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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.

JANUARY 1, 1890.

WASHINGTON:
GOVERNMENT PRINTING OFFICE
1890.

DEPARTMENT OF THE INTERIOR,
 GENERAL LAND OFFICE,
 Washington, D. C., December 2, 1889.

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 and your deputy surveyors.

Very respectfully,

LEWIS A. GROFF,
Commissioner.

To SURVEYORS GENERAL OF THE UNITED STATES.

INTRODUCTORY.

The present system of survey of the public lands was inaugurated by a committee appointed by the Continental Congress, and 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 record 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

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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 dis-

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tance 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 township, 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 watercourse 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

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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 watercourse, 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 two acts last 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 working 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 direct 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."

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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 comprise 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.

[The remainder of page 9 and pages 10 through 16 and part of page 17 are deleted. These pages contain the Revised Statutes pertaining to the public land surveys, and forms of contracts between Surveyors General and the Deputies.]

SYSTEM OF RECTANGULAR SURVEYING.

1. The public lands of the United States are ordinarily

surveyed into rectangular tracts, bounded by lines conforming to the cardinal points.

2. The public lands shall be laid off, in the first place, into bodies of land of 24 miles square, as near as may be. This shall be done by the extension of standard lines from the principal meridian every 24 miles, and by the extension, from the base and standard lines, of guide meridians every 24 miles. Thereafter they shall be laid off into bodies of land of 6 miles square, as near as may be, called *townships*, containing as near as may be 23,040 acres. The townships shall be subdivided into 36 tracts, called sections, each containing as near as may be 640 acres. Any number or series of contiguous townships, situate north or south of each other, constitute a *range*.

The law requires that the lines of the public surveys shall be governed by the true meridian, and that the townships shall be *six miles square*—two things involving in connection a mathematical impossibility—for, strictly to conform to the meridian, necessarily throws the township out of square, by reason of the convergency of meridians, and hence, by adhering to the true meridian, results the necessity of departing from the strict requirements of law as respects the precise area of townships and the subdivisional parts thereof, the townships assuming something of a trapezoidal form, which inequality develops itself more and more as such, the higher the latitude of the surveys. It is doubtless in view of these circumstances that the law provides (see section 2 of the act of May 18, 1796) that the sections of a mile square shall contain the quantity of 640 acres, *as nearly as may be*; and, moreover, provides (see section 3 of the act of May 10, 1800) in the following words: "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 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 the 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 accompanying diagram, marked B, and the specimen field-notes pertaining to the same, will serve to illustrate the method of running

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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 conforming with the township diagram C. The method here presented is designed to insure as full a compliance with all the requirements, meaning, and intent of the surveying laws as, it believed, is practicable.

The section lines are surveyed from *south* to north on true meridians,¹ and from *east* to west, in order to throw the

1. See method of subdividing and remarks under the heading "Table III. Azimuths of the tangent to the parallel."

excesses or deficiencies in measurements 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 the only north or west portions of the township can be surveyed, this rule can not be strictly adhered to, but, in such cases, must 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 townships are to bear numbers in respect to the base line, either north or south of it; and the tiers of townships called "ranges" will bear numbers in respect to the meridian line according to their relative position to it, either on the east or west.

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, until THE NUMBER THIRTY/SIX IN THE SOUTHEAST ANGLE. In all cases of surveys of fractional townships, the sections should bear the same numbers as they would 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; the object being to confine the errors resulting from convergence of meridians, and inaccuracies in measurements, within the tracts of lands bounded by the lines so established.

6. The survey of all principal base and meridian, standard parallels, and guide meridian, and township lines must be made with an instrument operating independently of the magnetic needle. Burt's *improved solar compass*, or other instrument of equal utility, must be used of necessity in such cases; and it is deemed best that such instrument should be used under all circumstances. Where the needle can be relied on, however, the ordinary compass, if provided with a revolving compass box and variation arc, may be used in subdividing and meandering. Whenever deputies use instruments with magnetic apparatus only, they must test the accuracy of their work and the condition of their instruments by at least three observations upon a circumpolar star, upon different days, between the commencement and the close of surveying operations in any given township, an preferably at the southeast and southwest corners of the township and at or near the corner to sections 9, 10, 15 and 16. Deputies using instruments with solar apparatus are also required to make observations of the star Polaris at the *beginning* of every survey and they must examine the adjustments of their instruments and take the latitude² daily, weather

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permitting, in running base, standard, meridian, and range lines, and upon three different days during the execution of subdivisional surveys in each township. They must make complete records in their field-notes, under proper dates, of the making of *all observations* in compliance with these instructions, showing the style and condition of the instrument

in use, and the angle formed, by comparing the line run with the meridian as by observation determined.

7. The construction and adjustments of all surveying instruments used in the surveying of the public lands of the United States must be tested at least once a year,³ and often if necessary, by comparison with the true meridian, established under the direction of the surveyor-general of the district; and the instruments must be so modified in construction, or in such a way corrected, as may be necessary to produce the closest possible approximation to accuracy and uniformity in the operation of all such instruments. A record will be made of such examinations, showing the number and style 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 for correction. The surveyor-general will allow no surveys to be made until the instruments to be used therefor have been approved by him.

8. The township lines and the subdivision lines will usually be measured by a two-pole chain of 33 feet in length,⁴ consisting of 50 links, and each link being seven and ninety-two hundredths of an inch long. On uniform and level ground, however, the four-pole chain may be used. The measurements will, however, always be represented according to the four-pole chain of 100 links. The deputy surveyor must 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 must be compared and adjusted with this field standard each working day, and such field standard must be returned to the surveyor-general's office for examination when his work is completed.

OF TALLY PINS.

9. You 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 is to 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.

10. In measuring lines with a two-pole chain, every *five* chains are called "*a tally*," and in measuring lines with a four-pole chain, every *ten* chains are called "*a tally*," because at that distance the last of the ten tally pins with which the forward chainman set 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

2. Taking the latitude does not necessarily prove the correctness of adjustments.

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

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

setting the pins that he has taken up, so that one is forward in all

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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 mis-tally almost impossible.

LEVELING THE CHAIN AND PLUMBING THE PINS.

11. The length of every line you run is to 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:

(1) Ever keeping the chain *stretched* to its utmost degree of tension on even ground.

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

(3) 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.

12. All lines on which are to be established the legal corner boundaries are to be marked after this method, viz: Those trees which may intercept your line must have two chops or notches cut on each side of them 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, are to 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 the farther the line passes from the blazed trees. Due care must ever be taken to have the lines so well marked as to be readily followed, and to cut the blazes deep enough to have recognizable scars as long as the trees stand.

Where trees 2 inches or more in diameter are found, the required blazes must 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.

ON TRIAL, OR RANDOM LINES,

the trees are not to be blazed, unless occasionally, from indispensable necessity, and then it must 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 lines and establish therefrom the *true line*. To prevent confusion, the temporary stakes set on the trial or random lines must be *pulled up* when the surveyor returns to establish the true line.

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INSUPERABLE OBJECTS ON LINE— WITNESS POINTS.

13. Under circumstances where your course is obstructed by impassable obstacles, such as ponds, swamps, marshes, lakes, rivers, creeks, &c., you will prolong the line across such obstacles by taking the necessary right angle offsets; or, if such be inconvenient, by a traverse or trigonometrical operation, until you regain the line on the opposite side. And in case a north and south, or a true east and west, line is regained in advance of any such obstacle, you will prolong and mark the line back to the obstacle so passed, and state all the particulars in relation thereto in your field-book. And at the intersection of lines with both margins of impassable obstacles, you will establish a *witness point* (for the purpose of perpetuating the intersections therewith), by setting a post, and giving in your field-book the course and distance therefrom to two trees on opposite sides of the line, each of which trees you will mark with a blaze and notch facing the post; but on the margins of navigable water-courses, or navigable lakes, you will mark the trees with the proper number of the fractional section, township, and range.

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

ESTABLISHING CORNERS.

To procure the faithful execution of this portion of a surveyor's duty is a matter of the utmost importance. After a true coursing and most exact measurements the establishment of corners is the consummation of the work. If, therefore, the corner be not perpetuated in a permanent and workmanlike manner the *great aim* of the surveying service will not have been attained.

The following are the different points for perpetuating corners, viz:

1. For township boundaries, at intervals of every 6 miles.
2. For section boundaries, at intervals of every mile, or 80 chains.
3. For quarter-section boundaries, at intervals of every half mile, or 40 chains. Exceptions, however, occur as fully set forth hereafter in that portion of the manual showing the manner of running township lines and methods of subdividing.
4. Meander corners are established at all those points where the lines of the public surveys intersect the banks of such rivers, bayous, lakes, or islands as are by law directed to be meandered.

DESCRIPTION OF CORNERS.

The following is the form and language to be used by deputy surveyors in describing the establishment of corners in their field-notes, and their work in the field must strictly comply with the same.

STANDARD TOWNSHIP CORNERS.

SEC. 1. ⁵Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground, for Standard Cor. to (e. g.) Tps. 5 N., R's 2 & 3 W., marked S. C., with 6 notches on N., E., & W. edges, dug pits 24 x 18 x 12 ins. crosswise on each line, N., E., & W. of stone 6 ft. dist. and raised a mound of earth, 2½ ft. high, 5 ft. base alongside.

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SEC. 2. ⁶Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground, for Standard Cor. to (e. g.) Tps. 5 N., R's 2 & 3 W., maked S. C., with 6 notches on N., E. & W. edges, and raised a mound of stone, ⁷ ½ ft. high, 2 ft. base, alongside. Pits impracticable.

SEC. 3. ⁸Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground, for Standard Cor. to (e. g.) Tps. 5 N., R's 2 & 3 W., marked S. C., with 6 notches on N., E. & W. edges, from which

A _____, _____ ins. diam., bears N. _____° E. _____ lks., dist. marked T. 5 N., R. 2 W. S. 31, B. T.

A _____, _____ ins. diam. bears N. _____° W. _____ lks., dist. marked T. 5 N., R. 3 W. S. 36, B. T.

A _____, _____ ins. diam., bears S. _____° W. _____ lks., dist. marked⁹ S. C. T. 5 N., R's 2 & 3 W., B. T.

SEC. 4. ¹⁰Set a post, 4½ ft. long, 4 ins. square, with marked stone (charred stake or quart of charcoal), 12 ins. in the ground, for Standard Cor. to (e. g.) Tps. 5 N., R's 2 & 3 W., marked

S. C. T. 5 N. on N.

R. 2 W. S. 31, on E. and

R. 3 W. S. 36 on W. faces, with 6 notches on N., E., & W. faces, dug pits, 24 x 18 x 12 ins. crosswise on each line, N., E., & W. of post, 6 ft. dist. and raised a mound of earth 2½ ft. high, 5 ft. base, around post.

SEC. 5. ¹¹Set a post, 4½ ft. long, 4 ins. square, 24 ins. in the ground for Standard Cor. to (e. g.) Tps. 5 N., R's 2 & 3 W. marked.

S. C. T. 5 N. on N.

R. 2 W. S. 31, on E. and

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

A _____, _____ ins. diam., bears N. _____° E. _____ lks., dist. marked T. 5 N., R. 2 W. S. 31, B. T.

A _____, _____ ins. diam., bears N. _____° W. _____ lks., dist. marked T. 5 N., R. 3 W. S. 36, B. T.

A _____, _____ ins., diam. bears S. _____° W. _____ lks., dist. marked⁹ S. C. T. 5 N., R's 2 & 3 W., B. T.

SEC. 6. ¹²Deposited a marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for Standard Cor. to (e. g.) Tps. 5 N., R's 2 & 3 W., dug pits. 24 x 18 x 12 ins. crosswise on each line, N., E., & W. of cor., 6 ft. dist. and raised a mound of earth 2½ feet high, 5 ft. base, over it. In E. pit drove a stake 2 ins. square, 2 ft. long, 12 ins. in the ground, marked

S. C. T. 5 N. on N.

R. 2 W. S. 31 on E. and

R. 3 W. S. 36 on W. faces, with 6 notches on N., E., & W. faces.

SEC. 7. ¹³A _____, _____ ins. diam., which I marked (e. g.)

S. C. T. 5 N. on N.

R. 2 W. S. 31 on E. and

R. 3 W. S. 36 on W. sides, with 6 notches on N., E., & W. sides, dug pits 24 x 18 x 12 ins. crosswise on each line, N., E., & W. of tree 6 ft. dist. and raised a mound of earth around tree, for Standard Cor. to Tps. 5 N., R's 2 & 3 W.

SEC. 8. ¹⁴A _____, _____ ins. diam., which I marked (e. g.)

T. 5 N. S. C. on N.

R. 2 W. S. 31, on E. and

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R. 3 W. S. 36 on W. sides, with 6 notches on N., E., & W. sides, for Standard Cor. to Tps. 5 N., R's 2 & 3 W.; from which A _____, _____ ins. diam., bears N. _____° E. _____ lks. dist. marked T. 5 N., R. 2 W. S. 31, B. T.

A _____, _____ ins. diam., bears N. _____° W. _____ lks. dist. marked T. 5 N., R. 3 W. S. 36, B. T.

A _____, _____ ins. diam., bears S. _____° W. _____ lks. dist. marked⁹ S. C. T. 5 N., R's 2 & 3 W., B. T.

CLOSING TOWNSHIP CORNERS.

SEC. 1. ⁵Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground for Closing Cor. to (e. g.) Tps. 4 N., R's 2 & 3 W., marked C. C. with 6 notches on S. E. & W. edges, dug pits, 24 x 18 x 12 ins., crosswise on each line, S., E. & W. of stone, 6 ft. dist., and raised a mound of earth, 2½ ft. high, 5 ft. base alongside.

SEC. 2. ⁶Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground for Closing Cor. to (e. g.) Tps. 4 N., R's 2 & 3 W., marked C. C. with 6 notches on S., E. & W. edges, and raised a mound of stone 1½ ft. high, 2 ft. base, alongside. Pits impracticable.

SEC. 3. ⁸Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground for Closing Cor. to (e. g.) tps. 4 N., R's 2 & 3 W., marked C. C. with 6 notches on S., E., & W. edges; 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.

5. Stone with Pits and Mound.

6. Stone with Mound of Stone.

7. To consist of not less than four stones. Mound to be at least 1½ ft. high, with 2 ft. base.

8. Stone with Bearing Trees.

9. See "Miscellaneous," sec. 4, page 32.

10. Post in Mound.

11. Post with Bearing Trees.

12. Mound without Post or Stone.

13. Tree Corner without Bearing Trees.

14. Tree Corner with Bearing Trees.

A _____, _____ ins. diam. bears N. _____° W. _____ lks. dist. marked⁹ C. C. T. 4 N., R's 2 & 3 W., B. T.

SEC. 4. ¹⁰Set a post, 4½ ft. long, 4 ins. square, with marked stone (charred stake or quart of charcoal) 12 ins. in the ground for Closing Cor. to (e. g.) Tps. 4 N., R's 2 & 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 notches on S., E., & W. faces, dug pits 24 x 18 x 12 ins., crosswise on each line, S., E., & W. of post, 6 ft. dist., and raised a mound of earth 2½ ft. high, 5 ft. base, around post.

SEC. 5. ¹¹Set a post, 4½ ft. long, 4 ins. square, 24 ins. in the ground, for Closing Cor. to (e. g.) Tps. 4 N., R's 2 & 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 notches on S., E. & 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.

A _____, _____ ins. diam., bears N. _____° W. _____ lks. dist., marked⁹ C.C.T. 4 N., R's 2 & 3 W., B. T.

SEC. 6. ¹²Deposited a marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for Closing Cor., to (e. g.) Tps. 4 N., R's 2 & 3 W., dug pits 24 x 18 x 12 ins. crosswise on each line, S., E., & W. of corner, 6 ft. dist., and raised a mound of earth 2½ ft. high, 5 ft. base, over it. In E pit drove a stake 2 ins. square, 2 ft. long, 12 ins. in the ground, marked

C. C. T. 4 N. on S.

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R. 2 W. S. 6, on E. and

R. 3 W. S. 1 on W. faces, with 6 notches on S., E. & W. faces.

SEC. 7. ¹³A _____, _____ ins. diam., which I marked (e. g.)

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. & W. sides, dug pits 24 x 18 x 12 ins. crosswise on each line S. E. & W. of tree, 6 ft. dist., and raised a mound of earth around tree, for Closing Cor. to Tps. 4 N., R's 2 & 3 W.

SEC. 8. ¹⁴A _____, _____ ins. diam., which I marked (e. g.)

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. & W. sides for Closing Cor. to Tps. 4 N., R's 2 & 3 W.; 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.

A _____, _____ ins. diam. bears N. _____° W. _____ lks. dist., marked⁹ C. C. T. 4 N., R's 2 & 3 W., B. T.

SEC. 9. All Closing Township Corners must be connected with the nearest standard corner on the Standard Line.

STANDARD SECTION CORNERS.

SEC. 1. ⁵Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Standard Cor. to (e. g.) Secs. 35 & 36, marked S. C., with 1 notch on E. and 5 notches on W. edges, dug pits, 18 x 18 x 12 ins., N., E. & W. of stone 5½ ft. dist., and raised a mound of earth 2 ft. high, 4½ ft. base, alongside.

SEC. 2. ⁶Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Standard Cor. to (e. g.) Secs. 33 & 34, marked S. C., with 3 notches on E. & W. edges, and raised a mound of stone, ½ ft. high, 2 ft. base, alongside. Pits impracticable.

