General for Montana.

To each of the original field books the surveyor general will append his official approval, according to the following form, or so varied as to suit the facts in the case:

OFFICE OF THE U. S. SURVEYOR GENERAL,
Helena, Montana, September 1, 1889.

The foregoing field notes of the survey of [here describe the survey], executed by Robert Acres under his contract No. 87, dated March 22, 1893, having been critically examined, and the necessary corrections and explanations made, the said field notes, and the surveys they describe, are hereby approved.

A—— B——,
U. S. Surveyor General.

To the copies of the field notes transmitted to the General Land Office the surveyor general will append the following certificate:

I certify that the foregoing transcript of the field notes of the survey of the [here describe the character of the surveys, whether meridian, base line, standard parallel, exterior township lines, or subdivision lines and meanders of a particular township], in the State [or Territory] of ....., has been correctly copied from the original notes on file in this office.

A—— B——,
U. S. Surveyor General.

PRIVATE LAND CLAIM SURVEYS.

1. Before ordering any survey of a private land claim the surveyor general will receive full instructions from this office, by which he will be governed in issuing his instructions to the deputy. The instructions to the deputy must be entered in full at the commencement of the field notes of such survey.

2. The instruments used in the survey of private land claims must be the same as those required for the survey of public lands, and must be registered and tested in like manner at the surveyor general's office previous to the deputy's commencing work; and the instructions for the survey of public lands must, as far as applicable, be strictly observed in the survey of private land claims.

3. The true magnetic variation must be noted at the beginning point of each survey, and wherever the variation of the needle is observed to change along the line the same must be noted and the reasons therefor stated, if known.

4. At the end of each mile along a boundary, the character of the soil and amount of timber, grass, etc., will be stated; and the date of each day's work in the field must be noted at the end of the record thereof.

5. The requirements in the "Summary of objects and data required to be noted," as set forth in the instructions for the survey of public lands, must be observed by the deputy in the survey of private land claims. Where practicable, bearings must be taken from at least two points on the line to all prominent or otherwise notable objects in the vicinity, and where only one bearing can be taken the estimated distance must be noted.

6. At the beginning point upon the boundaries of each grant survey, a corner must be established of the same character, size, and materials as prescribed for township corners upon the lines of the survey of public lands, except that only two pits will be dug, one on each side of the corner, on the line. Upon the side of such corner facing the claim, the initial letters of the name of the grant, and immediately under the same the letters "Beg. Cor. 1" (for beginning corner one) must be neatly cut or chiseled.

7. Each of the mile corners or stations of survey must be established in the manner prescribed for the establishment of section corners upon the lines of public surveys, except that they will be marked on the side facing the grant with the initials of the grant and the number of the station or mile, as the case may be; and only two pits will be dug, one on each side of the corner, on the line.

8. Where mile corners are established, except upon meandered portions of the line, half-mile corners will also be established in the manner prescribed for the establishment of quarter-section corners upon the lines of public surveys, except that they will be marked upon the side facing the grant with the initials of the grant.

9. Such other marks, in addition to those above described, will be placed upon the corners as may be required by the surveyor general in his special written instructions.

10. As far as practicable, bearings and distances must be taken from each of the corners or stations to two or more trees, or prominent natural objects, if any, within a convenient distance, in the same manner as required in the instructions for the survey of public lands, and such trees or objects must be marked with the initials of the grant, and underneath same the letters "B. T." or "B. O.," as the case may be.

11. Witness corners will be established, where necessary, in the same manner as required in the instructions for the survey of public lands.

12. In all cases where the lines of the grant boundary surveys intersect established lines of survey of public lands or private land claims, the course and distance from such point of intersection to the nearest corner on the line of the prior survey must be carefully run, measured, and noted, and whenever necessary such corner must be reëstablished.

13. The survey of a private land claim must always be connected by a line actually run and measured in the field with some corner of the public surveys, if any such have been established within a distance not exceeding two miles from any point on the boundary lines of the private land claim.

14. Boundaries or portions of boundaries of previously established grant surveys, which also form a portion of the boundaries of the claim to be surveyed, will be adopted so far as common to both grants, but no payment will be made for such common boundaries unless it is necessary to reëstablish the same.

15. The field notes must embrace a full, clear, and concise statement of the deputy's reasons for his location and establishment of each boundary.

16. A general description of each tract must be given at the end of the field notes of the survey of same, which description must embrace a brief statement of the main features of the tract surveyed, character of the land, timber, and other natural growth, kinds of mineral, if any, population of towns and settlements, characteristics of mountains, streams, springs, etc., and such other data as may be of importance.

17. The deputy must particularly note all facts relative to present inhabitancy of the land and designate all tracts occupied by actual settlers or residents.

18. The deputy surveyor must return with the field notes a topographical map or plat of the survey. As far as practicable all objects described in field notes, and the main features of the tract surveyed, including towns, streams, mountains, roads, etc., must be protracted on such plat as accurately as possible.

19. The field-note books must embrace a list of assistants, and preliminary and final oaths, as required in the instructions for the survey of public lands.