SEC. 3. ⁸Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Standard Cor. to (e. g.) Secs. 35 & 36, marked S. C., with 1 notch on E. and 5 notches on W. edges, from which

A _____, _____ ins. diam. bears N. _____° E. _____ lks. dist. marked T. 5 N., R. 3 W. S. 36, B. T.

A _____, _____ ins. diam. bears N. _____° W. _____ lks. dist. marked T. 5 N., R. 3 W. S. 35, B. T.

A _____, _____ ins. diam. bears S. _____° E. _____ lks. dist. marked⁹ T. 5 N., R. 3 W. S. C. S. 35 & 36, B. T.

SEC. 4. ¹⁰Set a post, 4 ft. long, 4 ins. square, with marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for Standard Cor. to (e. g.) Secs. 35 & 36, marked S. C. T. 5 N., R. 3 W., on N.

S. 36, on E., and

S. 35 on W. faces, with 1 notch on E. and 5 notches on W. faces, dug pits 18 x 18 x 12 ins., N., E. and W. of post, 5½ ft. dist., and raised a mound of earth 2 ft. high, 4½ ft. base round post.

SEC. 5. ¹¹Set a post 4 ft. long, 4 ins. square, 24 ins. in the ground, for Standard Cor. to (e. g.) Secs. 35 & 36, marked S. C. T. 5 N., R. 3 W., on N.

S. 36, on E. and

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S. 35 on W. faces, with 1 notch on E. and 5 notches on W. faces; from which

A _____, _____ ins. diam. bears N. _____° E. _____ lks. dist., marked T. 5 N., R. 3 W. S. 36, B. T.

A _____, _____ ins. diam. bears N. _____° W. _____ lks. dist. marked T. 5 N., R. 3 W. S. 35, B. T.

A _____, _____ ins. diam. bears S. _____° E. _____ lks. dist. marked⁹ T. 5 N., R. 3 W. S. C. S. 35 & 36, B. T.

SEC. 6. ¹²Deposited a marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for Standard Cor. to (e. g.)

5. Stone with Pits and Mound.

6. Stone with Mound of Stone.

7. To consist of not less than four stones. Mound to be at least 1½ ft. high, with 2 ft. base.

8. Stone with Bearing Trees.

9. See "Miscellaneous," sec. 4, page 32.

10. Post in Mound.

11. Post with Bearing Trees.

12. Mound without Post or Stone.

13. Tree Corner without Bearing Trees.

14. Tree Corner with Bearing Trees.

Secs. 33 & 34, dug pits, 18 x 18 x 12 ins., N., E. and W. of corner, 5½ ft. dist., and raised a mound of earth 2 ft. high, 4¼ ft. base, over it. In E. pit drove a stake 2 ins. square, 2 ft. long, 12 ins. in the ground, marked

T. 5 N., R. 3 W., S. C. on N.

S. 34 on E. and

S. 33 on W. faces, with 3 notches on E. & W. faces.

SEC. 7. ¹³A _____, _____ ins. diam., which I marked (e. g.)

S. C. T. 5 N., R. 3 W., on N.

S. 36. on E. and

S. 35 on W. sides, with one notch on E. and 5 notches on W. sides, dug pits, 18 x 18 x 12 ins. N., E. & W. of tree, 5½ ft. dist. and raised a mound of earth around tree, for Standard Cor. to Secs. 35 & 36.

SEC. 8. ¹⁴A _____, _____ ins. diam., which I marked (e. g.)

S. C. T. 5 N., R. 3 W., on N.

S. 36, on E. and

S. 35 on W. sides, with 1 notch on E. and 5 notches on W. sides, for Standard Cor. to Secs. 35 & 36; from which

A _____, _____ ins. diam. bears N. _____° E. _____ lks. dist. marked T. 5 N., R. 3 W., S. 36, B. T.

A _____, _____ ins. diam. bears N. _____° W. _____ lks. dist. marked T. 5 N., R. 3 W., S. 35, B. T.

A _____, _____ ins. diam. bears S. _____° E. _____ lks. dist. marked⁹ T. 5 N., R. 3 W., S. C. S. 35 & 36, B. T.

CLOSING SECTION CORNERS.

SEC. 1. ⁵Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Closing Cor. to (e. g.) Secs. 1 & 2, marked C. C., with 1 notch on E. and 5 notches on W. edges, dug pits, 18 x 18 x 12 ins. S., E. & W. of stone, 5½ feet dist., and raised a mound of earth 2 ft. high, 4½ ft. base alongside.

SEC. 2. ⁶Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Closing Cor. to (e. g.) Secs. 3 & 4, marked C. C., with 3 notches on E. and W. edges, and raised a mound of stone 1½ ft. high, 2 ft. base, alongside. Pits impracticable.

SEC. 3. ⁸Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Closing Cor. to (e. g.) Secs. 1 & 2, marked C. C., with 1 notch on E. and 5 notches 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.

A _____, _____ ins. diam., bears N. _____° E. _____ lks. dist. marked⁹ T. 4 N., R. 3 W., C. C. S. 1 & 2 B. T.

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SEC. 4 ¹⁰Set a post 4 ft. long, 4 ins. square, with marked stone (charred stake or quart of charcoal) 12 ins. in the ground for Closing Cor. to (e. g.) Secs. 1 & 2, marked

C. C. T. 4 N., R. 3 W., on S.

S. 1 on E., and

S. 2 on W. faces, with 1 notch on E. and 5 notches on W. faces, dug pits 18 x 18 x 12 ins., S., E. & W. of post 5½ ft. dist.,

and raised a mound of earth 2 ft. high, 4½ ft. base around post.

SEC. 5. ¹¹Set a post 4 ft. long, 4 ins. square, 24 ins. in the ground, for Closing Cor. to (e. g.) Secs. 1 & 2, marked

C. C. T. 4 N., R. 3 W., on S.

S. 1 on E. and

S. 2 on W. faces, with 1 notch on E and 5 notches 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.

A _____, _____ ins. diam., bears N. _____° E. _____ lks. dist. marked⁹ T. 4 N., R. 3 W., C. C. S. 1 & 2, B. T.

SEC. 6. ¹²Deposited a marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for Closing Cor. to (e. g.) Secs. 3 & 4, dug pits, 18 x 18 x 12 ins., S., E. & W. of Cor. 5½ ft. dist., and raised a mound of earth 2 ft. high, 4½ ft. base, over it. In E. pit drove a stake, 2 ins. square, 2 ft. long, 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 notches on E. & W. faces.

SEC. 7 ¹³A _____, _____ ins. diam., which I marked (e. g.)

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 x 18 x 12 ins. S., E. & W. of tree, 5½ ft. dist., and raised a mound of earth around tree, for closing Cor. to Secs. 1 & 2.

SEC. 8. ¹⁴A _____, _____ ins. diam., which I marked (e. g.)

C. C. T. 4 N., R. 3 W., on S.

S. 1, on E., and

S. 2 on W. sides, with one notch on E. and 5 notches on W. sides, for Closing Cor. to Secs. 1 & 2; 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.

A _____, _____ ins. diam., bears N. _____° E. _____ lks. dist. marked⁹ T. 4 N., R. 3 W., C. C. S. 1 & 2, B. T.

SEC. 9. ¹⁵All Section Closing Corners must be connected with the nearest standard corner on the Standard line.

5. Stone with Pits and Mound.

6. Stone with Mound of Stone.

7. To consist of not less than four stones. Mound to be at least 1½ ft. high, with 2 ft. base.

8. Stone with Bearing Trees.

9. See "Miscellaneous," sec. 4, page 32.

10. Post in Mound.

11. Post with Bearing Trees.

12. Mound without Post or Stone.

13. Tree Corner without Bearing Trees.

14. Tree Corner with Bearing Trees.

15. Connection Lines.

CORNERS COMMON TO FOUR TOWNSHIPS.

SEC. 1. ⁵Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground for Cor. to (e. g.) Tps. 2 & 3 N., R's 2 & 3 W., marked with 6 notches on each edge, dug pits, 24 x 18 x 12 ins. lengthwise on each line, N., S., E. & W. of stone, 6 ft. dist., and raised a mound of earth 2½ ft. high, 5 ft. base alongside.

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SEC. 2. ⁶Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Cor. to (e. g.) Tps. 2 & 3 N., R's 2 & 3 W. marked with 6 notches on each edge, and raised a mound of stone 1½ ft. high, 2 ft. base, alongside. Pits impracticable.

SEC. 3. ⁸Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Cor. to (e. g.) Tps. 2 & 3 N. R. 2 & 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.

SEC. 4. ¹⁰Set a post, 4½ ft. long 4 ins. square, with marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for Cor. to (e. g.) Tps. 2 & 3 N., R's 2 & 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 x 18 x 12 ins., lengthwise on each line, N., S., E., & W. of post, 6 ft. dist., and raised a mound of earth 2½ ft. high, 5 ft. base around post.

SEC. 5. ¹¹Set a post 4½ ft. long, 4 ins. square, 24 ins. in the ground, for Cor. to (e. g.) Tps., 2 & 3 N., R's 2 & 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.

SEC. 6. ¹²Deposited a marked stone (charred stake or quart of charcoal) 12 ins. in the ground for Cor. to (e. g.) Tps. 2 & 3 N., R's 2 & 3 W., dug pits, 24 x 18 x 12 ins., lengthwise on each line, N., S., E., & W. of Cor., 6 ft. dist., and raised a mound of earth 2½ ft. high, 5 ft. base over it. In E. pit drove a stake 2 ins. square, 2 ft. long, 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.
SEC. 7. ¹³A _____, _____ ins. diam., which I marked (e. g.)

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 x 18 x 12 ins. lengthwise on each line, N., S., E., &

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W. of tree, 6 ft. dist., and raised a mound of earth around tree, for Cor. to Tps. 2 & 3 N., R's 2 & 3 W.

SEC. 8. ¹⁴A _____, _____ ins. diam., which I marked (e. g.)

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, for Cor. to Tps. 2 & 3 N., R's 2 & 3 W., 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 FOUR SECTIONS.

SEC. 1. ⁵Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground for Cor. to (e. g.) Secs. 25, 26, 35, & 36, marked with 1 notch on S. & E. edges, dug pits, 18 x 18 x 12 ins. in each Sec., 5½ ft. dist., and raised a mound of earth 2 ft. high, 4½ ft. base alongside.

SEC. 2. ⁶Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground, for Cor. to (e. g.) Secs. 14, 15, 22, & 23, marked with 3 notches on S. and 2 notches on E. edges, and raised a mound of stone 1½ ft. high, 2 ft. base, alongside. Pits impracticable.

SEC. 3. ⁸Set a _____ stone _____ x _____ x _____ ins. _____ ins. in the ground, for Cor. to (e. g.) Secs. 9, 10, 15, & 16, marked with 4 notches on S. & 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.

5. Stone with Pits and Mound.

6. Stone with Mound of Stone.

7. To consist of not less than four stones. Mound to be at least 1½ ft. high, with 2 ft. base.

8. Stone with Bearing Trees.

9. See "Miscellaneous," sec. 4, page 32.

10. Post in Mound.

11. Post with Bearing Trees.

12. Mound without Post or Stone.

13. Tree Corner without Bearing Trees.

14. Tree Corner with Bearing Trees.

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.

SEC. 4 ¹⁰Set a post 4 ft. long, 4 ins. square, with marked
stone (charred stake or quart of charcoal) 12 ins. in the
ground, for Cor. to (e. g.) Secs, 15, 16, 21, & 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. & E. edges, dug
pits, 18 x 18 x 12 ins. in each Sec., 5½ ft. dist., and raised a
mound of earth 2 ft. high, 4½ ft. base around post.

SEC. 5. ¹¹Set a post 4 ft. long, 4 ins. square, 24 ins. in the
ground, for Cor. to (e. g.) Secs. 25, 26, 35, & 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. & 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.

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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.

SEC. 6. ¹²Deposited a marked stone (charred stake or quart
of charcoal) 12 ins. in the ground, for Cor. to (e. g.) Secs. 25,
26, 35, & 36, dug pits, 18 x 18 x 12 ins. in each Sec., 5½ ft.
dist., and raised a mound of earth 2 ft. high, 4½ ft. base over
it.

In S. E. pit drove a stake 2 ins. square, 2 ft. long, 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. & E. edges.

SEC. 7. ¹³A _____, _____ ins. diam., which I marked (e.
g.)

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 x 18 x 12 ins. in each sec. 5½ ft. dist. and
raised a mound of earth around tree, for Cor. to Secs. 29, 30,
31, & 32.

SEC. 8. ¹⁴A _____, _____ ins. diam., which I marked (e.
g.)

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. & E. sides, for Cor.
to Secs. 5, 6, 7 & 8; 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.

ARTICLE X.

QUARTER SECTION CORNERS.

SEC. 1. ⁵Set a _____ stone _____ x _____ x _____
ins., _____ ins. in the ground, for ¼ Sec. Cor., marked ¼ on
N. (or W.) face, dug pits, 18 x 18 x 12 ins., N. & S. (or E. & W.)
of stone 5½ ft. dist., and raised a mound of earth 1½ ft. high,
3½ ft. base alongside.

SEC. 2. ⁶Set a _____ stone _____ x _____ x _____
ins., _____ ins. in the ground, for ¼ Sec. Cor., marked ¼ on
N. (or W.) face, and raised a mound of stone 1½ ft. high, 2 ft.
base, alongside. Pits impracticable.

SEC. 3. ⁸Set a _____ stone _____ x _____ x _____
ins., _____ ins. in the ground, for ¼ Sec. Cor., marked ¼ on
N. (or W.) face; from which

A _____, _____ ins. diam., bears N. _____ ° E. _____
lks. dist. marked ¼ S. B. T.

A _____, _____ ins. diam., bears S. _____ ° W. _____
lks. dist. marked ¼ S. B. T.

SEC. 4. ¹⁰Set a post 3 ft. long, 3 ins. square, with marked
stone (charred stake or quart of charcoal) 12 ins. in the
ground, for ¼ Sec. Cor., marked ¼ S. on N. (or W.) face, dug
pits, 18 x 18 x 12 ins., N. & S., (or E. and W.) of post 5½ ft.
dist., and raised a mound of earth 1½ ft. high, 3½ ft. base
around post.

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SEC. 5. ¹¹Set a post 3 ft. long, 3 ins. square, 24 ins. in the
ground, for ¼ Sec. Cor., marked ¼ S. on N. (or W.) face; from
which

A _____, _____ ins. diam., bears N. _____ ° E. _____
lks., dist. marked ¼ S. B. T.

A _____, _____ ins. diam., bears S. _____ W. _____
lks., dist. marked ¼ S. B. T.

SEC. 6. ¹²Deposited a marked stone (charred stake or quart
of charcoal) 12 ins. in the ground, for ¼ Sec. Cor., dug pits, 18
x 18 x 12 ins., N. & S. (or E. & W.) of corner 5½ ft. dist. and
raised a mound of earth 1½ ft. high, 3½ ft. base over it. In E.
(or N.) pit drove a stake 2 ft. long, 2 ins. square, 12 ins. in the
ground, marked ¼ S. on N. (or W.) face.

5. Stone with Pits and Mound.

6. Stone with Mound of Stone.

7. To consist of not less than four stones. Mound to be at least 1½ ft. high, with 2 ft. base.

8. Stone with Bearing Trees.

9. See "Miscellaneous," sec. 4, page 32.

10. Post in Mound.

11. Post with Bearing Trees.

12. Mound without Post or Stone.

SEC 7. ¹³A _____, _____ ins. diam., which I marked $\frac{1}{4}$ S. on N. (or W.) side, for $\frac{1}{4}$ Sec. Cor., dug pits, 18 x 18 x 12 ins. N. & S. (or E. & W.) of tree, $5\frac{1}{2}$ ft. dist. and raised a mound of earth around tree.

SEC. 8. ¹⁴A _____, _____ ins. diam., which I marked $\frac{1}{4}$ S. on N. (or W.) side, for $\frac{1}{4}$ Sec. Cor.; from which

A _____, _____ ins. diam., bears N. _____° E. _____ lks. dist. marked $\frac{1}{4}$ S. B. T.

A _____, _____ ins. diam., bears S. _____° W. _____ lks. dist. marked $\frac{1}{4}$ S. B. T.

SEC. 9. ¹⁶On N. and S. lines the marks must be made on W. side, and on E. and W. lines on N. side of the stone, post, or tree.

SEC. 10. ¹⁷On N. & S. lines the pits must be dug N. & S. of Cor., and on E. & W. lines E. & W. of Cor.

SEC. 11. ¹⁸On N. & S. lines the stakes must be driven in N. pit, and on E. & W. lines in E. Pit.

STANDARD QUARTER SECTION CORNERS.

All Quarter Section Corners on Standard lines must be established in all respects like other Quarter Section Corners, with the addition of the letters S. C., and if bearing trees are established for such Corners, each tree must be marked S. C. $\frac{1}{4}$ S. B. T.

MEANDER CORNERS.

SEC. 1. ⁵Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground for Meander Cor. to (e. g.) Fractional Secs. 1 & 2, marked M. C. on _____ face, dug a pit 3 ft. square, 1 ft. deep, 8 lks. _____ of stone, and raised a mound of earth 2 ft. high, $4\frac{1}{2}$ ft. base alongside.