20. The deputy will note all objections to his survey that may be brought to his knowledge, and the surveyor general will promptly report to the Commissioner of the General Land Office all complaints made to him, and send up all protests filed in his office, together with a full report thereon.

21. Official plats of the survey of private land claims will not be furnished to any person until the cost of surveying and platting the same shall have been paid to the United States.

APPENDIX RELATIVE TO ACCOUNTS FOR SURVEYING AND EXAMINATION.

U. S. surveyors general and deputy surveyors are required to comply strictly with the following instructions:

All surveying accounts transmitted to the General Land Office for adjustment must be in duplicate and in a separate letter from that forwarding the plats and field notes of the survey. The name of the deputy surveyor, date and number of the contract, the amount of the estimated liability, and whether said liability is limited or not, should be noted on the face of the deputy's account.

The amount of the account and the appropriation from which it is to be paid should be stated both in the letter of transmittal and in the account rendered. The deputy's affidavit that the survey was executed by him, and that it was just and correct, should be attached to the account.

The date of the surveyor general's approval should appear in the certificate thereto, and the destination of the draft or drafts, the name of the payee or payees, with the post-office address, should be added.

When the survey is chargeable to "Deposits by individuals for surveying the public lands," it should be so stated, and the deposit to which the field work is chargeable should be listed by number and date of certificate of deposit, with number of township and range for which the deposit is made, and the amount of each certificate.

When the amount of an account is in excess of the liability of the contract, a copy of office letter authorizing the excess must always accompany the account.

When stating an expense account for examination in the field or office on surveys, the number of the contract under which the survey was made, the name of the surveyor, with the number of township and range examined, should be inserted in the account, accompanied by a copy of letter of authorization, said account and vouchers to be furnished in duplicate and to have the affidavit of the examiner as to the correctness of the charges and the approval of the surveyor general attached.

When surveys are continued and executed beyond the time limited in the contract and the contract has expired, and there has been no properly-granted extension of time thereto, the compensation of the deputy surveyor for the lines of survey executed after the expiration of the contract will be reduced, and said lines completed at such rates as the Commissioner of the General Land Office may in his judgment determine to be proper, taking into consideration the value of the work and the limitations of the appropriation from which the account must be paid.

The field notes of a U. S. deputy surveyor, which are the data upon which his surveying account is stated by the surveyor general, and

subsequently adjusted by the Commissioner of the General Land Office, should describe the surface, soil, etc., at the end of each mile or fractional mile of survey, and should state the number of chains and links which are "mountainous," "heavily timbered," or covered with "dense undergrowth," using always the exact phraseology of the appropriation act which establishes the rates for said lines of surveys.

By dense undergrowth is meant thick bushes, boughs, or other vegetable growth of such height as to obstruct the use of the transit, and require cutting away to obtain sights along line; also bushes, brush, vines or other vegetation which is of such tangled and difficult character as to seriously impede the work of chaining the line.

Connecting lines, showing closing distances to closing corners, will be paid for at the minimum rate allowed in the contract for that class of line which is run to the closing corner, unless otherwise specially provided in the contract.

The practice of allowing deputies to retrace any and all lines which they may deem necessary in connection with their work, and compensating them therefor, has been discontinued.

If it becomes necessary to retrace any of the exterior lines in order to properly close their lines of survey it must be done at the deputy's own expense as a legitimate contingent in executing the contract. If it should be found to be absolutely necessary to resurvey and retrace any portion of the exterior township lines, except such as are clearly provided for in the article on pages 72, 73, and 74, the deputy should report the facts immediately to the surveyor general and await further instructions. The facts as reported to him will be promptly laid before the Commissioner of the General Land Office, specifying the number of miles of retracement required, and, if such resurvey is authorized, the deputy will be immediately notified. In no other case will any resurvey be paid for which is not specifically authorized by the Commissioner.

PROCEDURE OF COUNTY AND PRIVATE SURVEYORS IN RESTORING LOST AND OBLITERATED CORNERS AND SUBDIVIDING SECTIONS.

The General Land Office assumes no control or direction over the acts of local and county surveyors in the reestablishment of extinct corners of original surveys. It follows the general rule that disputes, arising from uncertain or erroneous location of original corners, are to be settled by the proper local authorities or by amicable adjustment; and to aid in this result it furnishes a circular pamphlet which is merely advisory and explanatory of the principles which should prevail in performing such duties.

Surveyors who have been United States deputies should bear in mind that in their private capacity they must act under somewhat different rules of law from those governing original surveys, and should carefully distinguish between the provisions of the statute which guide a Government deputy and those which apply to retracement of lines once surveyed. The failure to observe this distinction has been prolific of erroneous work and injustice to land owners.

The circular on "Restoration of lost and obliterated corners," dated March 13, 1883, and the circular on subdividing a section, dated June 2, 1887, are furnished to applicants.

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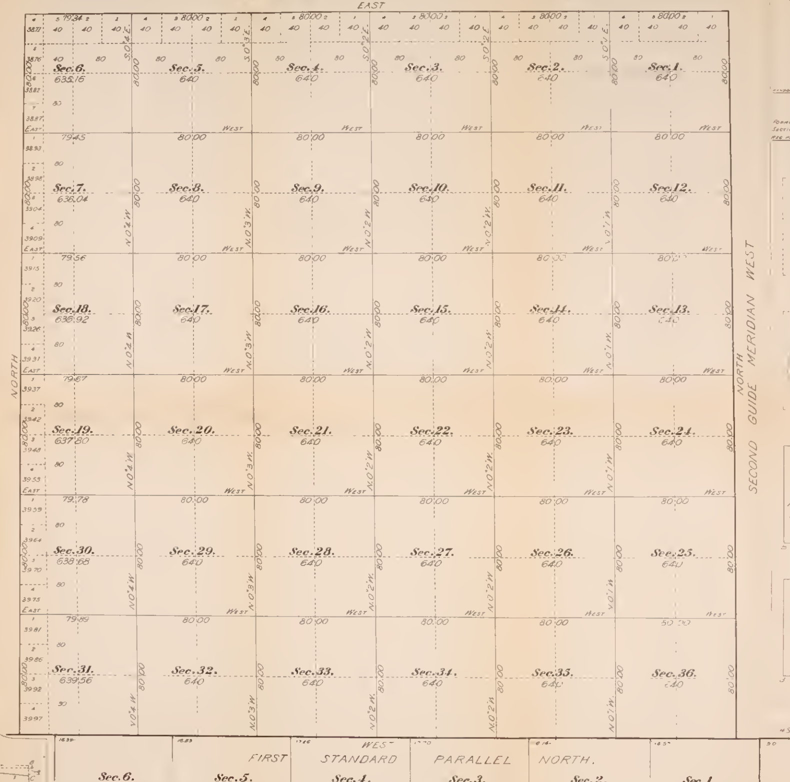
PLATE I.

Note:

Fig. 1.

Township No. 5 North, Range No. 9 West, of a Principal Meridian.



The above plat represents a Theoretical Township with perfect subdivisions, contiguous to the north side of a Standard Parallel in assumed Latitude 42° 15′ N. and Longitude 100° 00′ W. of Gr. Area 23024.16 A.

Fig. 2.

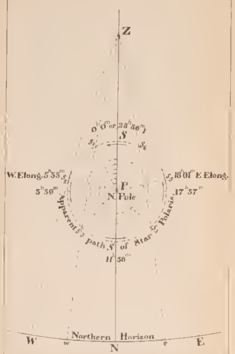


Fig. 3.

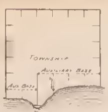


Fig. 4.

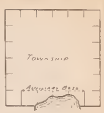
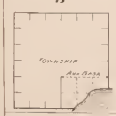


Fig. 5.



Note.

Figures 3, 4 and 5, illustrate possible cases under paragraph 10, "Method of Subdividing"

Note

AB and ab, are drawn parallel to S bdy of the sec ...

Fig. 6.

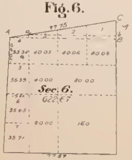


Fig. 7.

Note.

Figures 8, 9, 10, 11 and 12 illustrate applications of paragraph 7, of "Prescribed Limits" &c.

Fig. 8.

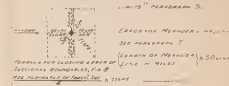
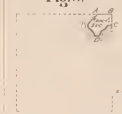


Fig. 9.



ABC = ¼ mile
ADC = ½ mile

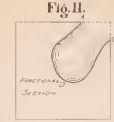
½ × 50 = 25 links,
¼/4 × 71 = 4 links,
Error allowed = 29 links

Fig. 10.

ABC = ½ mile
ADC = 2½ miles

2½ × 50 = 125 links,
½/4 × 71 = 9 links,
Error allowed = 134 links

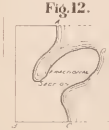
Fig. 11.



ABC = 3½ miles.
ADC = 1½ miles

1½ × 50 = 75 links,
3½/4 × 71 = 62 links,
Error allowed = 137 links

Fig. 12.



ABC = 2 miles
ADC = 2½ miles

2½ × 50 = 125 links,
2/4 × 71 = 35 links,
Theoretical error = 160 links
Reduce to 150 links

PLATE II.

Fig. 1.

SECANT METHOD.

Fig. 2.

Illustrating the Recovery of the Theoretical Position of the Parallel from the Established Position when the latter deviates from the former by less than One Minute of Arc as determined by Polaris Obs.

Regular Offsets Table III.

Dist's from 1st Pt. of Secant Junction	2	2½	3	3½	4	4½	5	5½	6
Corner of,	Secs. 82.438	½ S.	Secs 218.54	½ S.	Secs 364.05	½ S.	Secs 554.56	½ S.	Tp's 1371 Points
Diffs from Secant, Tab III (feet)	2.045	2.555	2.725	2.383	2.045	1.195	0.00	1.533 N	3.954 N