SEC. 2. ⁶Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Meander Cor. to (e. g.) Fractional Secs. 35 & 36, marked M. C. on _____ face, and raised a mound of stone $1\frac{1}{2}$ ft. high, 2 ft. base, alongside. Pits impracticable.

SEC. 3. ⁸Set a _____ stone _____ x _____ x _____ ins., _____ ins. in the ground, for Meander Cor. to (e. g.) Fractional Secs. 9 & 10, marked M. C. on _____ face; from which

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

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

SEC. 4. ¹⁰Set a post 4 ft. long, 4 ins. square, with marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for Meander Cor. to (e. g.) Fractional Secs. 35 & 36, marked M. C. on _____ face, with

T. 2 N. on N.

R. 2 W. S. 36, on E. and

S. 35 on W. faces, dug a pit 3 ft. square, 1 ft. deep, 8 lks. _____ of post, and raised a mound of earth 2 ft. high, $4\frac{1}{2}$ ft. base, around post.

R. 2 W. S 21 on E. and

S. 20 on W. faces; from which

A _____, _____ ins. diam., bears S. _____° E. _____ lks. dist. marked T. 2 N., R. 2 W. S. 21, M. C. B. T.

A _____, _____ ins. diam., bears S. _____° W. _____ lks. dist. marked T. 2 N., R. 2 W. S. 20, M. C. B. T.

SEC. 6. ¹²Deposited a marked stone (charred stake or quart of charcoal) 12 ins. in the ground, for Meander Cor. to (e. g.) Fractional Secs. 11 & 12, dug a pit, 3 ft. square, 1 ft. deep, 8 lks. _____ of Cor., and raised a mound of earth 2 ft. high, $4\frac{1}{2}$ ft. base, over it. In pit drove a stake 2 ins. square, 2 ft. long, 12 ins. in the ground, marked M. C. on _____ face, with

T. 2 N. on S.

R. 2 W. S. 12 on E. and

S. 11 on W. faces.

SEC. 7. ¹³A _____, _____ ins. diam., which I marked (e. g.) M. C. on _____ side, with

T. 2 N. on W.

R. 2 W. S. 13 on N. and

S. 24 on S. sides, for Meander Cor. to Fractional Secs. 13 & 24.

SEC. 8. ¹⁴A _____, _____ ins. diam., which I marked (e. g.) M. C. on _____ side, with

T. 2 N. on E.

R. 2 W. S. 6 on N. and

S. 7 on S. sides, for Meander Cor. to Fractional Secs. 6 & 7; from which

A _____, _____ ins. diam. bears N. _____° W. _____ lks. dist. marked T. 2 N., R. 2 W. S. 6, M. C. B. T.

A _____, _____ ins. diam. bears S. _____° W. _____ lks. dist., marked T. 2 N., R. 2 W. S. 7, M. C. B. T.

SEC. 9. ¹⁷When a pit is dug at a Meander Cor. it must be 8 lks. from the Cor., on the side opposite the river or lake meandered.

SEC. 10. ¹⁶The letters "M. C." for Meander Corner must be marked on the side facing the river or lake meandered.

WITNESS CORNERS.

A Witness Corner must bear the same marks that would be placed upon the Corner for which it is a witness, with the addition of the letters W. C., and be established in all respects like such Corner.

If bearing trees are established for a Witness Corner, each tree must be marked W. C., in addition to the usual marks.

SEC. 5. ¹¹Set a post 4 ft. long, 4 ins. square, 24 ins. in the ground, for Meander Cor. to (e. g.) Fractional Secs. 20 & 21, marked M. C. on _____ face, with

T. 2 N. on S.

15. Connection Lines.

16. Marks.

17. Pits.

18. Stakes in Pits.

MISCELLANEOUS.

SEC. 1. ¹⁹When a rock in place is established for a Corner, its dimensions above ground must be given, and a cross (x) marked at exact Corner point. In other respects the form for stone corners will be used.

SEC. 2. ²⁰Where mounds of earth are raised "alongside" of Corners, on N. and S. lines, they must be placed on the W. and on E. and W. lines on the N. side of Corner. In case the

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character of the land is such that this can not be done, the deputy will state in his notes instead of "alongside," "S" (or E.)

SEC. 3. ²¹In case where pits are practicable the deputy prefers raising a mound of stone, or stone covered with earth,²² as more likely to perpetuate the Corner, he will use the form given for mound of stone, omitting the words "pits impracticable," and adding "covered with earth," when so established. (See foot-note, p. 22.)

SEC. 4. ²³Where the requisite number of trees can be found within 300 links of the Corner point, three (3) bearing trees should be established for every Standard or Closing Cor., four (4) for every Cor. common to (four) Townships or Sections, and two (2) for every Quarter Sec. Cor. or Meander Cor. When a bearing tree is located on the side of a Base Line or Standard Parallel *opposite* the township to which the corner it witnesses belongs, it will be marked with the township and ranges, (if a *township* corner), and, (if a *section* corner), with the township, range, and sections to *which it belongs*, and with the letters S. C. (for Stand Cor.), or C. C. (for Closing Cor.), as the case may require. The number of the Section *in which the tree stands* will be omitted. See "Description of Corners." In case the requisite number of trees can not be found within limits, the deputy must state in his field notes after describing those established, "no other trees within limits," and "dug pits in Secs. _____ & _____," or "raised a mound of stone alongside." The bearing trees, being the most important adjuncts of the corners, their *exact* bearings from the true meridian must be taken with the *instrument used in running the lines of survey*, and the distance should be measured *from* the center of the tree to the center of the corner. The height of the *top* of all blazes and markings on trees must be limited to *two and one-half feet above the ground*.

SEC. 5. ²⁴Stones 18 ins. and less long must be set two-thirds, and over 18 ins. long, three-fourths, of their length in the ground. No stones containing less than 504 cubic inches must be used for corners.

SEC. 6. ²⁵Particular attention is called to the "Summary of objects and data required to be noted," on pages 44 and 45 of these instructions, and it is expected that the deputy will thoroughly comply with same in his work and field notes.

SEC. 7. ²⁶No mountains or lands not classed as surveyable are to be meandered, and all lines approaching such lands must be discontinued at the section or quarter section corner.

SEC. 8. ²⁷Where by reason of impassable objects the south boundary of a township can not be established, an auxiliary base-line should be run through the Township, first random, then corrected, from one range line to the other, connecting

corresponding corners, and as far *south* as possible, and from such line the section lines will be extended northwardly in the usual manner, and any fraction south of said line may be surveyed in the opposite direction from the Section Corners on the auxiliary base thus established.

SEC. 9. ²⁸When no part of the east or west boundaries can be run, both the north and south boundaries will be established as true lines.

SEC. 10. ²⁹Allowance for the convergency of meridians must be made whenever necessary.

SEC. 11. ³⁰All letters and figures cut in posts or trees must be marked over with red chalk to make them still more plain and durable.

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SEC. 12. ³¹Township corners common to four townships, and section corners common to four sections, are to be set diagonally in the earth, with the angles in the direction of the lines. All other corners are to be set square, with the sides facing the direction of the lines.

SEC. 13. ³²The sizes of wooden posts, mounds, and pits noted in foregoing descriptions of corners are to be regarded as *minimum*, and whenever practicable to increase their dimensions it is desirable to do so.

SEC. 14. ³³In establishing corners, stones should be used wherever practicable; then, posts; and lastly, mounds, with stake in pit.

SEC. 15. ³⁴It is expected that the deputy surveyors will carefully read and familiarize themselves with these instructions, and all others contained in this volume, and will instruct their assistants as to their duties before commencing work. Extra copies will be furnished the deputies for the use of their assistants.

19. Rock in Place.

20. Mounds of Earth.

21. Mounds of Stone.

22. For mound of stone "covered with earth," the height and base will be the same as for mound of earth.

23. Bearing Trees.

24. Stones.

25. Objects to be Noted

26. Lines Discontinued at Legal Corners.

27. Fractional Townships.

28. Boundaries.

29. Convergency.

30. Red Chalk.

31. Mode of Setting Corners.

32. Size of Posts, etc.

33. Corner Materials.

34. Examine Instructions.

MEANDERING.

SEC. 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 are to be universally used to distinguish the two banks of a river or stream.

SEC. 2. Both banks of *navigable* rivers, as well as of all rivers not embraced in the class denominated as "navigable," the right angle width of which is *three chains* and upwards, will be meandered on *both* banks by taking the general courses and distances of their sinuosities, and the same are to 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.

At those points where either the township or section lines intersect the banks of a navigable stream, or any meanderable line, corners are to be established at the time of running these lines. These are called "meander corners;" and in meandering you are to commence at one of those corners, coursing the banks or boundary line, and measuring the distance of each course from your commencing corner to the next "meander corner." By the same method you are to meander the opposite bank of the same river.

The crossing distance *between* the MEANDER CORNERS on same line and the true bearing and distance between opposite meander corners is to be ascertained by triangulation or direct measurement, in order that the river may be protracted with entire accuracy. The particulars to be given in the field-notes.

The subdividing deputies will be required to establish meander corners on both banks of such meanderable streams at the intersection of all section lines, and the distances across the river, determined as above directed, will be noted in the field-book.

In meandering water-courses, where a distance is more than *ten chains* between 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 in the surveyor-general's office.

SEC. 3. You are also to meander, in manner aforesaid, all *lakes*, and deep ponds of the area of twenty-five acres and upwards; also naviga-

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ble bayous; *shallow* ponds, readily to be drained, or likely to dry up, are not to be meandered.

In meandering lakes, bayous, or ponds you are to commence at a meander corner, and proceed as above directed for meandering the banks of navigable streams; and from said corner take the courses and distances of the entire margin of the same, noting the intersections with all meander corners established thereon.

You will notice all streams of water falling into the river, lake, or bayou you are surveying, stating the width of the same at their mouth; also all springs, noting the size thereof and depth, and whether the water be pure or mineral; also the head and mouth of all bayous; and all islands, rapids, and bars are to be noticed, with intersections to their upper and

lower points to establish their exact situation. You will also note the elevation of the banks of river and streams, the heights of falls and cascades, and the length of rapids.

To meander a lake or deep pond lying entirely within the boundaries of a section, you will run and measure *two* lines thereunto from the nearest section or quarter-section corner on *opposite* sides of such pond, giving the courses of such lines. At *each* of the points where such lines shall intersect the margin of such pond or lake you will establish a meander corner as above directed. (See "Meander corners.")

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-book.

SEC. 4. Meander lines should not be established at the segregation line between dry and swamp or overflowed land, but at the ordinary low-water mark of the actual margin of the rivers or lakes on which such swamp or overflowed lands order. In cases where such meander lines were formerly established at the segregation line between dry and swamp or overflowed lands, new and proper meander lines may be established under the direction of the surveyor general, and the township and section lines extended over such swamp or overflowed lands and the corners established, as hereinbefore provided, in order that the plats and field-notes of surveys may show the actual facts in the case.

5. The precise relative position of islands, in a township made fractional by the river in which the same are situated, is to be determined trigonometrically; sighting to a flag or other fixed object on the island, from a special and carefully measured base line, connected with the surveyed lines, on or near the river bank, you are to form connection between the meander corners on the river to points corresponding thereto, in direct line, on the bank of the island, and there establish the proper meander corners, and calculate the distance across.

6. In taking the connection of an island with the main land, when there is no meander corner in line, opposite thereto, to sight from, you will measure a special base from the most convenient meander corner, and from such base you will triangulate to some fixed point on the shore of the island, ascertain the distance across, and there establish a *special* meander corner, wherefrom you will commence to meander the island.

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

8. The field-notes of meanders will be set forth in the field-books showing the dates when the work is performed, as illustrated in the specimen notes annexed. They are to state and describe particularly

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the meander corner from which they commenced, and each one upon which they close, and are to 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 you are meandering. The utmost care must be taken to pass no object of topography, or *change therein*, without giving a particular description thereof in its proper place in your meander notes.

SURVEYING.

Initial points from which the lines of the public surveys are to be extended must 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 must be selected with great care and due consideration for their prominence and easy identification, and must be established astronomically.

The initial point having been established, the lines of the public surveys are to be extended therefrom as follows:

BASE LINE.

The base line shall be extended east and west from the initial point by the use of solar instruments or transits, as may be directed by the surveyor-general, in his special written instructions. The *transit* should be designated for the alignment of all important lines. Where solar instruments are used the deputy must test said instruments in every 12 miles of line run by observation on the polar star; and in *all* cases where he has reason to suppose that said instrument is in error, he must take an observation on the polar star, and if error be found, must make the necessary corrections before proceeding with his survey. The proper corners shall be established at each 40 and 80 chains, and at the intersection of the line with rivers, lakes, or bayous that should be meandered, in accordance with the instructions for the establishment of corners. In order to check errors in measurement, two sets of chainmen, operating independently of each other, must be employed.

Where transits are used, the line will be run by setting off at the point of departure on the principal meridian³⁵ a tangent to the parallel of latitude, which will be a line falling at right angles to said meridian. The line thus determined will be prolonged by *two* back and *two* fore sights at *each* setting of the instrument, turning the horizontal limb 180 in azimuth between the observations. The survey will be continued on this line for twelve (12) miles,³⁶ but the corners will be established at the proper points by offsets northerly from said line, at the end of each half mile. In order to offset correctly from the tangent to the parallel, the deputy will be guided by the tables of offsets and azimuths contained in this volume³⁷. As the azimuth of the tangent is shown, the angle thence to the true meridian at each mile is readily found, thus indicating the direction of the offset line. The computations are made for a distance of 12 miles, at the end of which observations on the polar star must be taken for the projection of a new tangent. The computations are also upon whole degrees of latitude; offsets for intervening parallels can be readily determined by interpolation. Where offset distances to quarter-section corners exceed 50 links, their direction to the parallel can be determined in like manner by interpolation for azimuth.

Where said distances are less than 50 links interpolations for determining directions will not be required.

PRINCIPAL MERIDIAN.

The principal meridian shall be extended north and south from the initial point, by the use of solar instruments or transits, as may be directed by the surveyor general in his special written instructions. Where solar instruments are used, the line will be run in the same manner as prescribed for running the base line by solar instruments. Where transits are used, observations upon the polar star must be taken within each 12 miles of line run. In addition to the above general instructions, it is required that 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. Two set of chainmen, operating independently of each other, must be employed.

STANDARD PARALLELS.

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 same manner as prescribed for running the base line, and two sets of chainmen must be employed.

GUIDE MERIDIANS.

Guide meridians shall be extended north and south from the base line, at intervals of every 24 miles east and west from the principal meridian, in the same manner as prescribed for running the principal meridian, and two sets of chainmen must be employed.

It is contemplated that these base, principal meridian, standard, and guide meridian lines shall first be extended over the territory to be surveyed, and that afterwards township and section lines shall be run, where needed, within these tracts of 24 miles square, formed by the extension of these principal lines; and each surveyor-general will therefore cause said principal lines to be extended as rapidly as practicable.

Paragraph 5, "System of rectangular surveying,"³⁸ declares that the object of running standard parallels and guide meridians is "to confine the errors resulting from convergency of meridians, and inaccuracies in measurement, within the tracts of lands bounded by the lines so established."

As the convergency is rapidly increased in the higher latitudes and resulting inaccuracies developed in about the same

35. See diagram A, Fig. 1.

36. Or a less distance.

37. See Tables III, IV, and V, and Diagram A, Fig. 1.

38. Page 18.

proportion, it would seem to be consistent with the spirit of the above paragraph to so contract the blocks of 24 miles square, by diminishing either the distances between correction lines, or by reducing the interval between guide meridians, or by using both contractions simultaneously, as to confine convergency errors, as near as practicable, to a uniform amount.

Unfortunately, guide meridians have been so irregularly spaced in the several surveying districts, in some cases exceeding the authorized 24 miles by *three times its amount* or even more, that any attempt to provide a general rule for use in all parts of the country would

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probably result in failure to correct existing irregularities and help still further to increase the present confusion.

Therefore, the only thing that can be done is to reiterate the above directions limiting the tracts bounded by guide meridians and standard parallels to *24 miles square and direct, that in future, compliance with the above requirement will be insisted upon.*

EXTERIORS OR TOWNSHIP LINES.

The east and west boundaries of townships are always to be run from south to north on a true meridian line; and the north and south boundaries are to be run from east to west, or from west to east (according to the location of the township to be surveyed with reference to prior surveys), on a *random* or trial line and corrected back on a true line. The distance north or south of the township corner to be closed upon, from the point of intersection of these random lines with the east or west boundary of the township, must be carefully measured and noted. Should it happen, however, that such random line should fall short, or overrun in length, or intersect the east or west boundary more than *three chains'* distance from the township corner thereon, as compared with the corresponding boundary on the south (due allowance being made for convergency), the line, and if necessary the entire exterior boundaries of the township, must be retraced, so as to discover and correct the error. In running random lines temporary corners are to be set at each 40 and 80 chains, and permanent corners established upon the true line as corrected back, in accordance with instructions, throwing the excess or deficiency on the west half mile, as prescribed by law. Permanent corners are to be established in accordance with instructions on the east and west township boundaries at the time they are run. Whenever practicable the township lines within these tracts of 24 miles square must be surveyed in regular order from *south to north*, i. e., the exterior boundaries of the township in any one range lying immediately north of the south boundary of such tract of 24 miles square must first be surveyed, and the exteriors of the other three townships in said range extended therefrom, in regular order from *south to north*, and it is preferable to first survey the entire range of townships in such tract adjoining the east boundary or adjoining the west boundary, and the other three ranges in regular sequence. In cases, however, where the character of the land is such that this rule cannot be complied with, the following will be observed:

In extending the *south* or *north* boundaries of a township to the *west*, where the *southwest* or *northwest* corners cannot 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 cannot 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. One set of chainmen only is required in running township lines.

METHOD OF SUBDIVIDING.

1. The variation is to be found by observations on Polaris taken at or near the S. E. corner of the township. The first mile, both of the

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south and east boundaries of each township you are required to subdivide, is to be carefully traced and measured before you enter upon the subdivision thereof. This will enable you to observe any errors that may have been made in former surveys either in direction or length of the lines and will also enable you to compare your chaining with that upon the township boundaries.

2. Any discrepancy arising either from a disagreement of bearings or a difference in measurement, is to be carefully noted in the field-notes. In this article the term "bearing" is to be construed to mean the *true* bearing or angle made with the *true meridian*.

3. After adjusting our compass to the variation which you have determined by observation, you will commence at the corner to sections 35 and 36, on the south boundary, and run a line northwardly *with the true bearing of the range line*, forty chains, to the quarter-section corner, which you are to establish between sections 35 and 36; continuing on said course forty chains farther, you will establish the corner to sections 25, 26, 35, and 36.

4. From the section corner last named run a *random* line, without blazing, *parallel to the south boundary of section 36*, for the corner of sections 25 and 36, on east boundary, and at forty chains from the starting point set a post for *temporary* quarter-section corner. If you intersect exactly at the corner, you will blaze your random line back, and establish it as the *true* line; but if your random line intersects the said east boundary, either north or south of said corner, you will measure the distance of such intersection, from which you will calculate a course that will run a *true* line back to the corner from which your random started. You will establish the *permanent* quarter-section corner at a point equidistant from the two terminations of the *true* line.

5. From the corner of sections 25, 26, 35, and 36, run northwardly with the *true* bearing of the range line between sections 25 and 26, setting the quarter-section post as before, at forty chains, and at eighty chains establishing the corner of sections 23, 24, 25, and 26. Then run a random *parallel to the south boundary of section 36* for the corner of sections 24

and 25 on east boundary; setting temporary quarter-section post at forty chains; correcting back, and establishing permanent quarter-section corner at the equidistant point on the true line, in the manner directed on the line between sections 25 and 36.

6. In this manner you will proceed with the survey of each successive section in the first tier, until you arrive at the north boundary of the township, which you will reach in running up a random line between sections 1 and 2, *with the true bearing of the range line*, setting the temporary quarter-section corner at forty chains from the interior section corner so as to throw the excess or deficiency of measurement on the quarter-sections adjoining the north boundary of the township. If this random line should not intersect at the corner established for sections 1, 2, 35, and 36, upon the township line, you will note the distance that you fall east or west of the same, from which distance you will calculate a course that will run a *true line* to the corner from which your random started, on which line you will establish the permanent quarter-section corner. If the north boundary of a township is a base or standard line, the line between sections 1 and 2 is to be run *with the true bearing of the range line* as a *true line*, and the closing corner 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 must be carefully measured and noted as a *connection line*.

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7. In like manner proceed with the survey of each successive tier of sections, until you arrive at the fifth tier; and from each section corner which you establish upon the west boundary of this tier you are to run random lines *parallel to the south boundary of section 31*, towards the corresponding corners established upon the range line forming the western boundary of the township; setting, as you proceed, each *temporary* quarter-section corner at forty chains from the interior section corner, so as to throw the excess or deficiency of measurement on the extreme tier of quarter sections contiguous to the township boundary; and on returning establish the *true line*, and establish thereon the *permanent* quarter-section corner. The *random* of an east and west section line must always be run *parallel to the south boundary of the tier of sections to which it belongs and with the true bearing of said boundary*.

8. It is not required that the deputy shall complete the survey of the first tier of sections from south to north, before commencing the survey of the second or any subsequent tier, but the corner on which the random line closes must 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 may be established by running the east and west line as a *true line*, with a *true bearing*, determined as above directed for *random* lines, setting the quarter-section corner at 40 chains and the section corner at 80 chains.

9. Quarter-section corners, both upon north and south and upon east and west lines, are to be established at a point 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 excess or deficiency in the measurements will be thrown, according to law, on the extreme tier of quarter sections.

If, in the subdivision of part of a township, the lands to be surveyed can not be reached by lines extending from the south boundary of the township, a line corresponding to the south boundary of the same shall be extended from some section corner on the east boundary of the township to the west boundary thereof, in order that it may constitute the south boundary of the surveyable area; from which subdivisional meridian lines will be projected northward, and the surveys carried forward in the same manner as for the subdivision of a full township, in order that regular and fractional areas shall occupy their true and legal positions.

Fragmentary portions of surveyable lands lying south of the provisional base last described may be included in the survey by extending lines *southwardly* from the same in harmony with the general system.

When the proper point for the establishment of a section corner is inaccessible, and a witness monument can be erected upon each of the two lines which approach the same at distances not exceeding twenty chains therefrom the quarter-sections depending thereon will be disposed of in the same manner as if the corner had been regularly established.

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

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

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PRESCRIBED LIMITS FOR CLOSINGS AND LENGTH OF LINES IN CERTAIN CASES.

1. Every north-and-south section line, except those terminating in the north boundary of the township, must be *eighty chains* in length.

2. The east-and-west *section lines*, except those terminating in the west boundary of the township, are to be within *eighty links* of the actual distance established on the south boundary line of the township for the width of said tier of sections, and must close within fifty links north or south of the section corner.

3. The north boundary and south boundary of any one section, except in the extreme western tier, are to be within *eighty links* of equal length.

4. The meanders within each fractional section, or between any two meander posts, or of an island in the interior of a section, must close within a limit determined by allowing *five-eighths of a link for each chain* of said meander line when less than 80 chains in length. When the meander line is more than 80 chains in length the closing error must in no *case* exceed 150 links.

5. In running *random* township exteriors, if such random lines fall short or overrun in length, or intersect the eastern or western boundary, as the case may be, of the township, at more than *three chains* north or south of the true corner, the

lines must be *retraced*, even if found necessary to remeasure the meridional boundaries of the township. One set of chainmen only is required in subdividing.

RETRACING TOWNSHIP LINES AND BOUNDARIES OF PRIVATE LAND CLAIMS.

If, in subdividing a township, it is found that the exterior boundaries have been improperly run, measured, or marked, or the corners established thereon have been obliterated, the deputy will resurvey so much of said exterior boundaries as may be necessary, and establish new corners upon same wherever necessary. Where no subdivisions have been made on either side of a township boundary, it will be corrected, if necessary, in point of alignment as well as measurement, by establishing the section corners at lawful distances from the south or east boundaries of the township (as the case may be), and upon a right line extending between the township corners; and in such case, the old corners on said township boundaries will be destroyed.

Where subdivisional lines have been closed upon a township boundary in advance of the preliminary survey of the same, its alignment will not be changed. If it is found necessary to establish new corners on such boundary they will receive only the marks referring to the sections in the township being subdivided, and the marks on the old corners on such boundary, which refer to such sections, will be obliterated.

In all cases such necessary corrections will be made as will place the section corners at the aforesaid lawful distances from the south or east boundary, in order that a legal subdivision of the township may be made, and where new corners are thus necessarily established, the distance and direction between new and old corners must be carefully noted.

New corners on township boundaries must be established by a survey of such lines, and *in no case* will such corners be established from *data* acquired in running lines closing such boundaries. One set of chainmen, only, is required in retracing township lines.

When township or subdivision lines intersect the boundaries of confirmed private land claims, the latter must be retraced so far as may be necessary to establish the corners to the fractional sections at their

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proper places, and such corners must be established, in all respects, like meander corners, except that instead of the letters "M. C." the letters used to designate such private land claim must be marked on corners. In retracing the boundary of such claim the deputy must set stakes thereon, at each forty chains, where the ground is level, and on broken ground, at every spur, ridge, or other prominent point, and also at each angle formed by a change in the direction of such boundary.

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 are not to be limited to calling attention to certain paragraphs in this Manual, reiteration of its requirements and in providing the deputy with a printed copy of directions of a *general* nature; but they must, in all cases, and particularly for the survey of exteriors, 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, advise him, so far as he can, 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, inform him how much *convergency* to use, and provide for his use a *diagram*, 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, blue prints, or tracings. *In no case must the deputy be sent into the field without full and accurate information in regard to all irregularities which will in any manner affect the extent or accuracy of his survey.*

FIELD NOTES.

The proper blank books for field notes will be furnished by the surveyor-general, and in such books the deputy surveyor must make a faithful, distinct, and minute record of everything officially 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, a full and complete topographical description of the country surveyed.

From the *data* thus recorded at the time when the work is done on the ground, the deputy must prepare *true* field notes of the surveys executed by him, in the manner hereinafter prescribed, and return same to the surveyor-general, together with the required sketches, at the earliest practicable date after the completion of his work in the field.

The true field notes are in no case to be made out in the office of the surveyor-general.

The field notes of the survey of base, meridian, standard, exterior,

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and subdivision lines are each to be written in *separate books*. The subdivisions of *each* township will form one book. *No adhesive material of any kind will be used to fasten the leaves or covers.*

The first, or title page of each field-note book is to describe the subject matter of the same, the locus of the survey, by

whom surveyed, date of contract, and the dates of commencement and completion of the work. The second page is to contain the names and duties of the assistants, and the index is to be placed on same or following page. Whenever a new assistant is employed, or the duties of any one of them changed, such facts are to be stated in an appropriate entry immediately preceding the notes taken under such changed arrangements.

The exhibition of every mile of surveying, whether on township, or subdivisional lines, and of meanders in each section, must be *complete in itself*, and be separated by a black line drawn across the paper.

The *change* in the variation, if any is observed, the *hour* of the day and *cause* of the change will be stated at the commencement of every line run.

The variation of the *needle* must always occupy a *separate line* preceding the notes of measurements on line.

The description of the surface, soil, minerals, timber, undergrowth, etc., on *each mile* of line, is to follow the notes of survey of such line, and not be mixed up with them.

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

No abbreviations of words are allowable, except of such words as are *constantly* occurring, such as "*sec.*" for "*section*"; "*in. diam.*" for "*inches diameter*"; "*chs.*" for "*chains*"; "*lks.*" for "*links*"; "*dist.*" for "*distant*"; "*1/4 sec. cor.*" for "*quarter-section corner*"; "*va.*" for "*variation*," etc.; for 14 inches long, 12 inches wide, and 3 inches thick, in describing a corner stone, use 14 x 12 x 3, being particular to always observe the same order of length, width, and thickness. Proper names must never be abbreviated, however often their recurrence.

When the lines of survey cross hills or ravines, the height or depth of same, in feet, must be noted as nearly as practicable.

The corners established in previous surveys, from which the lines start, or upon which they close, must be fully described in the field notes. A full description of such corners will in all cases be furnished the deputy from the surveyor-general's office at the date authority is given for commencing work.

In all cases where a corner is re-established the field notes must describe fully the manner in which it is done.

Field notes of the survey of base, standard, and meridian lines must 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 townships on each side of the lines run.

Field notes of the survey of exterior boundaries of townships must describe the corners and topography, as above required, and the "general description" at the end of such notes must describe the townships as fully as may be, and also state whether or not they should be subdivided.

Near the end of his field notes and immediately before the "general description," the deputy surveyor will add, in form similar to that shown in specimen field notes, No. 3, a tabular statement of the latitude and departure of each boundary line of the township, taken from a traverse table, giving the *totals* and *errors* in latitude and departure,

which must in no case exceed the "prescribed limits for closings" contained in this manual.³⁹ If a part or the whole of one or more of the boundaries is made up of meander lines,⁴⁰ the *total* northings, southings, eastings and westings of such lines will take the place of the missing N. and S. or E. and W. lines, so as to present the *total errors* of the township boundaries, considered as 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 an older contract, the deputy will use the bearings and distances supplied by the Surveyor General in connection with his own lines, and if the errors *exceed* the allowance defined in paragraphs 4 and 5 of the "prescribed limits," he will determine *where* the error occurs, correct the same *before he leaves the field*, and place the table in his *field note book*. This requirement is made necessary by the frequent occurrence of errors in the exterior lines, of which nothing is known in this office until after the township has been subdivided and the returns taken up for examination and settlement of the account, and *then* much correspondence and delay results in injury to the service and sometimes in trouble for settlers.

Field notes of the subdivisional survey of townships must describe the corners and topography as above required, and the "general description" at the end of such notes must state minutely the character of the land, soil, timber, etc., found in such townships.

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

A blank line must be left at the bottom of each page of the field notes, and the notes must be written in a plain, legible hand, and in clear and precise language, so that the figures, letters, words, and meaning will always be unmistakable, and erasures and interlineations avoided, as far as possible.

With the notes of the survey of principal lines forming a tract of 24 miles square the deputy will submit a plat of the lines run on a scale of one-half inch to the mile, and with the notes of survey of the exterior lines of townships a plat of the lines run on the scale of two inches to the mile, on which are to be noted all the objects of topography on line necessary to illustrate the notes, viz, the distance on line at the crossings of streams, so far as such can be noted on the paper, and the direction of each by an arrow-head pointing down stream; also, the intersection of line by prairies, marshes, swamps, ravines, ponds, lakes, hills, mountains, and all other matters indicated by the notes, to the fullest extent practicable.

With the instructions for making subdivisional surveys of townships into sections, the deputy will be furnished by the surveyor-general with a diagram of the *exterior* lines previously established of the townships to be subdivided (on the above-named scale), upon which are carefully to be laid down the measurements of each of the lines on such boundaries whereon he is to close, and the magnetic variation of each mile. And on such diagram 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

39. See page 40.

40. In the table, meanderable lines of new surveys will be left blank.

points on line at which the same occur, but also the direction and position of each between the lines, or within each section, as far as practicable, so that every object of topography may be properly completed or connected in the showing.

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 and mode thereof.

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 first intersects and then leaves every *settler's claim and improvement*; prairie, river, creek, or other "bottom;" or swamp, marsh, grove, and wind-fall, with the course of the same at both points of intersection; also the distances at which you begin to ascend, arrive at the top, begin to descend, and reach 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.

6. Intersections by line of *water objects.* All rivers, creeks, and smaller streams of water which the line crosses; the distances on line at the 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, or hilly.

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.

10. *Bottom lands*—to be described as wet or dry, and if subject to inundation, state to what depth.

11. *Springs of water*—whether fresh, saline, or mineral, with the course of the stream 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; sugar-tree groves, sugar camps, mill seats, forges, and factories. To be located by bearing and distance or 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 you can obtain respecting these objects, whether they be on your immediate line or not, is to appear on the general description to be given at the end of the notes.

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, petrifications, organic remains, etc.; also all ancient works of art, such as mounds, fortifications, embankments, ditches, or objects of like nature.

19. The *variation* of the needle must be noted at all points or places on the lines where there is found any material *change of variation,* and the position of such points must be perfectly identified in the notes.

20. Besides the ordinary notes taken on line (and which must always be written down on the spot, leaving nothing to be supplied by mem-

ory), 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.

Following the "general description" of the township is to be "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 are to be affixed to the *true* field notes returned to the surveyor-general by the deputy surveyor; the preliminary oaths being placed immediately after the index of the first book, and the final oaths at the end of the last book of field notes of the surveys to which they refer:

PRELIMINARY OATHS OF ASSISTANTS.

We, _____ and _____, do solemnly swear that we will well and faithfully execute the duties of chain-carriers; 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.
_____, Chainman.
_____, Chainman.

Subscribed and sworn to before me this _____ day of _____, 18__.

_____,
_____.

We, _____ and _____, do solemnly swear that we will well and truly perform the duties of axemen, 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 _____.

_____, *Axeman.*
_____, *Axeman.*

Subscribed and sworn to before me this _____ day of _____, 18__.

_____,
_____.

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 _____, 18__.

_____,
_____.

FINAL OATHS FOR SURVEYS.

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.*
_____, *Axeman.*
_____, *Axeman.*
_____, *Flagman.*

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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 _____, as 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.*

_____, *Axeman.*
_____, *Axeman.*
_____, *Flagman.*

Subscribed and sworn to before me this _____ day of _____, 18__.

_____,
_____.

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 _____, 18__, 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 surveying manual, and the laws of the United States, surveyed all those parts or portions of _____ of the _____ base and _____ meridian in the _____ of _____, as 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 surveying manual, printed instructions, 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 _____, deputy surveyor, and sworn to before me this _____ day of _____, 18__.

_____,
U. S. Surveyor-General for _____.

The final oath of the deputy surveyor must, in all cases, be taken before the *U. S. Surveyor-General* for the State or Territory in which the survey is executed. Before the above final oath is administered to the deputy surveyor, the surveyor-general will make such *personal* examination of the *notes taken in the field* and such general investigation of the returns as he may consider necessary to fully assure himself that *all* the observations for determination of the true meridian and variation and the tabular statement of closing errors, when one is required, are actually contained in the *original notes taken by the deputy on the ground*, and that his contract and special instructions have been complied with in *every particular*. It is preferable that all oaths—both preliminary and final—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 must submit a full written report to the proper surveyor general of the circumstances of such case.