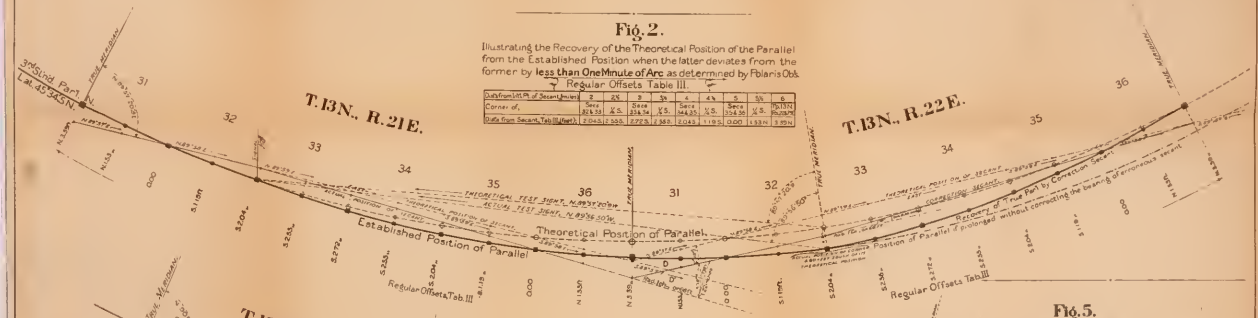


Fig. 3.

TANGENT METHOD.

Fig. 5.

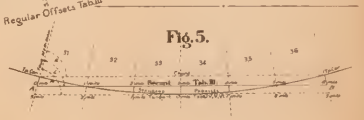


Fig. 4.

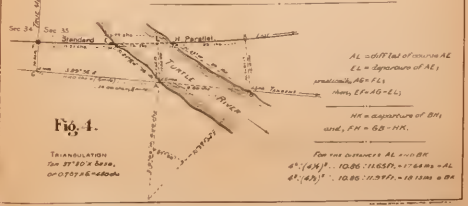


PLATE III.

TOWNSHIP EXTERIORS.

Scale: 1 inch to 160 chains

FOURTH STANDARD PARALLEL NORTH.

East

FIFTH GUIDE MERIDIAN EAST. North

SIXTH GUIDE MERIDIAN EAST. North

T.16N. R.21E. | T.16N. R.22E. | T.16N. R.23E. | T.16N. R.24E.

T.15N. R.21E. | T.15N. R.22E. | T.15N. R.23E. | T.15N. R.24E.

T.14N. R.21E. | T.14N. R.22E. | T.14N. R.23E. | T.14N. R.24E.

T.13N. R.21E. | T.13N. R.22E. | T.13N. R.23E. | T.13N. R.24E.

East.

THIRD STANDARD PARALLEL NORTH.

Latitude 45° 31' 5" N.
Longitude 107° 21' West Gr.
Mean Mag. Dec. 16° 02' East.

Explanations.

Old Surveys.

Surveyed under current contract.

Unsurveyed.

Table of Mileage

Surv's Designated	Amount	When Surveyed.
	No. Ch. Lks.	
Standard Lines	30 00 00	Aug. 22 to 30, 1890.
Township "	11 79 25	Sept. 5 to 13, "
Connecting "		

This Plat.
of the
3rd Standard Parallel North
through Ranges 21, 22, 23 & 24 E.;
East Boundary of T. 13 N., R. 21 E.;
North " " " "
and the
Sixth Guide Meridian East
through Township 13 North.
Montana Principal Meridian;
is strictly conformable to the
field notes of the survey thereof
by
Richard Roods, U.S. Dep. Surv.
under his
Contract No. 97,
dated July 10th 1890,
which have been examined,
approved and filed in this office.
U.S. Surv. Gen'l's Office,
Helena, Montana,
(Date of Approval)

U.S. Surv. Gen'l.

Township Nº 15 North, Range Nº 20 East of the Principal Meridian Mont.

Latitude 48°43 N.
Longitude 107°54 W.
Mean mag. decl. 18°0 E

Area in acres.	Public Land, 29872.27. Townsite 199.01. Water surface 1362.99.	Private Land Claim, 452.80. Mineral Claims 61.08.	Total Area, 22969.05 Acres.

Surveys Designated	By Whom Surveyed	Contract No.	Contract Date	Amount of Surveys Ms Chs	Lks	When Surveyed
Subdivisions	Robert Acres	207	March 22nd 1893	56 60	72	Aug. 5th to 15th 1893.
Connections	"	"	"	73 60		"
Meanders	"	"	"	12 19	26	"

Scale 60 Chains to an Inch.

The above Plat of Township Nº 15 North, of Range Nº 20 East of the Principal Meridian, Montana, is strictly conformable to the field notes of the survey thereof on file in this Office, which have been examined and approved.

Surveyor Generals Office,

Surr Genl

PLATE V.

PLANS OF CORNERS.

Scale: 4 inch = 1 foot.

EXPLANATIONS.

S. Corner Stone. M. Mound. M' Mound with deposit. P. Pit. ▫ Stake.

Fig. 1. Fig. 2.

Standard Township Corners.

Fig. 3. Fig. 4.

Standard Section Corners.

Fig. 5. Fig. 6.

Standard Quarter Section Corners.

Fig. 7. Fig. 8.

Closing Township Corners.

Fig. 10. Fig. 11.

Closing Section Corners

Fig. 12. Fig. 13.

Corners common to 4 Sections.

Fig. 14. Fig. 15.

Corners common to 4 Townships.

PERSPECTIVE.

of Standard Tp Cor. with Closing Tp Cor. in the distance

Fig. 18. Fig. 19.