To enable the deputy surveyor to fully understand and appreciate the responsibility under which he is acting, his attention is invited to the

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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," and 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."

SPECIMEN FIELD NOTES AND PLATS.

Diagram B illustrates the method of laying off tracts of land 24 miles square, as nearly as practicable, by the survey of principal lines, and the survey of exteriors or township lines within such tracts, north of the base line and east of the principal meridian. The same general principles will apply equally to the survey of such tracts differently located with reference to the initial point. The topography noted on said diagram is on those portions of the lines of surveys for which specimen field notes are given.

Diagram C illustrates the method of laying off a township into sections and quarter sections. In the subdivision of townships lying *south* of and *contiguous* to the base line, or to any standard parallel, the lines between the sections of the northern tier will be run with the true bearing of the east boundary of the township as *true* lines; quarter-section corners will be established at 40 chains, closing section corners will be established at the points of intersection of such lines with the base or standard lines (as the case may be), and the *course* and *distance* from such corners to the nearest standard corner upon the line closed upon are to be accurately ascertained and set down in the field notes.

Diagram D illustrates the mode of establishing stone, post, and mound corners for townships, sections, and quarter sections.

Specimen field notes Nos. 1, 2, 3, 4, and 5 illustrate, respectively, the mode and order of surveying standard lines, meridian lines, exteriors or township lines, resurveying ex-

teriors or township lines, and subdividing a township into sections and quarter sections. The attention of the deputy is particularly directed to these specimens, as indicating not only the method in which his work is to be conducted, but also the order, manner, language, etc., in which his field notes are required to be returned to the surveyor general's office; and such specimens are to be deemed part of these instructions, and any *departure* from their details, without special authority, in cases where the circumstances are

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analogous in practice, *will be regarded as a violation of his contract and oath.*

The subdivisions of fractional sections into the 40-acre lots (as near as may be) are to be so laid down on the official township plat in broken black lines as to admit of giving to each a specific designation, if possible, according to its relative position in the fractional section, as per example afforded by Diagram C, as well as by a number, in all cases where the lot can not properly be designated as a quarter-quarter. Those fractional subdivision lots which are not susceptible of being described according to relative local position, are to be numbered in 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 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.

In numbering fractional lots, other than those above specified (wherever practicable and as a general rule), the series should commence with No. 1 in the northeastern or the most easterly fractional lot, and continue from east to west, and west to east, alternately, to the end of the series, as shown in Diagram C; but such general rule is departed from under circumstances given as examples in said diagram.

Interior lots are to be, as nearly as possible, 20 chains long by 20 chains wide; and the excess or deficiency of measurement is always to be thrown on the lots bordering on the northern and western boundaries of the township, or those made fractional by meander lines.

The official township plat to be returned to the General Land Office is to show on its face, on the right-hand margin, the meanders of navigable streams, islands, and lakes. Such details are wanted in the adjustment of the surveying accounts, but may be omitted in the copy of the township plat to be furnished to the district land office by the surveyor general. A suitable margin for *binding* is to be preserved on the left-hand side of each plat. Each plat is to be certified, with table annexed, according to the forms subjoined to "Diagram C," and is to show the areas of public land, of private surveys, and of water, with the aggregate area as shown on the diagram.

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

The plat for the local land office must 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 must be prepared as nearly as possible in accordance with the specimen plat designated as "Diagram C." 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., must be sharply defined. All lettering on the plats must be clear and sharp in outline and design, and 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, canons,

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roads, railroads, telegraph lines, canals, etc., will be shown upon the plats and designated by proper names where such are known.

The true meridian and declination of the magnetic needle, or variation of the compass, must be determined, by *observation on Polaris*, at or near the southeast corner of the township, or at the point where the survey begins. The mean local time of observation and all particulars will be stated in the field notes. In all cases the *mean declination* will be the value to insert in the tabular statement (See Diagram C), below the plat. A table will be found in this manual⁴¹ for reducing the *observed* to the *mean* declination. If the observation is taken away from the corner, the point must be so connected with the township line as to define its exact direction with reference to the *true meridian*. For the above determination the surveyor may use any one of methods herein described.

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

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

The true field books, each bearing the *written approval* of the surveyor-general, are to be substantially bound into volumes of suitable size, and retained in the surveyor-general's office, and certified *transcripts* of such field books (to be of *foolscap* size) are to be prepared and forwarded, from time to time, to the General Land Office.

All transcripts of surveys, made out as described under the head "FIELD NOTES," must be written in a bold, legible hand, with durable black ink, and such transcripts of any series of surveys included in one account forwarded to the General Land Office must be securely put up in *one package*, but not fastened together, at the office of the surveyor-general prior to transmittal.

With the copy of each township plat furnished to a district

land office, the surveyor-general is required by law to furnish *descriptive notes* as to the character and quality of the soil and timber found on and in the vicinity of each surveyed line, and giving a description of each corner.

Printed blank forms for such notes will be 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 face of the township plat, to be furnished to the register of the district land office, or on the supplemental blank form.

There is shown a series of meander corners on Diagram C, viz, from No. 1 to No 12 on the river and island, and No. 1 to No. 5 on Lin's Lake, and No. 1 to No. 2 on small lake in Sec. 33.

GEOGRAPHICAL POSITIONS OF BASE-LINES AND PRINCIPAL MERIDIANS GOVERNING THE PUBLIC SURVEYS.

Since the adoption of the rectangular system of public surveys, May 20, 1785, twenty-four initial points, or the intersection of the principal bases with surveying meridians, have been brought into requisition to secure the certainty and brevity of description in the transfer of public lands to individual ownership. From the principal bases townships of six miles square are run out and established, with regular series of numbers counting north and south thereof, and from

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the surveying meridians a like series of ranges are numbered both east and west of the principal meridians.

During the period of ninety years since the organization of the system the following numerical and independent principal meridians and bases have been initiated, to wit:

The first principal meridian divides the States of Ohio and Indiana, having for its base the Ohio River, the meridian being coincident with 84° 51' of longitude west from Greenwich. The meridian governs the surveys of public lands in the State of Ohio.

The second principal meridian coincides with 86° 28' of longitude west from Greenwich, starts from the confluence of the Little Blue River with the Ohio, runs north to the northern boundary of Indiana, and governs the surveys in Indiana and a portion of those in Illinois.

The third principal meridian starts from the mouth of the Ohio River and extends to the northern boundary of the State of Illinois, and governs the surveys in said State east of the meridian, with the exception of those projected from the second meridian, and the surveys on the west to the Illinois River. This meridian coincides with 89° 10' 30" of longitude west from Greenwich.

The fourth principal meridian begins in the middle of the channel of the mouth of the Illinois River, in latitude 38° 58' 12" north and longitude 90° 29' 56" west from Greenwich, and governs the surveys in Illinois west of the Illinois River and west of the third principal meridian lying north of the river. It also extends due north through Wisconsin and northeastern Minnesota, governing all the surveys in the former and those in the latter State lying east of the Mississippi and the

41. On page 55.

third guide meridian (west of the fifth principal meridian) north of the river.

The fifth principal meridian starts from the mouth of the Arkansas River, and, with a common base-line running due west from the mouth of the Saint Francis River, in Arkansas, governs the surveys in Arkansas, Missouri, Iowa, Minnesota west of the Mississippi, and the third guide meridian north of the river, and in Dakota Territory east of the Missouri River. This meridian is coincident with 90° 58' longitude west from Greenwich.

The sixth principal meridian coincides with longitude 97° 22' west from Greenwich, and, with the principal base line intersecting it on the 40th degree of north latitude, extends north to the intersection of the Missouri River and south to the 37th degree of north latitude, controlling the surveys in Kansas, Nebraska, that part of Dakota lying south and west of the Missouri River, Wyoming, and Colorado, excepting the valley of the Rio Grande del Norte, in southwestern Colorado, where the surveys are projected from the New Mexico meridian.

In addition to the foregoing six principal meridians and bases governing public surveys, there have been established the following meridians and bases, viz:

The Michigan meridian, in longitude 84° 19' 09" west from Greenwich, with a base-line on a parallel seven miles north of Detroit, governing the surveys in Michigan.

The Tallahassee meridian, in longitude 84° 18' west from Greenwich, runs due north and south from the point of intersection with the base-line at Tallahassee, and governs the surveys in Florida.

The Saint Stephen's meridian, longitude 88° 02' west from Greenwich, starts from Mobile, passes through Saint Stephen's, intersects the base line on the 31st degree of north latitude, and controls the surveys of

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the southern district in Alabama and of the Pearl River district lying east of the river and south of township 10 north in the State of Mississippi.

The Huntsville meridian, longitude 86° 31' west from Greenwich, extends from the northern boundary of Alabama as a base, passes through the town of Huntsville, and governs the surveys of the northern district in Alabama.

The Choctaw meridian, longitude 89° 10' 30" west from Greenwich, passes two miles west of the town of Jackson, in the State of Mississippi, starting from the base-line twenty-nine miles south of Jackson, and terminating on the south boundary of the Chickasaw cession, controlling the surveys east and west of the meridian and north of the base.

The Washington meridian, longitude 91° 05' west from Greenwich, seven miles east of the town of Washington, in the State of Mississippi, with the base-line corresponding with the 31st degree of north latitude, governs the surveys in the southwestern angle of the State.

The Saint Helena meridian, 91° 11' longitude west from Greenwich, extends from the 31st degree of north latitude, as a base, due south, and passing one mile east of Baton Rouge, controls the surveys in the Greensburgh and the southeastern districts of Louisiana, both lying east of the Mississippi.

The Louisiana meridian, longitude 92° 20' west from

Greenwich, intersects the 31st degree north latitude at a distance of forty-eight miles west of the eastern bank of the Mississippi River, and, with the base-line coincident with the said parallel of north latitude, governs the surveys in Louisiana west of the Mississippi.

The New Mexico meridian, longitude 106° 52' 09" west from Greenwich, intersects the principal base-line on the Rio Grande del Norte about ten miles below the mouth of the Puerco River, on the parallel of 34° 19' north latitude, and controls the surveys in New Mexico, and in the valley of the Rio Grande del Norte, in Colorado.

The Great Salt Lake meridian, longitude 111° 53' 47" west from Greenwich, intersects the base-line at the corner of Temple Block, in Salt Lake City, Utah, on the parallel of 40° 46' 04" north latitude, and governs the surveys in the Territory of Utah.

The Boise meridian, longitude 116° 20' west from Greenwich, intersects the principal base between the Snake and Boise Rivers, in latitude 43° 26' north. The initial monument, at the intersection of the base and meridian, is nineteen miles distant from Boise City, on a course of south 29° 30' west. This meridian governs the surveys in the Territory of Idaho.

The Mount Diablo meridian, California, coincides with longitude 121° 54' west from Greenwich, intersects the base-line on the summit of the mountain from which it takes its name, in latitude 37° 53' north, and governs the surveys of all central and northeastern California and the entire State of Nevada.

The San Bernardino meridian, California, longitude 116° 56' west from Greenwich, intersects the base-line at Mount San Bernardino, latitude 34° 06' north, and governs the surveys in southern California lying east of the meridian and that part of the surveys situated west of it which are south of the eighth standard parallel south of the Mount Diablo base-line.

The Humboldt meridian, longitude 124° 11' west from Greenwich, intersects the principal base-line on the summit of Mount Pierce, in latitude 40° 25' 30" north, and controls the surveys in the northwestern

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corner of California lying west of the Coast range of mountains and north of township 5 south of the Humboldt base.

The Willamette meridian is coincident with longitude 122° 44' west from Greenwich, its intersection with the base-line is on the parallel of 45° 30' north latitude, and it controls the public surveys in Oregon and Washington Territory.

The Montana meridian extends north and south from the initial monument established on the summit of a limestone hill, eight hundred feet high, longitude 111° 40' 54" west from Greenwich. The base line runs east and west from the monument on the parallel of 45° 46' 27" north latitude. The surveys for the entire Territory of Montana are governed by this meridian.

The Gila and Salt River meridian intersects the base-line on the south side of the Gila River, opposite the mouth of Salt River, in longitude 112° 15' 46" west from Greenwich, and latitude 33° 22' 57" north, and governs the public surveys in the Territory of Arizona.

The Indian meridian intersects the base-line at Fort

Arbuckle, Indian Territory, in longitude 97° 15' 56" west from Greenwich, latitude 34° 31' north, and governs the surveys in that Territory.

THE MAGNETIC DECLINATION OR VARIATION OF THE NEEDLE.

The following account of the geographical distribution and of the annual change of the magnetic declination or variation of the needle, with tables, explanations, and charts, presenting the latest information on the subject, were prepared by direction of the Superintendent of the U. S. Coast and Geodetic Survey, in accordance with a request of the Commissioner of the General Land Office.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, D.C., November 30, 1889.

For the following article with tables and their explanation, relating to the use of the compass in surveying, the Commissioner of the General Land Office is indebted to Prof. 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 January, 1878, by Assistant C. A. Schott, in charge of the computing division, has been revised and enlarged by him in order to present the latest information on the subject; it is also accompanied by two charts, taken from the Coast and Geodetic Survey Report for 1889 illustrating the present distribution of the magnetic declination.

This paper is designed to take 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 article will be found of great interest and value as an aid in the prosecution of the surveys of the public lands.

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AN ACCOUNT OF THE PRESENT GEOGRAPHICAL DISTRIBUTION AND OF THE ANNUAL CHANGE OF THE MAGNETIC DECLINATION (COMMONLY KNOWN AS THE VARIATION OF THE COMPASS NEEDLE⁴²) WITHIN THE LIMITS OF THE UNITED STATES.

The magnetic declination at any place is the angle contained between two vertical planes, one being the astronomical or true meridian of the place and the other a plane in which the horizontal axis of a freely suspended magnetic needle lies at the time. The former is a fixed plane, the latter is variable since observation shows that the direction of a magnetic needle, when delicately suspended, is constantly changing, nor is it the same at different places. The magnetic declination, thus varying with respect to locality and time, it is necessary on the part of the observer to give with his statement of the declination the exact local time, year, month, day and hour, and fraction when the measure was taken, as well as the geographical position or the latitude and longitude of the place, which co-ordinates may be expressed

in minutes of arc, and it generally suffices to give the nearest whole minute; longitudes are to be reckoned westward from Greenwich as the initial meridian.

The declination is called "west" when the north-seeking end of the magnet or needle points to the west of the true meridian, and is called "east" when the same end points to the east of the true meridian. The north end of the needle tends approximately toward the north and more particularly toward a region which surrounds the magnetic pole of dip; the magnetic declination within the limits of the United States presents, such great extremes as 18½° west at Eastport, Me., 3° east at Key West, Fla., 13¼° east at San Diego, Cal., 23° east in the Strait of Fuca, Washington Territory, and about 33° east at Fort Yukon, Alaska. The general distribution of the declination in the United States at the present time is shown on the accompanying charts, taken from the annual report of the Coast and Geodetic Survey for 1889 (as yet unpublished), the large MS. charts on two sheets having been greatly reduced to suit the present publication. These charts are for the epoch 1890 (January).

With regard to changes with the lapse of time the declinations, as observed, have undergone variations of several degrees. Thus at Boston, Mass., the declination changed from 10° west in 1700 to about 6½° west in 1778, and is now approaching 12° west and still increasing; at Monterey, Cal., the declination was 11½° east in 1780; it is now 16° east. On this subject the reader may consult the Coast and Geodetic Survey Report for 1888.⁴³

The accuracy with which the declination may be determined depends chiefly upon the instrumental means at command, but also in a great measure upon the ability and care of the observer in using his instruments and in selecting the proper method and best time for observation. The instruments ordinarily in the hands of the observer are sufficiently described in works on surveying or in catalogues of instrument-makers; but for descriptions and illustrations of more refined instruments and for their adjustment and the methods of using them the reader may be

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referred to Coast and Geodetic Survey Report for 1881, Appendix No. 8, entitled "Directions for Measurement of Terrestrial Magnetism."

It is a matter of observation that the needle, especially when light and delicately suspended, is seldom or never at rest; the principal laws of the angular changes have been made out; others and minor ones are known with more or less certainty and some are conjectural. These motions have, for convenience, been classified as regular and irregular variations, but we shall notice here only the principal ones.

To the former class belongs the solar variation depending upon the hour of the day, the time of the year, and the condition of the sun with respect to spot-activity; to the same class belongs the lunar variation depending on the moon's

42. In scientific treatises on terrestrial magnetism the term magnetic declination is always used in order to avoid any confusion which would arise when treating of such notions of the needle as the diurnal annual, and secular variations.

43. The Coast and Geodetic Survey Report for 1888, Appendix No. 7, it is expected, will soon pass through the press.

hour-angle and her position in the orbit, but this is of little interest to the practical surveyor on account of the small amplitude. In the same class is also included the secular variation, which is a systematic alteration in the earth's magnetism involving centuries to unfold itself, and as yet of unexplained origin. To the second class belong the so-called magnetic disturbances or storms, which frequently and simultaneously affect large parts and sometimes apparently the whole surface of the earth. On large averages these disturbances are found subject to complex laws, and they are noticed generally to accompany auroral displays and strong earth-currents.

They may be expected to occur at any time. Omitting any detailed notice of these disturbances and confining our attention to those more or less systematic changes which are of special interest to the surveyor as possibly affecting his work, we shall briefly review the effects of the principal regular variations as exhibited within the area of the United States.