Corners common to 2 Sections.

Fig. 16. Fig. 17.

Corners common to 2 Townships.

Fig. 22. Fig. 23.

Corners, referring to 1 Township only.

Fig. 20. Fig. 21.

Corners, referring to 1 Section only.

Fig. 24.

Quarter Sec. Cor. on a meridional line.

MEANDERABLE BODY OF WATER

Fig. 25.

Meander Corners.

PLATE VI.

N.W.Corner of Resvn.

Fig.1.

Corners on Reservation Boundaries.

17th M.Corner.

33 M.Cor.

S.E.Corner of Resvn.

S.W.Cor. of Resvn.

Mound of Stone 3ft. base, 3ft. high.

Fig.2.

Closing Township Corners.

(On Irregular Bndries.)

Fig.3.

Closing Section Corners,

(On Irregular Boundaries).

PLANS OF CORNERS.

(Scale: 4 inch = 1 foot.),

AND

Miscellaneous Diagrams.

EXPLANATIONS.

S. Stone M. Mound M. Mound with deposit. P. Pit.

• Stake

Convergency of Meridians.

Fig.5.

Fig.6.

Fig.7.

Fig.8.

Meander Corner.

PERSPECTIVE.

Fig.9.

Cor. common to Four Townships.

View Looking North.

View Looking West.

Fig.10.

Cor. common to Four Sections.

View Looking West.

Fig.11.

Quarter Section Corner.

Fig.4.

Tp or Sec., (interfering). Closing Corners.

Intersections 8 ft. apart.

Intersections less than 8 ft. apart.

Intersections 10 ft. apart.

Intersections less than 10 ft. apart.

Intersections less than 1 ft. apart.

Fig. 3

Fig. 1

Fig. 2.

Fig. 3.

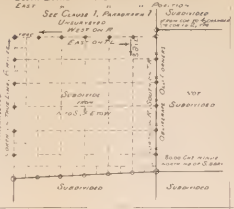


Fig. 4.

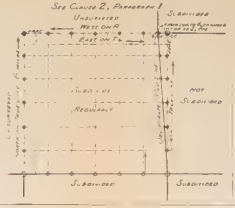


Fig. 5.

Fig. 6.

Fig. 7.

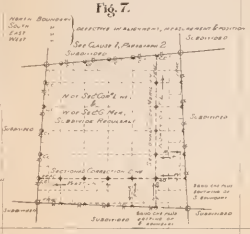


Fig. 8.

Fig. 15.

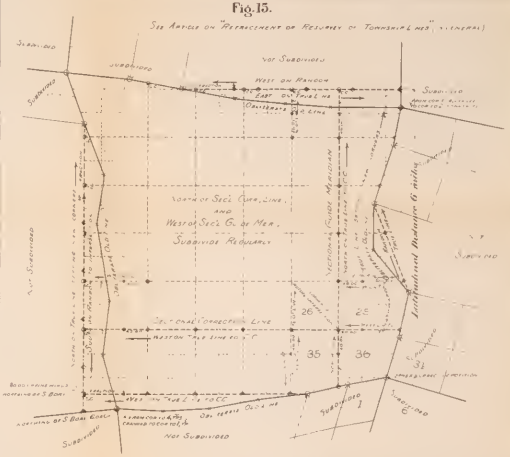


Fig. 9.

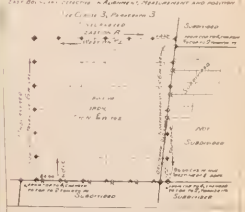


Fig. 10.

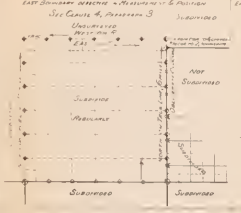


Fig. 11.

Fig. 12.

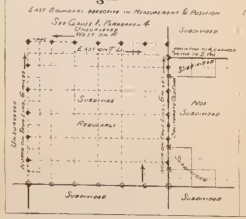


Fig. 13.

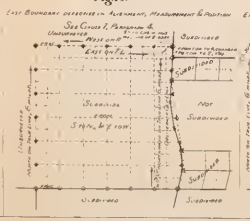
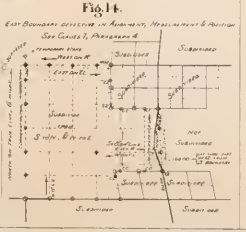


Fig. 14.



EXPLANATIONS

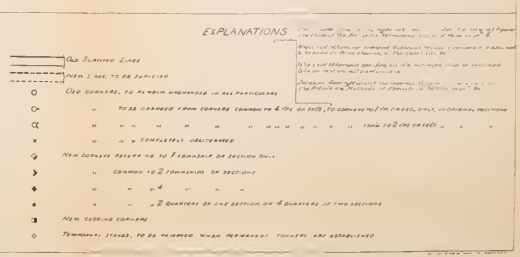


PLATE VIII.

PLATE VIII.

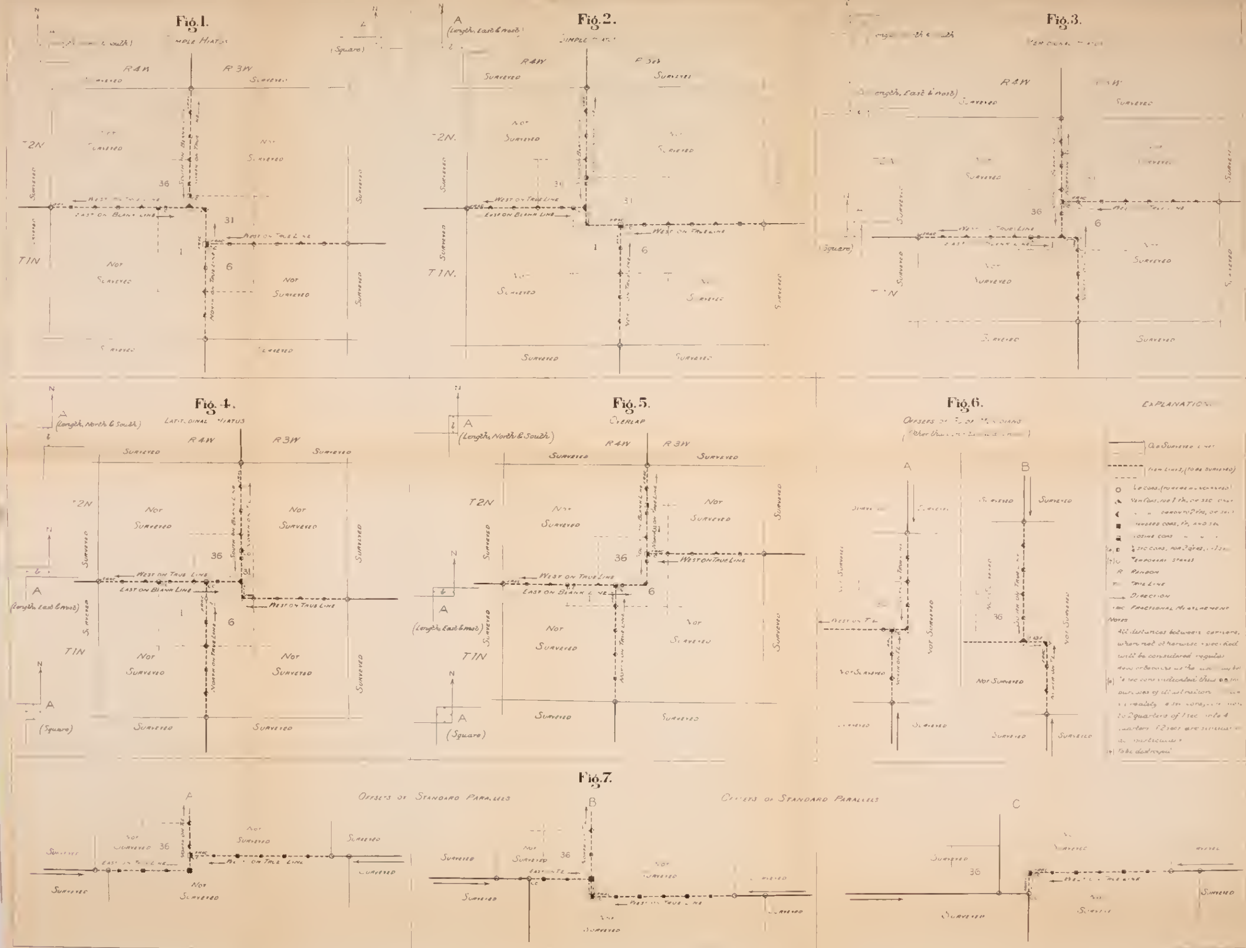
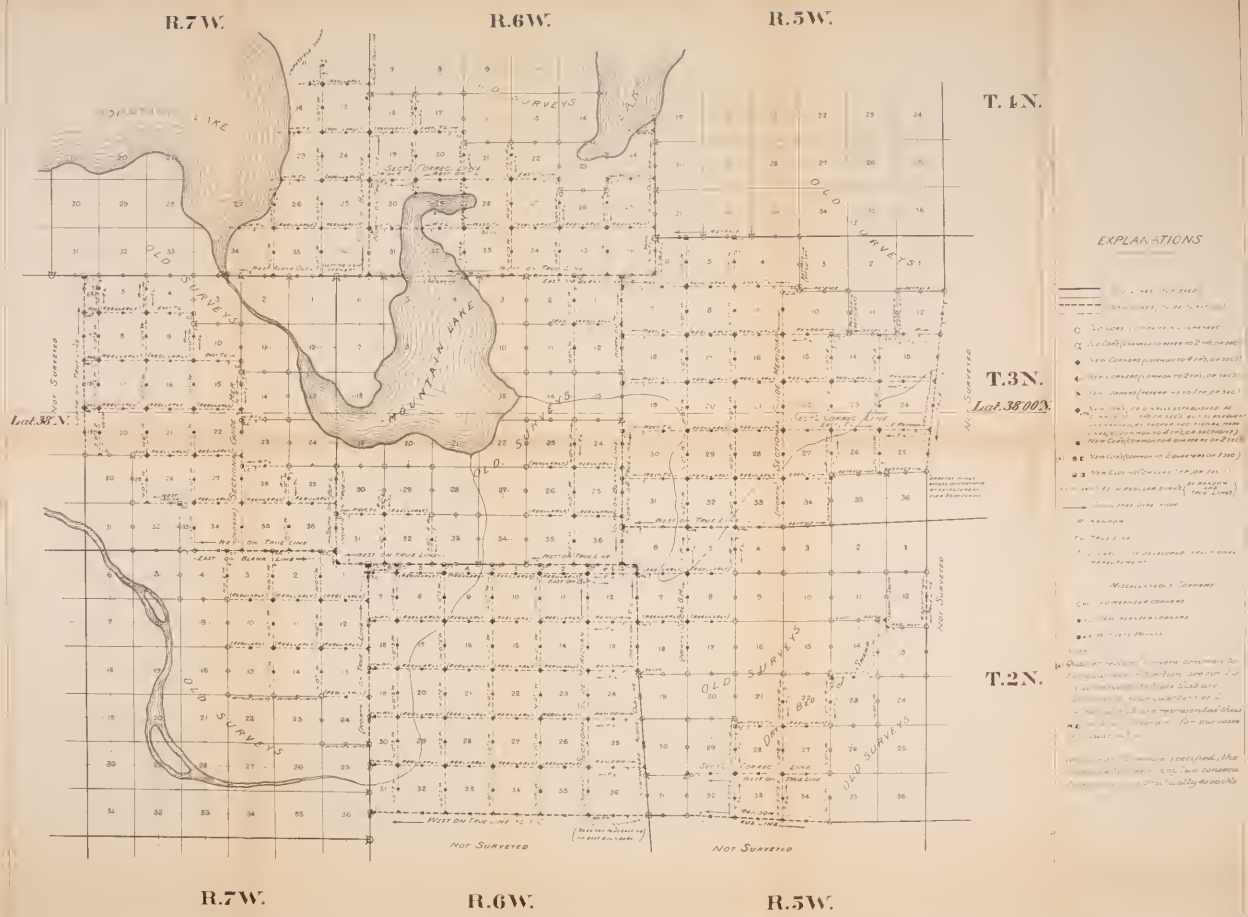