The solar diurnal variation consists in a systematic movement of the direction of a magnet, having for its period the solar day; its character is the same for the greater part of the northern hemisphere. About the time of sunrise, or soon after it, the north-seeking end of the needle is generally found approaching to or near its easternmost position, i. e., near or at its eastern elongation. This phase happens, for instance, at Philadelphia, Pa., on the yearly average about 8^h a. m., at Key West, Fla., about 8¹/₄^h a. m., and at Los Angeles, Cal., at 8¹/₃^h a. m.; it is subject to an annual variation, the time being earlier in summer and near 7¹/₂^h a. m. at Philadelphia, near 7¹/₂^h a. m. at Key West, near 7³/₄^h at Los Angeles, near 8^h a. m. at Fort Steilacoom, Wash., and near 7³/₄^h a. m. at Camp Date Creek, Arizona. In the winter, this phase is reached later—about 8³/₄^h or 9^h a. m. at Philadelphia, about 9¹/₂^h a. m. at Key West and Los Angeles. The needle after remaining nearly stationary about this time, soon begins its principal daily motion toward the west, at first slowly, but after about 9¹/₂^h a. m. quite rapidly, and slackening again when nearing its western daily extreme, known as the western elongation, about 1¹/₂^h p. m. This phase is reached on the yearly average about 1¹/₃^h p. m. at Philadelphia, about 1³/₄^h p. m. at Key West, and about 1¹/₄^h at Los Angeles, a few minutes earlier in summer and a few minutes later in winter, but it will generally fall between 1^h and 2^h p. m. After this second temporary stand the needle reverses its angular motion and gradually returns to the direction from which it had set out in the early morning. Not infrequently a small or secondary oscillation takes place during the night. The average daily direction of the needle is reached in summer about 10¹/₄^h a. m. and in winter about 10³/₄^h a. m. at Philadelphia, about 10¹/₄^h a. m. and 11³/₄^h a. m., at Key West, and about 10^h a. m. and 11¹/₂^h a. m., respectively, at Los Angeles.

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The needle crosses a second time the average magnetic meridian about 7^h p. m. at the former place, and about 8¹/₂^h p. m. at the latter places, but these p. m. times are subject to considerable irregularity. The amount of displacement between the morning and afternoon elongations is called the diurnal range; it is about 8' on the average during the year at Philadelphia, about 5¹/₂' at Key West, and about 6¹/₃' at Los

Angeles. This range is greater for northern stations than for southern stations, and is also subject to an annual inequality, being more conspicuous in summer than in winter; thus, at Philadelphia, it reaches in August 12', but in November only 5', and at Key West it is in August 8', and in November 3'; at Los Angeles, the ranges in these months are 8³/₄' and 4'. This change from the maximum to the minimum and return is gradual. The solar diurnal variation is further subject to a periodic inequality related to the eleven-year cycle of the sun-spots. The diurnal range is least in years of minimum spots, as in 1878 or 1889, and is greatest in years of maximum sun spots, generally occurring about four years after the minima, as in 1883. In minimum years the range is about 0.8 and in maximum years about 1.3 of the average range. The daily variation appears at times intensified, at other times irregular and occasionally, and especially in the winter season, there are days when it is obscured or not recognizable.

The following table will be found useful for reducing observed declinations, taken at any time of the day between 6 a. m. and 6 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. The tabular values answer approximately to the middle epoch in the sun-spot cycle, and the nearest whole minute derived from them will give a degree of accuracy quite sufficient in view of the ordinary irregularities in the diurnal motion itself.

The tabular quantities give the average deviations of the direction of the needle at the respective hours of the day from the direction that would have been obtained had the mean been taken of twenty-four hourly observations. The letter W indicates that the needle points to the westward of the daily average, the letter E the reverse, whence the sign of the correction can be inferred whether the declination be westerly or easterly. Two sets of figures are given; the upper one is the mean from observations at Toronto, Canada; Philadelphia, Pa.; and Madison, Wis.; and answers, therefore, for northern stations; the lower one is the mean from observations at Key West, Fla., and Los Angeles, Cal., and answers, therefore, for southern stations.

Table for reducing an observed declination to the average declination of the day.

Mean local time.	6 ^h a. m. 7 ^h a. m. 8 ^h a. m. 9 ^h a. m. 10 ^h a. m. 11 ^h a. m.					
	E.	E.	E.	E.	E.	W.
December, January, February:						
Northern stations	0.7	1.1	1.9	2.2	1.5	0.1
Southern stations	0.1	0.3	1.4	2.3	2.4	1.3*
March, April, May:						
Northern stations	2.6	3.8	4.4	3.5	1.2	1.6
Southern stations	1.4	2.7	3.2	2.6	1.2	0.4
June, July, August:						
Northern stations	4.0	5.6	5.7	4.5	1.7	1.6
Southern stations	2.1	3.5	3.6	2.4	0.3	1.5
September, October, November:						
Northern stations	1.8	2.6	3.1	2.5	1.0	1.5
Southern stations	9.6	2.1	2.5	1.9	0.6	0.9

*East

Table for reducing an observed declination to the average declination of the day—Cont'd.

Mean local time.	Noon. 1 ^h p. m. 2 ^h p. m. 3 ^h p. m. 4 ^h p. m. 5 ^h p. m. 6 ^h p. m.						
	W.	W.	W.	W.	W.	W.	W.
December, January, February:							
Northern stations	1.8	2.9	2.8	2.1	1.3	0.7	0.2
Southern stations	0.4	1.3	1.5	1.3	0.8	0.3*	0.0
March, April, May:							
Northern stations	3.8	4.8	4.6	3.8	2.5	1.4	0.7
Southern stations	1.6	2.3	2.6	2.2	1.5	0.8	0.4
June, July, August:							
Northern stations	4.1	5.6	5.6	4.6	3.0	1.4	0.6
Southern stations	2.6	3.1	2.9	2.4	1.5	0.9	0.5
September, October, November:							
Northern stations	3.3	4.0	3.4	2.3	1.2	0.6	0.1
Southern stations	1.9	2.1	1.7	1.2	0.8	0.7	0.4

*East

The *annual variation* of the declination is so small that a mere mention here suffices; its amplitude is at most 1½ minutes of angular measure.

The lunar variations and inequalities.—These we likewise pass over briefly on account of their small amplitude or general minute effect. The principal inequality is the lunar diurnal variation, which exhibits the peculiarity of two maximum and two minimum values each lunar day. The range at Philadelphia is about 27" and at Toronto about 38". Other lunar inequalities are generally of smaller order.

The secular variation of the magnetic declination is, as has already been pointed out, a subject of great importance to the surveyor, especially when he is called upon to re-run old compass lines or to decide between conflicting claims as to the position of boundary lines marked out by compass many years ago, but the traces of which on the ground have become lost in the course of time. The most complete investigation of this remarkable change is contained in Coast and Geodetic Survey Report for 1888,⁴⁴ Appendix No. 7, and the tables here given of decennial values of the declination have been taken from this appendix. The variation in question is most probably of a periodic character, requiring centuries for its complete development, whence its specific name; it is undoubtedly of a highly complex nature. As yet at no station has a complete cycle been observed or completed, nor do we know whether the needle will ever trace out a similar one in period, in amplitude, or in other particulars; hence the necessity of continuing systematic observations at a number of stations specially selected for following up the inquiry.

These observations will enable us in time to introduce any needed change in the law as hitherto observed and improve the expression of the same, or gain a deeper insight into the secular variation. The motion may be compared to that of an oscillation of a pendulum, which alternately comes to rest at its extreme elongations and moves fastest midway between these extremes. Smaller oscillations within the period have also been discovered. About the times of maximum deflections the needle seems to fluctuate about an average position, apparently stationary for several years to ordinary or coarsely-divided instruments; but soon a perceptible change takes place, and the direction of motion is noticed to have slowly

changed to one opposite to that followed before the stationary epoch. The annual change increases year by year, until the motion reaches a maximum speed, after which it

gradually declines till the opposite stationary phase is attained, when it becomes once more zero.

This stately swing is gone through within our geographical limits in from about two hundred and fifty to about three hundred and fifty years. Thus, for example, at Baltimore and vicinity the needle was observed to be stationary about 1680, the north end of the needle pointing then nearly 6° west; in 1802 it had reached the opposite phase and was observed to point nearly ½° west; since that time the westerly motion has been kept up, and at present has already reached 4¾° west.

As might be expected the range varies greatly with geographical position, and so does the epoch of the elongations: thus the last easterly extreme occurred earliest in Maine; later in Florida, Texas, and Mexico, and has just reached but not yet touched all parts of the Pacific coast north of southern California; beyond the Straits of Fuca and for Alaska we have but little information. We have here at present a region or broad belt of no annual change or where the effect of secular variation is nil; it passes off and on the coast from the Strait of Fuca to near Point Conception, California, where it leaves the coast and stretches southward to the west of Lower California. On the other hand there is a region of no annual change but of opposite phase, and passing through Nova Scotia and New Brunswick. Between these two belts, and comprising the greater part of the United States, the effect of the secular variation is to increase west declination, or, what comes to the same thing, to decrease east declination, whereas on the Pacific coast there is still a narrow strip of land to the west of the belt first described, where the annual change is opposite, i. e., easterly declination is still slightly increasing.

The following table gives the latitude and longitude as well as the annual change of the declination for each station, and the next table the computed decennial values of the declination (and after 1850 for every fifth year), at all places where the observations were sufficiently numerous and of sufficient range to admit of the recognition of the law of secular variation:

Geographical position of stations and annual change of declination for 1890 and 1895.

+ signifies increasing west or decreasing east declination.

Name of places.	Latitude	Longitude west from Greenwich.	Annual change of declination.	
			For 1890.	For 1895.
Eastern Group				
Eastport, Me.	44 54.4	66 59.2	+0.8	+0.2
Bangor, Me.	44 48.2	68 46.9	+2.4	+1.9
Portland, Me.	43 38.8	70 16.6	+2.6	+2.2
Burlington, Vt.	44 28.5	73 12.0	+5.0	+3.8
Hanover, N. H.	43 42.3	72 17.1	+4.4	+3.9

44. Still in MS, in the hands of the printer.

(Ed. Note: The remainder of this table, which continued on pages 58 through 65 are deleted.)

It will be observed that the character of the secular variation is the same over large areas, though each place has apparently minor features peculiar to itself. In consequence of our very imperfect data the deduced annual change (in minutes of arc) due to the action of the secular variation, can only claim to be a fair approximation for the several States and Territories at the present time.

In the following table the + sign indicates an increase of west declination, or its equivalent a decrease of east declination.

Table showing the annual change of the magnetic declination for the epoch 1890 and referring to the central part of each State, Territory, or subdivision.

Locality	Annual Change	Locality	Annual Change
Alabama	+3.5	Mississippi.....	+3.5
Alaska:		Missouri.....	4.2
Dixon Entrance	1 (?)	Montana.....	2 (?)
Sitka Bay.....	3	Nebraska	
Off Mount St. Elias	9 (?)	Western part.....	3 (?)
Arizona.....	2 (?)	Eastern part.....	4 (?)

[The remainder of the table is deleted.]

It is to be hoped that before long we shall be in possession of sufficient material to render the above table more comprehensive and satisfactory. The numbers may be used for a few years (five) without serious error, but they certainly need recomputing after the lapse of a few years.

Isogonic charts.—If for any epoch we connect by curves all positions where the needle was observed to have the same declination, we trace out the so-called isogonic lines. On the accompanying charts they are laid down for equal differences of 1°, every fifth line, for greater distinction, being heavier. Such charts need reconstruction from time to time, not only for the purpose of improvements, but in consequence of the ever changing direction of the magnetic force. Thus, for instance, the line of no declination, or agonic line, as such lines are called, but which have no other distinction (beyond declination equal to zero), over any other isogonic line, is now seen to pass through the Strait of Mackinaw, Mich., Toledo, Ohio, and crossing the coast near Charleston, S. C.;

whereas about the years 1797 and 1803, when this same agonic line had its most northeasterly position on this coast, it passed near Buffalo, N. Y., Harrisburg, Pa., Annapolis, Md., to Cape Henry, Va. This and its neighboring lines will continue for some time to move southwestward on the Atlantic coast.

Magnetic disturbances.—These irregular motions of the needle may not infrequently be 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 aver-

ages are taken of many thousands they are nevertheless found to be subject to precise laws.

Their presence is generally indicated by sudden deflections and by rapid and great fluctuations in the direction of the needle, greatly exceeding all ordinary variations.

These deflections occur alternately on opposite sides of the normal position, and often take place simultaneously at distant regions of the globe; they may last from a few hours to a day, or even several days, and are frequently accompanied by auroral displays. These disturbances are found to be strictly under solar influence. Irrespective of direction of the disturbing force, the most disturbed hours of the day are frequently those between 7^h and 10^h a. m., and the least disturbed those between 2^h and 6^h p. m., but we can not here enter more fully into this subject. The greatest number of disturbances occur in the months of August, September, and October, the least number in January and June, and the disturbances are most active in years of sunspot maxima, and least so in years of minima. In the United States (excepting Alaska) deflections on either side of the normal of ¼° are common; deflections of ¼° may occasionally be noticed, but those exceeding 1° are rare, unless the place be near the northern boundary.—[C. A. S., AUGUST 26, 1889.]

METHOD OF ASCERTAINING THE MAGNETIC DECLINATION OR VARIATION OF THE COMPASS.

The following chapter, on the subject of the declination of the magnetic needle, is extracted from the revised edition of the work on surveying by Dr. Charles Davies, a graduate of the Military Academy at West Point. The work itself will be a valuable acquisition to the deputy surveyor, and his attention is particularly invited to the following chapter, which sets forth the usual easy modes by which the true meridian and magnetic declination may be approximately ascertained; his attention is also called to more complete statements on the subject given in the work "A treatise on land-surveying, etc.," by Dr. W. M. Gillespie, professor of engineering, Union College, in chapter treating of the declination of the magnetic needle. For more refined methods, he may consult Coast and Geodetic Survey Report for 1881, Appendix No. 8.

METHOD OF ASCERTAINING THE VARIATION.

"The best practical method of determining the true meridian of a place is by observing the north star. If this star were precisely at the point in which the axis of the earth, prolonged, pierces the heavens, then the intersection of the vertical plane passing through it and the place, with the surface of the earth, would be the true meridian. But the star being at a distance from the pole equal to 1° 30' nearly,⁴⁵ it performs a revolution about the pole in a circle, the polar distance of which is 1° 30';⁴⁵ the time of revolution is 23 hours and 56 minutes.

"To the eye of an observer this star is continually in motion and is due north but twice in 23 hours and 56 minutes; and is then said to be on the meridian. Now, when it departs from

45. 1° 17' in 1890.

the meridian, it apparently moves east or west for 5 hours and 59⁴⁶ minutes, and then returns to the meridian again.

"When at its greatest distance from the meridian, east or west, it is said to be at its *eastern* or *western* elongation."

The following table⁴⁷ shows the times of the eastern and western elongations for 1889, computed for latitude 40° and for longitude 90° W. of Greenwich, also the times of culminations of Polaris; with directions for use for any year between 1889 and 1910; and for different latitudes.

Local mean (astronomical⁴⁸) time of the culminations and elongations of Polaris in the year 1889.

[Computed for latitude +40° and longitude 6^h west from Greenwich.]

Date.	Eastern elongation.	Upper culmination.	Western elongation.	Lower culmination.
	h. m.	h. m.	h. m.	h. m.
1889.				
Jan. 1	0 36.2	6 31.0	12 25.7	18 29.1
15	23 37.0	5 35.7	11 30.4	17 33.8
Feb. 1	22 29.9	4 28.6	10 23.3	16 26.7
15	21 34.6	3 33.3	9 28.1	15 31.4
Mar. 1	20 39.4	2 38.1	8 32.8	14 36.2
15	19 44.4	1 43.0	7 37.7	13 41.1
April 1	18 37.4	0 36.0	6 30.7	12 34.1
15	17 42.4	23 37.1	5 35.7	11 39.0
May 1	16 39.5	22 34.2	4 32.9	10 36.1
15	15 44.6	21 39.3	3 38.0	9 41.2
June 1	14 37.9	20 32.7	2 31.3	8 34.6
15	13 43.0	19 37.8	1 36.4	7 39.7
July 1	12 40.4	18 35.2	0 33.8	6 37.1
15	11 45.5	17 40.3	23 35.0	5 42.2
Aug. 1	10 39.0	16 33.8	22 28.4	4 35.7
15	9 44.1	15 38.9	21 33.5	3 40.8
Sept. 1	8 37.5	14 32.3	20 26.9	2 34.2
15	7 42.6	13 37.4	19 32.0	1 39.3
Oct. 1	6 39.7	12 34.5	18 29.1	0 36.4
15	5 44.7	11 39.5	17 34.1	23 37.6
Nov. 1	4 37.9	10 32.1	6 27.3	22 30.8
15	3 42.7	9 37.5	15 32.2	21 35.6
Dec. 1	2 39.7	8 34.5	14 29.2	20 32.6
15	1 44.4	7 39.3	13 34.0	19 37.3

It will be noted that for the tabular year two eastern elongations occur on January 10 and two western elongations on July 9; there are also two culminations on April 10 and on October 9.