Fig. 1.
R 4 W
R 3 W
T 2 N
T 1 N
West on True Line
East on Blank Line
Not Surveyed
Surveyed
Fig. 2.
A
(Length, East & West)
(Square)
West on True Line
East on Blank Line
Fig. 3.
(Length, East & West)
(Square)
Fig. 4.
A
(Length, North & South)
Latitudinal Hiatus
R 4 W
R 3 W
T 2 N
T 1 N
West on True Line
East on Blank Line
North on True Line
(Length, East & West)
(Square)
Fig. 5.
Overlap
A
(Length, North & South)
R 4 W
R 3 W
T 2 N
T 1 N
West on True Line
East on Blank Line
West on True Line
(Length, East & West)
(Square)
Fig. 6.
Offsets of Guide Meridians
A
B
Not Surveyed
Explanation.
Fig. 7.
Offsets of Standard Parallels
A
B
C
Surveyed
Not Surveyed

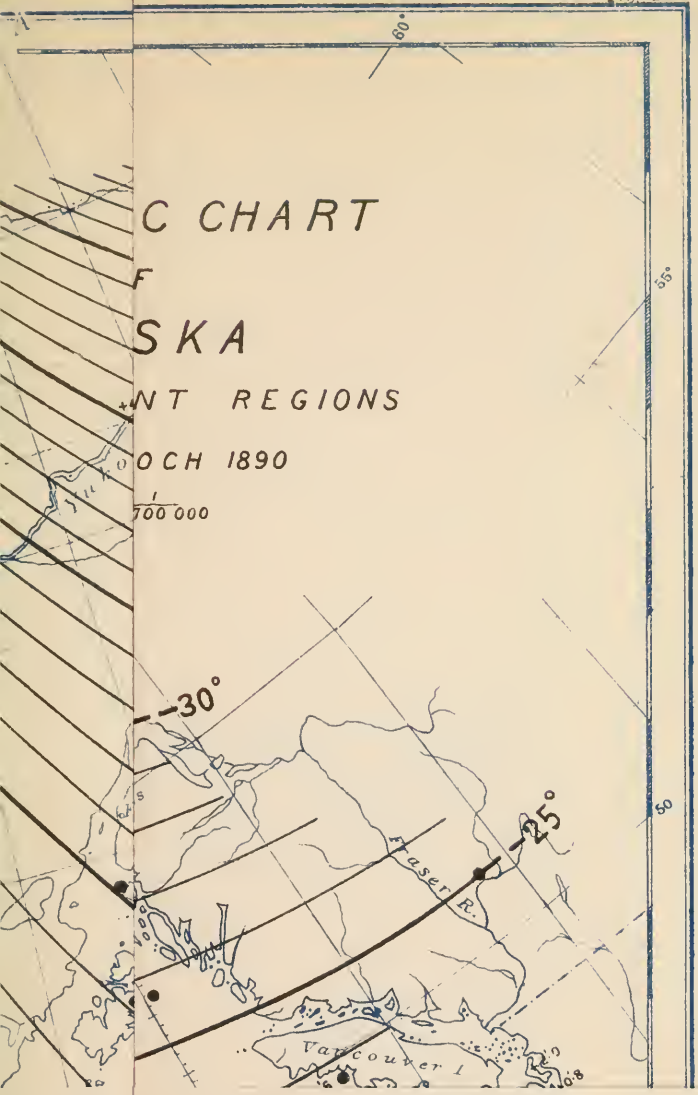
PLATE IX.

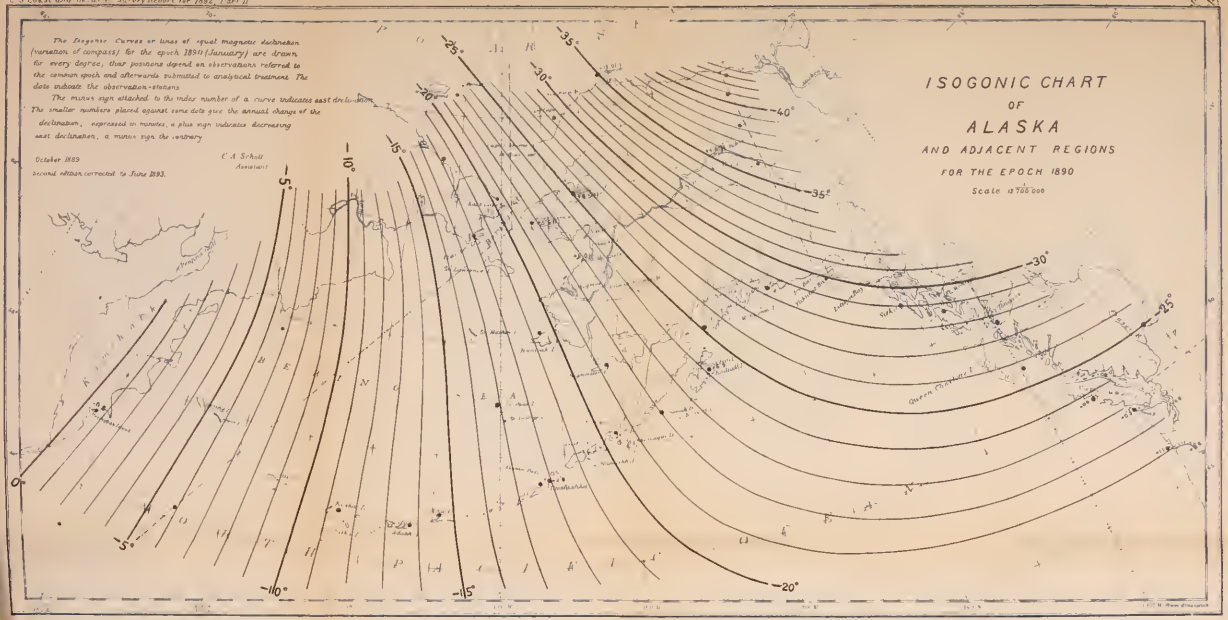

R.7W.
R.6W.
R.5W.
T. 4N.
T.3N.
T.2N.
Lat. 38.00 N.
Lat. 38.00 N.
MOUNTAIN LAKE
OLD SURVEYS
NOT SURVEYED
EXPLANATIONS
R.7W.
R.6W.
R.5W.

UNITED STATES COAST AND GEODETIC SURVEY

T C Mendenhall, Superintendent.

ISOGONIC CHART OF THE UNITED STATES FOR THE EPOCH 1890


C CHART
F
SKA
NT REGIONS
OCH 1890
1/700 000
60°
55°
50°
-30°
-25°
Fraser R.
Vancouver I.


The Isogonic Curves or lines of equal magnetic declination (variation of compass) for the epoch 1890 (January) are drawn for every degree, their positions depend on observations referred to the common epoch and afterwards submitted to analytical treatment. The dots indicate the observation-stations.
The minus sign attached to the index number of a curve indicates east declination. The smaller numbers placed against some dots give the annual change of the declination, expressed in minutes, a plus sign indicates decreasing east declination, a minus sign the contrary.
October 1889
C. A. Schott
Assistant
Second edition corrected to June 1893.
ISOGONIC CHART
OF
ALASKA
AND ADJACENT REGIONS
FOR THE EPOCH 1890
Scale 1:7 500 000
0°
-5°
-10°
-15°
-20°
-25°
-30°
-35°
-40°

U S COAST AND GEODETIC SURVEY
T.C Mendenhall, Superintendent.

No XII.

MAGNETIC MERIDIANS OF THE UNITED STATES FOR JANUARY 1890.

Coast & Geodetic Survey Report for year 1888-89

AND PRESENT ANNUAL CHANGE OF THE DECLINATION.

The annual change of the magnetic declination is given for each secular variation station; it is expressed in minutes of arc and may be used for a few years before and after the year 1890, a + sign indicates increasing west declination or decreasing east declination, a minus sign the reverse motion.

Computing Division, C. & G. S. Office, Oct 1889

L. A. Schott
Assistant