The lower culmination either follows or precedes the upper culmination by 11 hours 58.1 minutes.

For other dates and positions than those implied by the table we need to apply the following corrections:

To refer the tabular times to any year subsequent to the tabular year (1889) add 0.33 minutes for every year. To refer the tabular times, corrected as above, to any year in a quadriennium observe that for first year after a leap year the table is correct; for second year after a leap year add 0.9 minutes to the tabular value; for third year after a leap year add 1.7 minutes to the tabular value; for leap year,

46. In 1890 and latitude 40°, for about 5^h 55^m easterly and 6^h 03^m westerly.

47. Computed at the Coast and Geodetic Survey Office, as was also the table of azimuths.

48. Counted from noon and from zero to twenty-four hours.

and before March 1, add 2.6 minutes to the tabular value; for leap year from and after March 1, subtract 1.2 minutes from the tabular value.

To refer to any calendar day other than the first and fifteenth of each month, subtract 3.94 minutes for every day between it and the preceding tabular day, or add 3.94 minutes for every day between it and the succeeding tabular day. The longitude correction will amount to 0.16 minutes for each hour.

To refer to any other than the tabular latitude and between the limits of 25° and 50° north, add to the time of west elongation 0.13 minutes for every degree south of 40° and subtract from the time of west elongation 0.18 minutes for every degree north of 40°; reverse these signs for corrections to times of east elongation.

It will be important to direct attention to the fact that the year 1900 is *not* a leap year, and this must be kept in view when dealing with dates from and after March 1 of that year. The twentieth century begins after the expiration of December 31, 1900.

The deduced tabular times may generally be depended upon with no greater error than 0.3 minute.

The following table exhibits the angle which the meridian plane makes with the vertical plane passing through the pole-star when at its eastern or western elongation; this angle is called the azimuth of the star at elongation:

[Ed. Note: Pages 70 through 89 and most of page 90 is deleted. These pages contain tables of Azimuths of Polaris, instructions for polaris observations, time of Upper Culmination, Azimuths of the Tangent to the Parallel, offsets from the Tangent to the Parallel and difference in latitude and departure for 80 chains. The copy picks up with the bottom of page 90.]

Random bearings, determined as above directed, are actually the true bearings of the lines and are so used for running fractional true lines. Any deviation from random bearings, derived from the application of the falling [Table VI], 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 is to be understood to refer to the line upon which the corners are established.

Table VI [A and B] is used to determine the return from the random course by the following rules, the meridians being regarded as parallel.

I.—If the random line is run east or west, subtract the falling [in minutes of arc] from 90°, reverse the departure letter, and name the meridional letter N. or S., like the falling.

II.—When the random course is nearly east and west, take the sum of the random course and closing error [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].

III.—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.

THE RANDOM AND TRUE LINE AND USE OF THE VARIATION.

In the article entitled "METHOD OF SUBDIVIDING," directions have been given to run east and west *random* lines *parallel* to the south boundary of the tier of sections to which they belong, instead of *due east* as given in former editions of these instructions. In many instances the south boundary of townships to be subdivided are found to depart, sometimes considerably, from the true east and west line, or parallel of latitude, which they are supposed to follow. The present instructions are intended to reduce the falling of the random to the smallest practicable amount and to show at once how much the *random* line departs from the *true* line, instead of complicating its departure with the deviation of the south boundary. When the south boundary makes a comparatively large angle with the parallel, the *random* line, if run *due east*, necessarily falls at a considerable distance north or south of the objective corner, and it appears to have been the practice of some surveyors to turn around the compass box until the north end of the needle points to the north mark, and to call the resulting reading of the vernier the *variation*. Thus, many old plats give the *variation* on east and west lines *one value* throughout, and on the north and south lines another *uniform variation*, the two differing by ten or fifteen minutes, or even more. In other instances two lines, making an angle of one or two degrees with each other, will be run, for example, *north*, and the *variation* recorded as differing by the angle between them. By this practice neither the *magnetic* nor the *true bearing* is given, and what is called the *variation* is simply an *arbitrary* angle, which may in some cases be the variation by accident, but oftener something else. The bearing of the south boundary will be the same from one end to the other if correctly run, and its bearing is of course the *true bearing* of *east* and *west section lines* if the corners are at the proper distance from said boundary. Therefore, for the sake of uniformity, it necessarily follows that the bearing of *random* lines should be *the same as that of the south boundary of the tier of sections to which they belong and the lines are to be so run*.

When the lines are run as above directed, that portion of the falling due to deviation of the south boundary no longer enters into consideration and the limit for the closing error may be consistently reduced to the limit allowed on exterior lines, or *fifty links per mile*, and this change has been made in the prescribed limits (on page 40), which are, even after this reduction, much greater than good work will ever require.

The variation, when once properly determined, is to be set off on the variation arc, which should then be clamped and

not again moved until natural causes—such as diurnal change or local attraction—require it to be corrected. Whenever any change in the variation is made on

-92-

the instrument, all particulars relating thereto must be recorded, as illustrated in Specimen Field Notes.

The compass used as above directed will always give the bearing from the *true meridian* or the *true bearing* of any point, or of any line upon which the compass is directed.

TABLES VII AND VIII.

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 VII 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 VII the length of a degree of the meridian, in the given latitude, and also in that differing from it, by the meridional 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 VIII 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 VIII 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.

-93-

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 is 6 miles, in latitude 42° 39' 12"; what is the convergency of the two range lines at the Base Line, the meridional distance being 24 miles?

Chains. Chains. Chains. Chains.

As 4075.67 : 22.71 :: 480 : 2.67, 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 77.33 chains; what is the divergency of the two range lines at the parallel 42° 39' 12", the meridional distance being 24 miles?

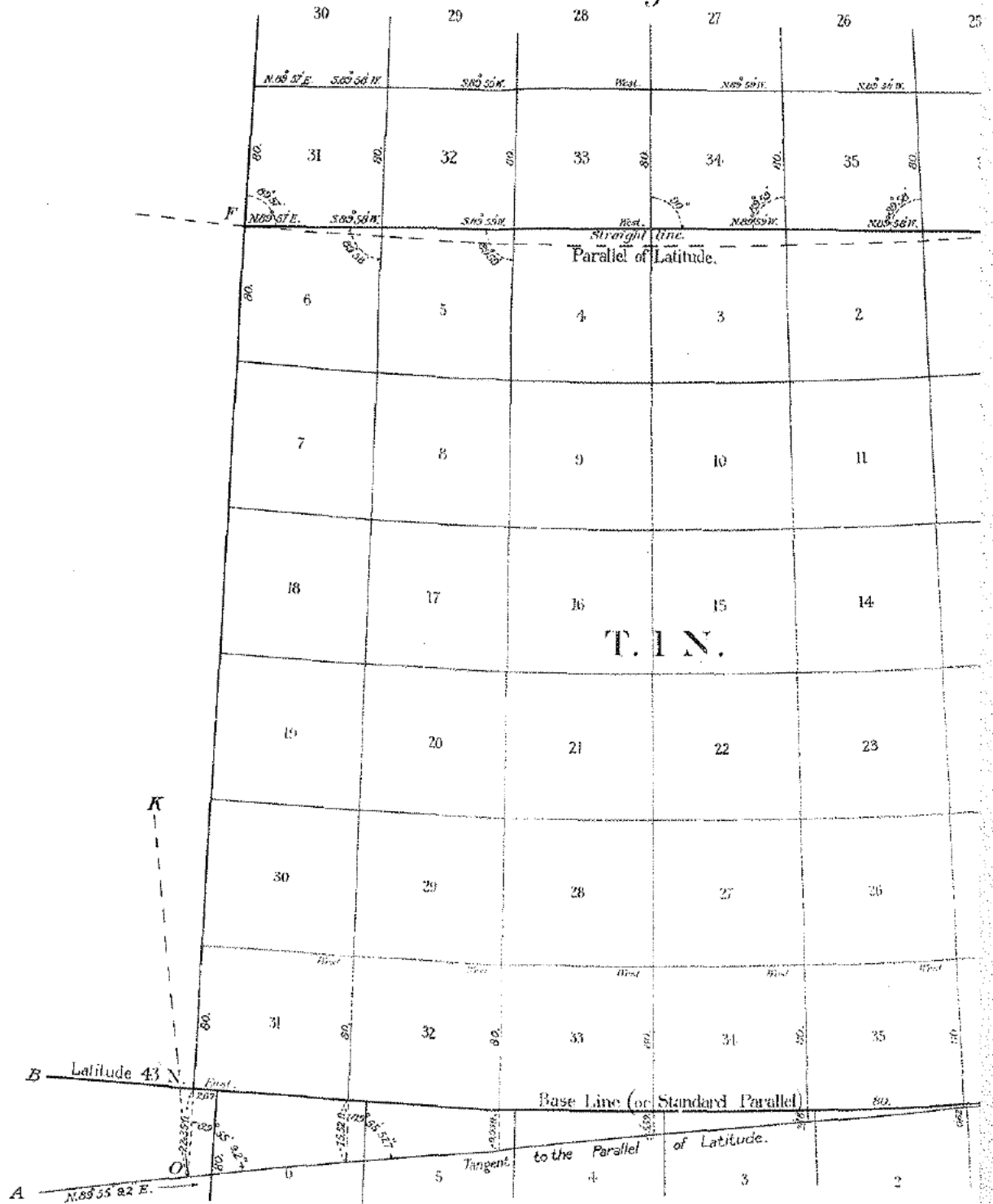
Chains. Chains. Chains. Chains.

As 4052.96 : 22.71 :: 477.33 : 2.67, the divergency required.

[Pages 94 through 99 deleted. They contain tables of the length of a degree of Latitude and degree of Longitude, and computations for convergency of meridians.]

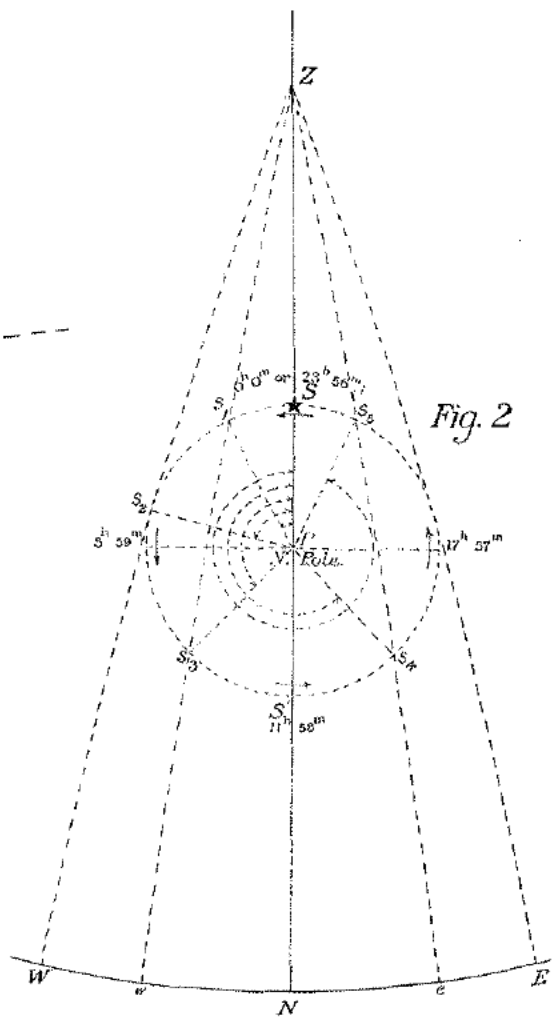
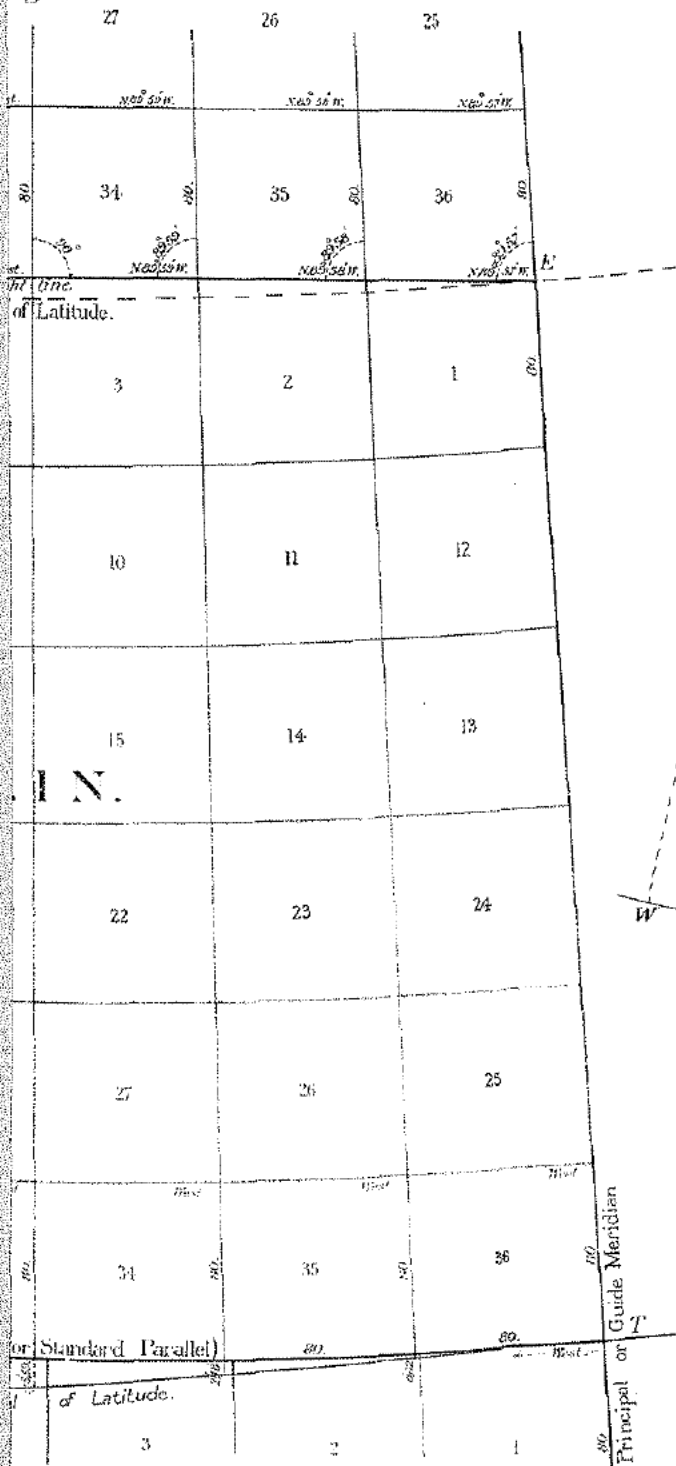
DIAGRAM A.

Fig. 1.



RAM A.

Fig. 1.



Note: Not drawn to scale. Intentionally distorted to show convergence of meridians and how it affects offsets, bearings, and length of lines.

DIAGRAM B

FOURTH STANDARD PARALLEL NORTH

FIFTH GUIDE MERIDIAN EAST

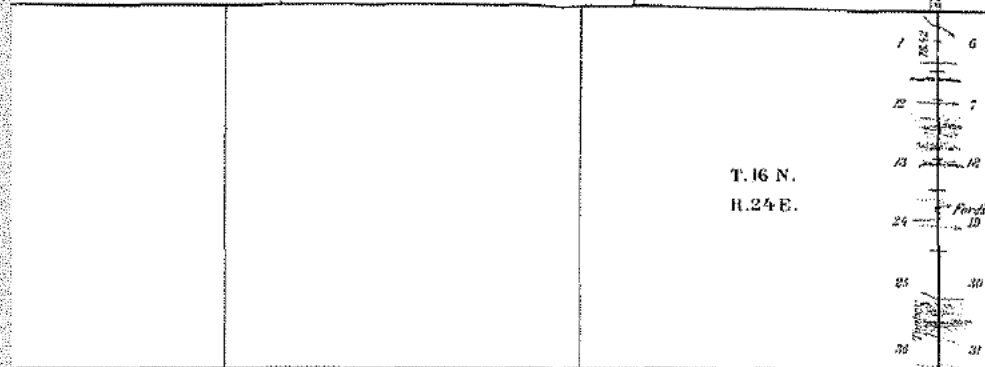
T. 13 N.
R. 21 E.

31 32 33 34 35 36
Number Number

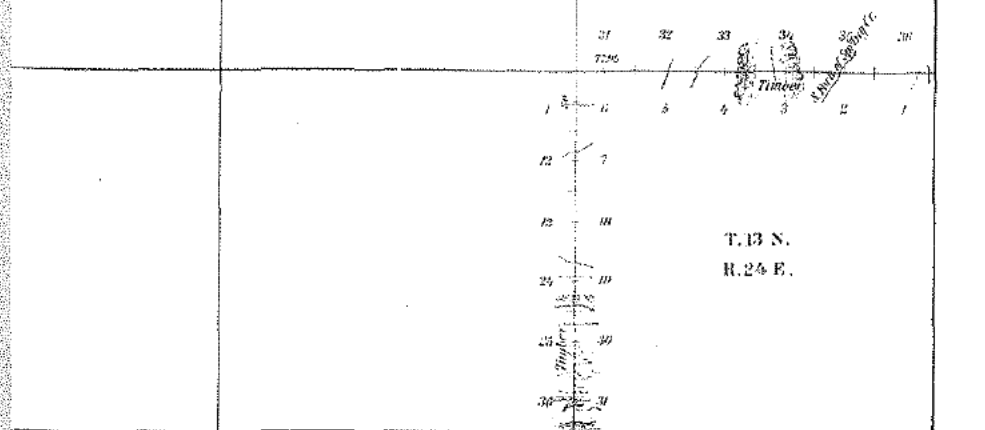
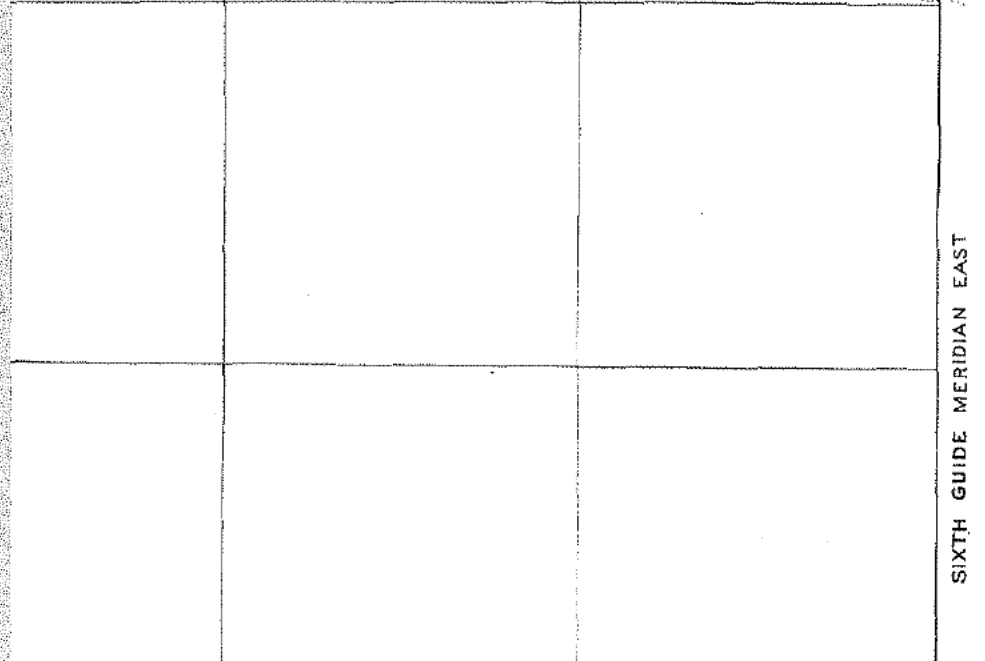
THIRD STANDARD PARALLEL NORTH

DIAGRAM B

FOURTH STANDARD PARALLEL NORTH



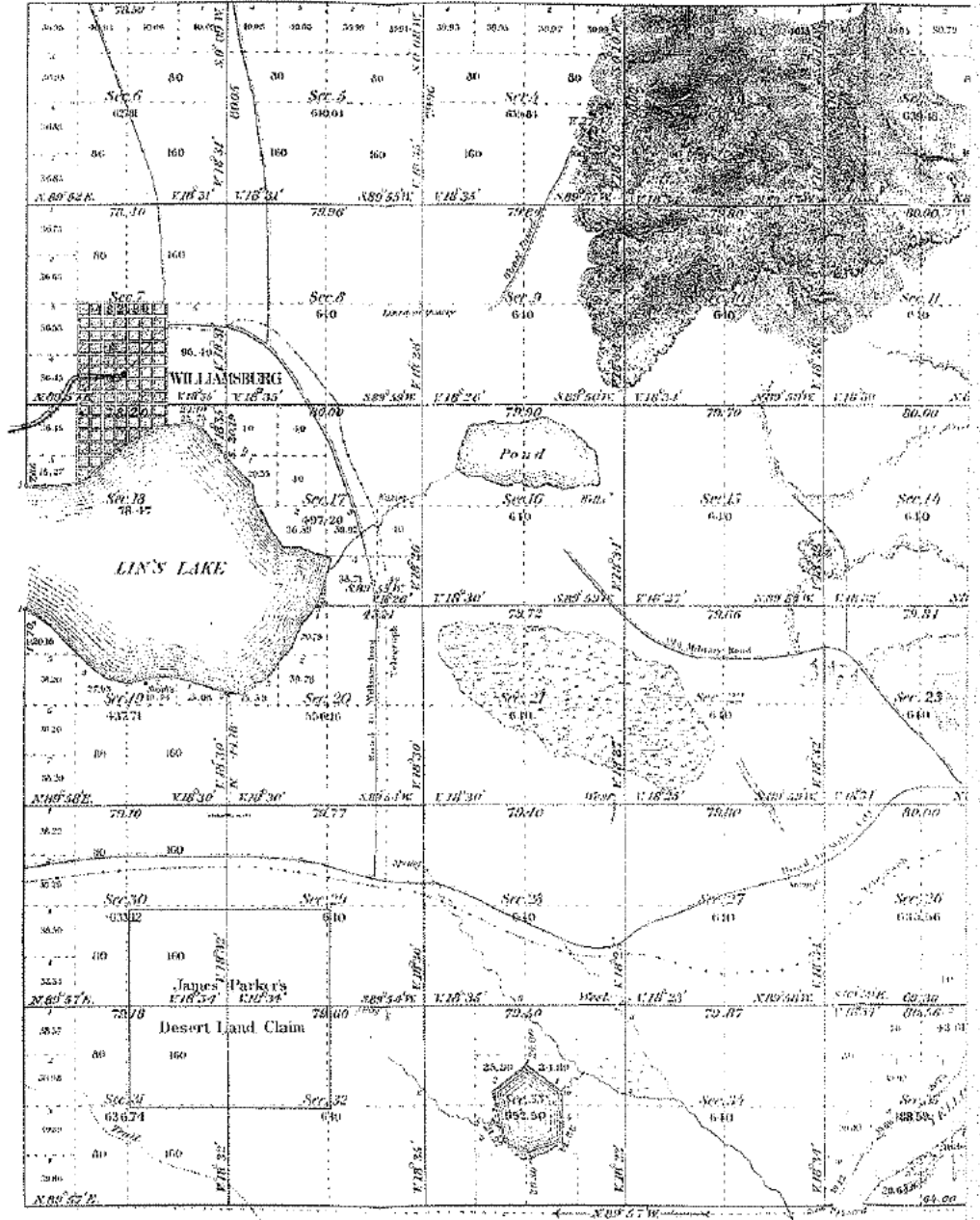
SIXTH GUIDE MERIDIAN EAST



THIRD STANDARD PARALLEL NORTH

DIAGRAM C

TOWNSHIP N° 6 NORTH RANGE N° 34 EAST OF THE PRIN

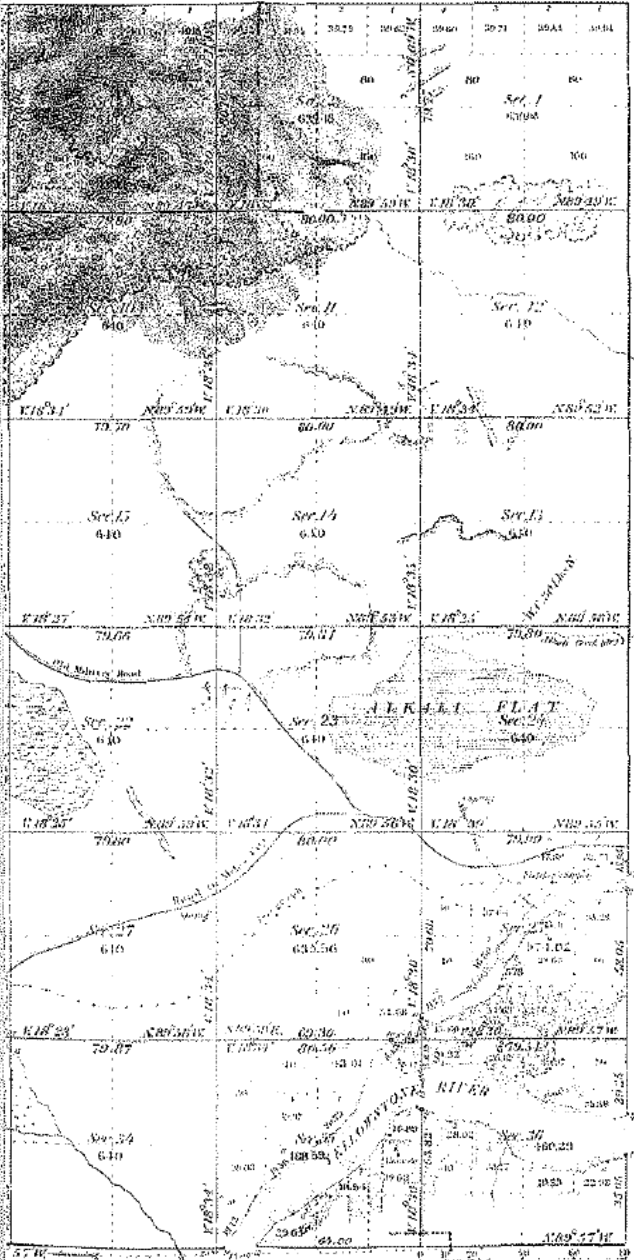


Area of Public Land 2137983 Acres. of Water Surface 129421 Acres. of Town Site 20660 Acres. Total number of Acres 2268135

Surveys designated	By Whom Surveyed	Date of Contract	Amount of Surveys	When Surveyed	Mean inclination
Township Lines			17	1871	1871
Subdivisions	Robert Acres	March 22 ^d 1889	37	18	79
Meadows			12	74	90
Connections			44	30	

DIAGRAM C

34 EAST OF THE PRINCIPAL MERIDIAN MONTANA



Meanders of Yellowstone River			
Right Bank	Sec. 23 Cont'd	Sec. 26 Cont'd	
N 61° E, 1.20	N 21° E, 1.00	N 21° E, 2.00	
N 74° E, 0.80	N 24° E, 0.80		
N 24° E, 0.80	N 26° E, 0.80	Sec. 17	
N 62° E, 0.60	S 20° W, 0.60		
N 23° E, 0.50			
N 40° E, 0.40			
N 22° E, 0.30			
N 25° E, 0.20			
N 27° E, 0.20			
N 28° E, 0.20			
N 29° E, 0.20			
N 30° E, 0.20			
N 31° E, 0.20			
N 32° E, 0.20			
N 33° E, 0.20			
N 34° E, 0.20			
N 35° E, 0.20			
N 36° E, 0.20			
N 37° E, 0.20			
N 38° E, 0.20			
N 39° E, 0.20			
N 40° E, 0.20			
N 41° E, 0.20			
N 42° E, 0.20			
N 43° E, 0.20			
N 44° E, 0.20			
N 45° E, 0.20			
N 46° E, 0.20			
N 47° E, 0.20			
N 48° E, 0.20			
N 49° E, 0.20			
N 50° E, 0.20			
N 51° E, 0.20			
N 52° E, 0.20			
N 53° E, 0.20			
N 54° E, 0.20			
N 55° E, 0.20			
N 56° E, 0.20			
N 57° E, 0.20			
N 58° E, 0.20			
N 59° E, 0.20			
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N 63° E, 0.20			
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N 68° E, 0.20			
N 69° E, 0.20			
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N 91° E, 0.20			
N 92° E, 0.20			
N 93° E, 0.20			
N 94° E, 0.20			
N 95° E, 0.20			
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N 98° E, 0.20			
N 99° E, 0.20			
N 100° E, 0.20			

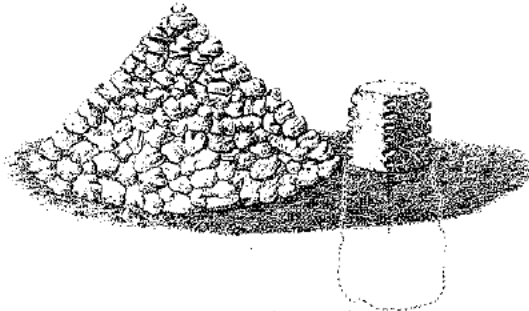
on Site 20663 Acres - Total number of Acres - 22981.33

Acres	When Surveyed	Mean Declination
73	Aug. 5 th to 20 th 1869	15° 30' East
79		
80		
30		

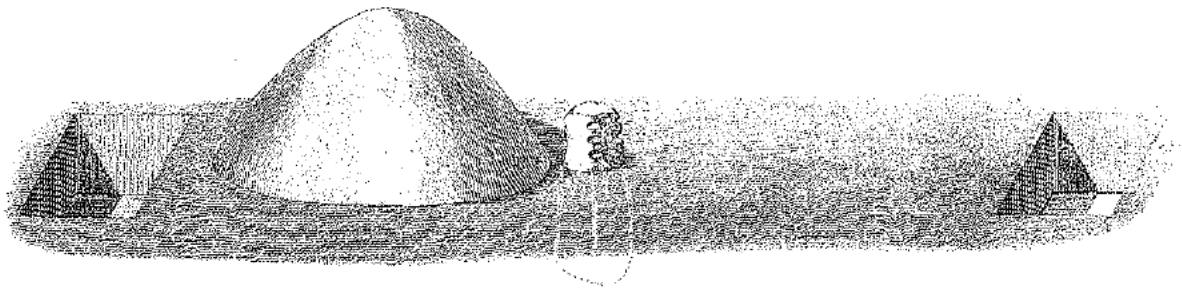
The above Map of Township No. 1 South, of Range No. 34 East of the Principal Meridian, Montana, is strictly conformable to the field notes of the survey there on file in this Office which have been examined and approved
Survey General's Office
Survey Genl

DIAGRAM D

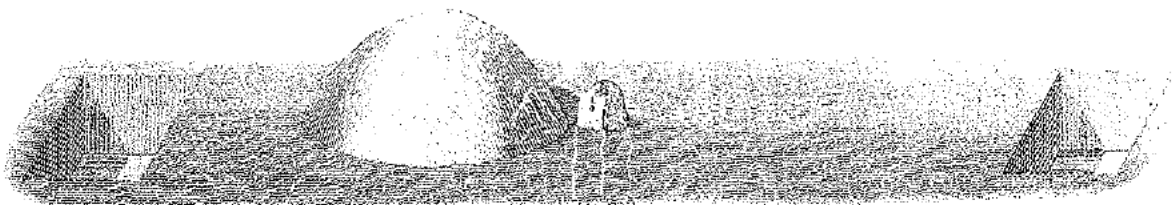
Illustrating mode of establishing Stone, Post and Mound Corners



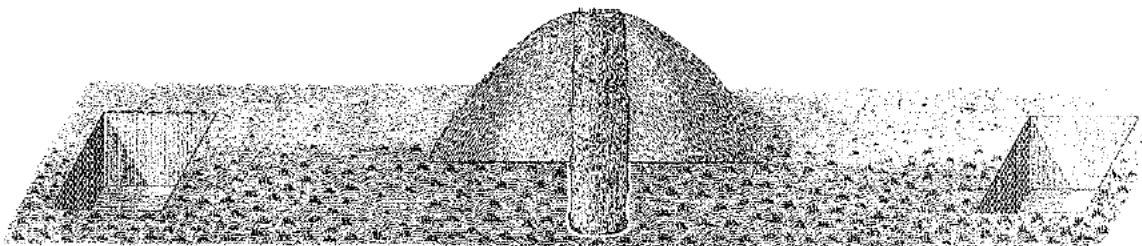
Township Corner Stone with mound of Stone



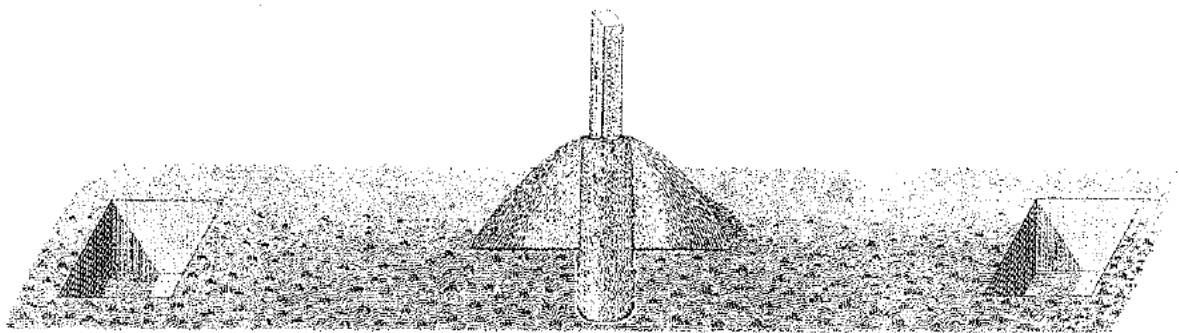
Section Corner Stone with pits and mound of earth



Quarter Section Corner with mound of earth



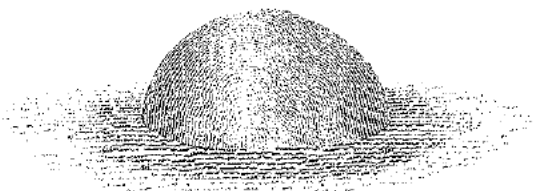
Section Corner Post with mound of earth



Quarter Section Corner Post with mound of earth



Mound Corner on Standard Line



Mound Corner Common to 4 Sections



Quarter Section Mound Corner